In [18]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import scipy as stats
```

In [19]:
```
df = sns.load_dataset('titanic')
df.head()
```

Out[19]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who	adul
0	0	3	male	22.0	1	0	7.2500	S	Third	man	
1	1	1	female	38.0	1	0	71.2833	C	First	woman	
2	1	3	female	26.0	0	0	7.9250	S	Third	woman	
3	1	1	female	35.0	1	0	53.1000	S	First	woman	
4	0	3	male	35.0	0	0	8.0500	S	Third	man	

In [20]:
```
sex = df["sex"]

sex.head()
```

Out[20]:
```
0      male
1    female
2    female
3    female
4      male
Name: sex, dtype: object
```

In [21]:
```
fare = df["fare"]
fare = fare.mode()

# fare
float(fare.iloc[0])
```

Out[21]:
```
8.05
```

In [22]:
```
df['deck'].value_counts()
```

Out[22]:
```
deck
C    59
B    47
D    33
E    32
A    15
F    13
G     4
Name: count, dtype: int64
```

In [23]:
```
# filtered = df.drop(df["deck"]=="NaN")
filtered = df.dropna(subset=["deck"])

filtered.head(2)
```

Out[23]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who	adul
1	1	1	female	38.0	1	0	71.2833	C	First	woman	
3	1	1	female	35.0	1	0	53.1000	S	First	woman	

In [24]:

```
# dirt = df[df["deck"] == "NaN"]
dirt =  df[df["deck"] != "NaN"]
dirt.head()
```

Out[24]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who	adul
0	0	3	male	22.0	1	0	7.2500	S	Third	man	
1	1	1	female	38.0	1	0	71.2833	C	First	woman	
2	1	3	female	26.0	0	0	7.9250	S	Third	woman	
3	1	1	female	35.0	1	0	53.1000	S	First	woman	
4	0	3	male	35.0	0	0	8.0500	S	Third	man	

In [25]:

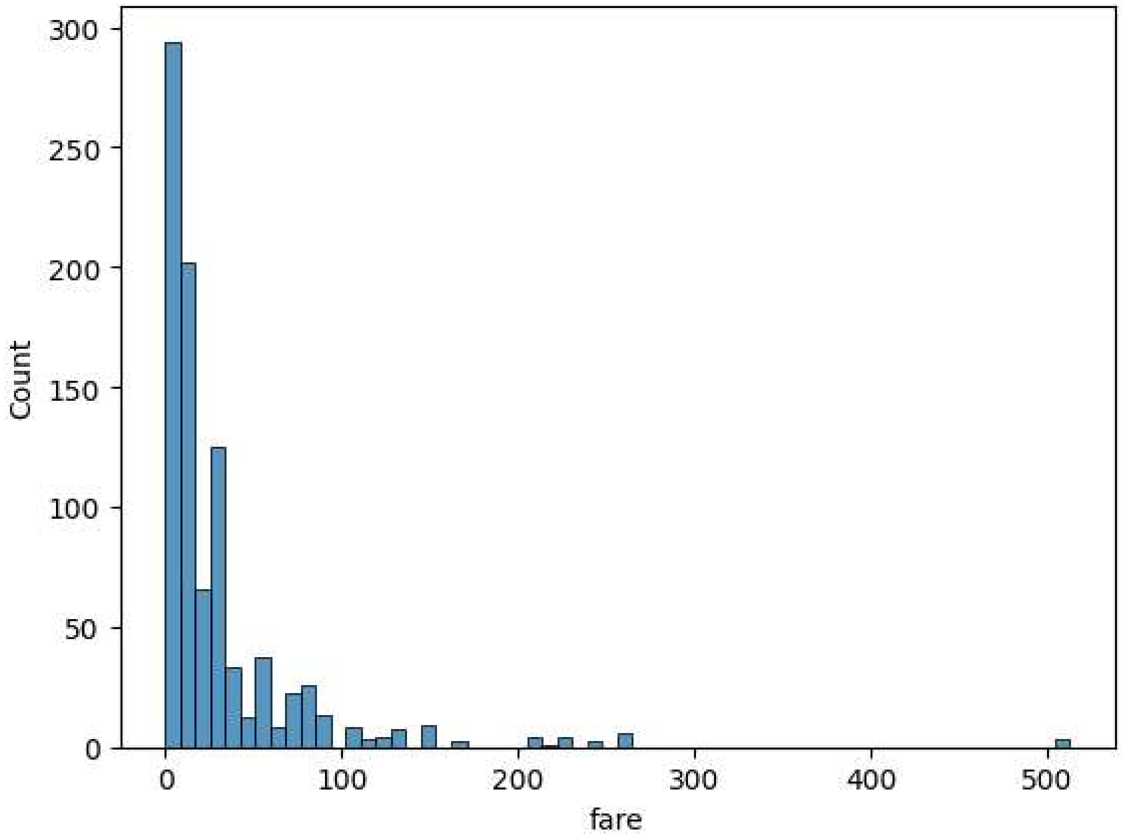
```
df["deck"].isna().sum()
```

Out[25]: np.int64(688)

In [26]:

```
sns.histplot(df,x="fare")
```

Out[26]: <Axes: xlabel='fare', ylabel='Count'>



In [27]:
```
df.describe()
```

Out[27]:

	survived	pclass	age	sibsp	parch	fare
count	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000
mean	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

In [28]:
```
# Lets find range of a data
# df = np.array([10, 20, 30, 40, 50])
fare = df["fare"]

max_fare = fare.max() # maximum value


np.ptp(fare)  # range (max - min)
```

Out[28]:
```
np.float64(512.3292)
```

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

# Generating a dataset with potential outliers
np.random.seed(0)
data = np.random.normal(100, 20, 200)
data = np.append(data, [300, 5])  # Adding potential outliers
```

In [33]:
```
Q1 = np.percentile(data,25)

Q3 = np.percentile(data,75)

IQR = Q3 - Q1
```

In [34]:
```
# Defining the outlier criteria (1.5 times the IQR)
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
```

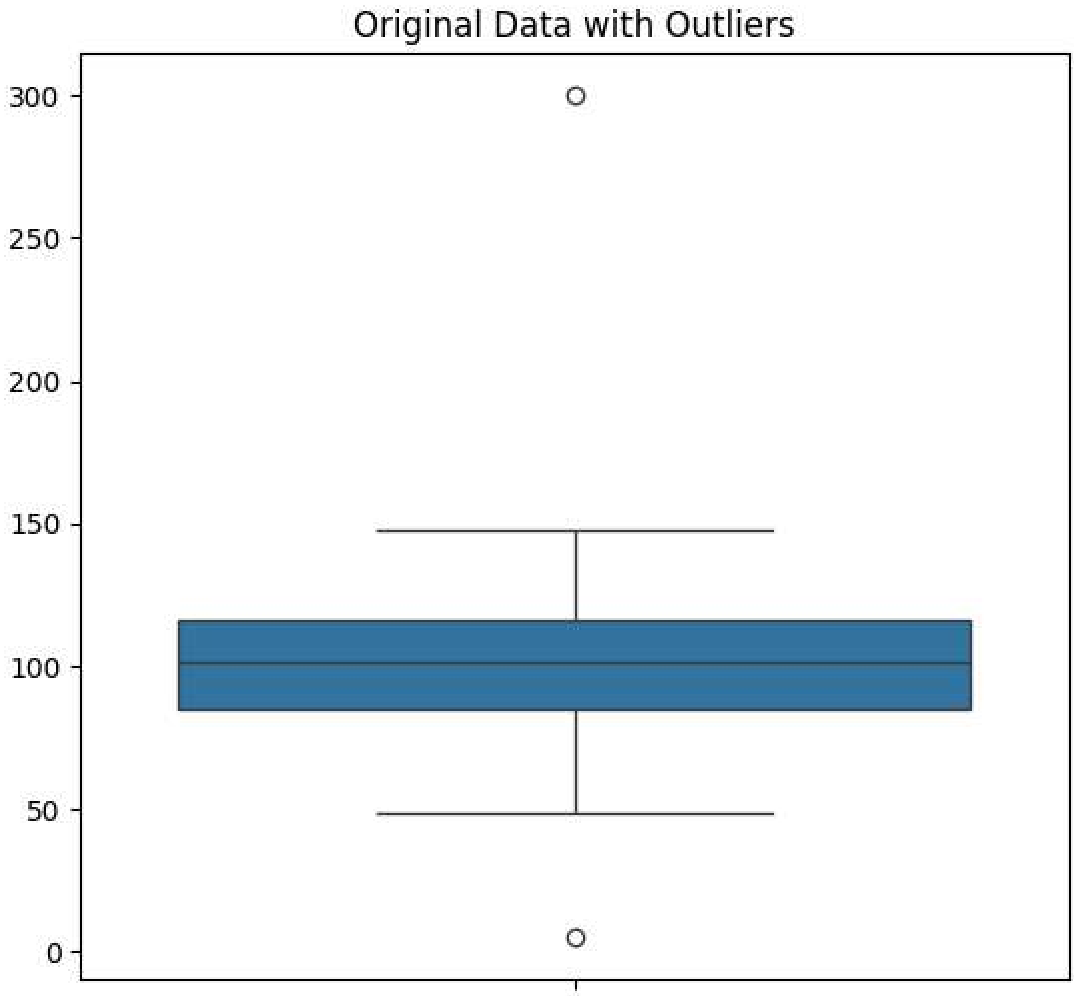
In [35]:
```
outliers = (data < lower_bound) | (data > upper_bound)

outliers
```

Out[35]:
```
array([False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False, False, False, False, False, False, False, False,
       False, False,  True,  True])
```

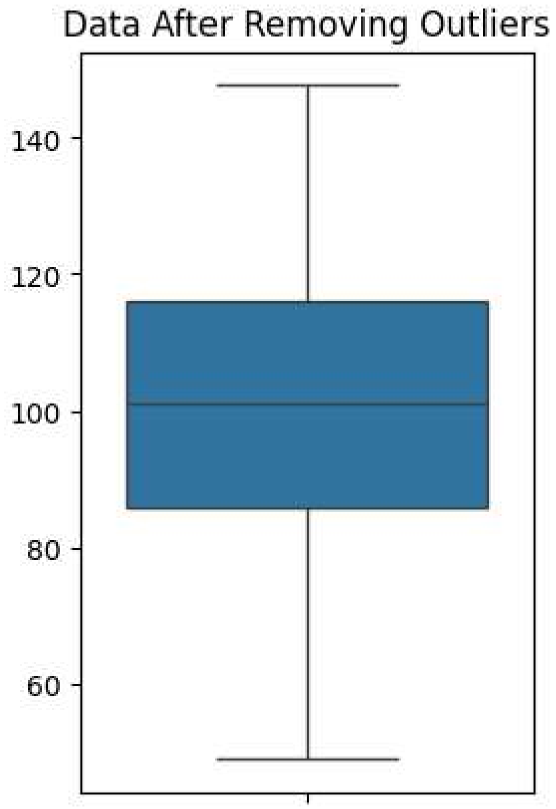
In [36]:
```
# Removing outliers
data_no_outliers = data[~outliers]
```

In [37]:
```
# Plotting the original data with outliers
plt.figure(figsize=(14, 6))
plt.subplot(1, 2, 1)
sns.boxplot(data=data)
plt.title('Original Data with Outliers')
```

Out[37]:
```
Text(0.5, 1.0, 'Original Data with Outliers')
```



In [38]:
```
# Plotting the data after removing outliers
plt.subplot(1, 2, 2)
sns.boxplot(data=data_no_outliers)
plt.title('Data After Removing Outliers')

plt.show()
```



In [39]:
```
# import library

import numpy as np

# create a dataset

df = np.array([2,3,4,5,6])
mean = np.mean(df)
var = np.var(df, ddof=1)
var
```

Out[39]: np.float64(2.5)

In [40]:
```
# import library
import numpy as np

df = np.array([2,3,4,5,6])

#calculate standard deviation
std = np.std(df, ddof=1)
std
print("Standard Deviation: ", std)
# calculate the standard error
se = std/np.sqrt(len(df))
print("Standard Error: ", se)
```

```
Standard Deviation:  1.5811388300841898
Standard Error:  0.7071067811865476
```

In [41]:
```
# load the data from seaborn
df = sns.load_dataset('tips')
df.head()
```

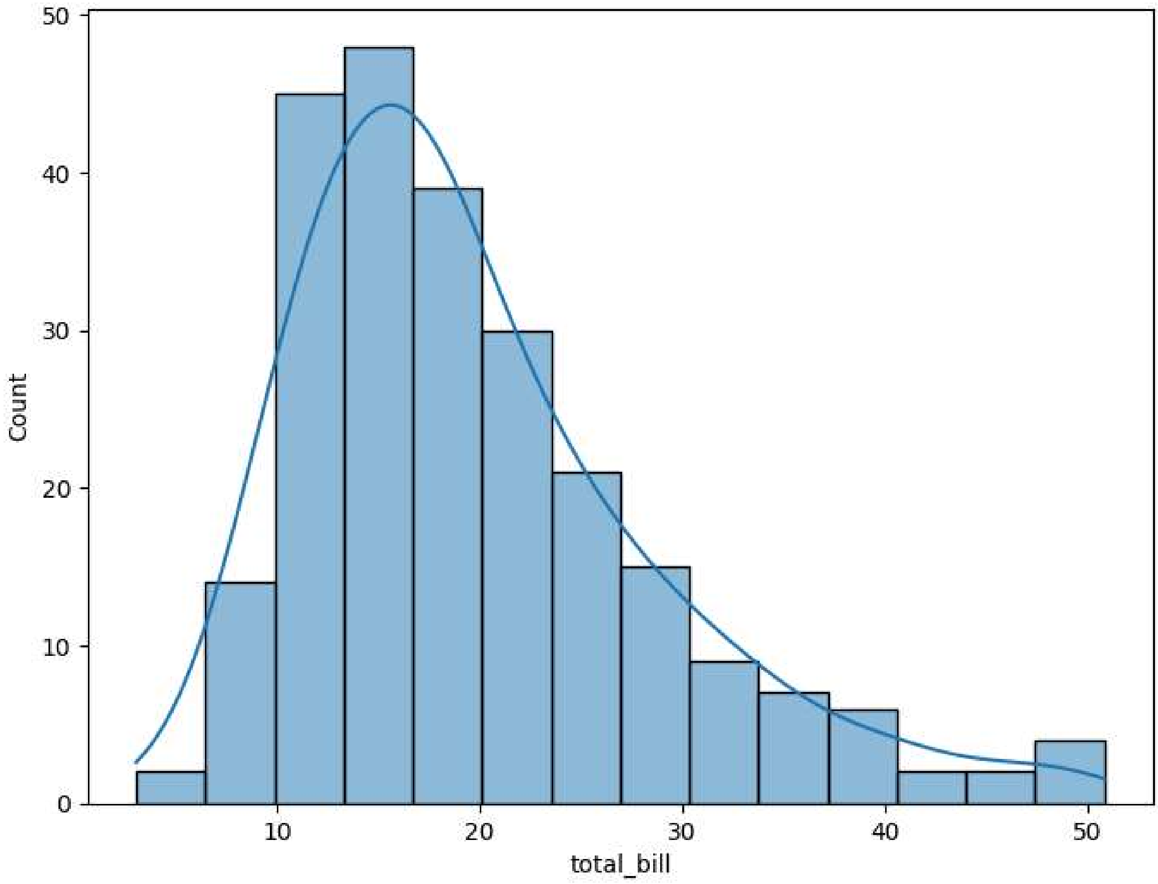
Out[41]:

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
1	10.34	1.66	Male	No	Sun	Dinner	3
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4

In [42]:

```
# draw a histplot curve on it
plt.figure(figsize=(8, 6))
sns.histplot(data=df, x='total_bill', kde=True)
```

Out[42]: <Axes: xlabel='total_bill', ylabel='Count'>



In [43]:

```
# load titanic data
df_01 = sns.load_dataset('titanic')
df_01.head()
```

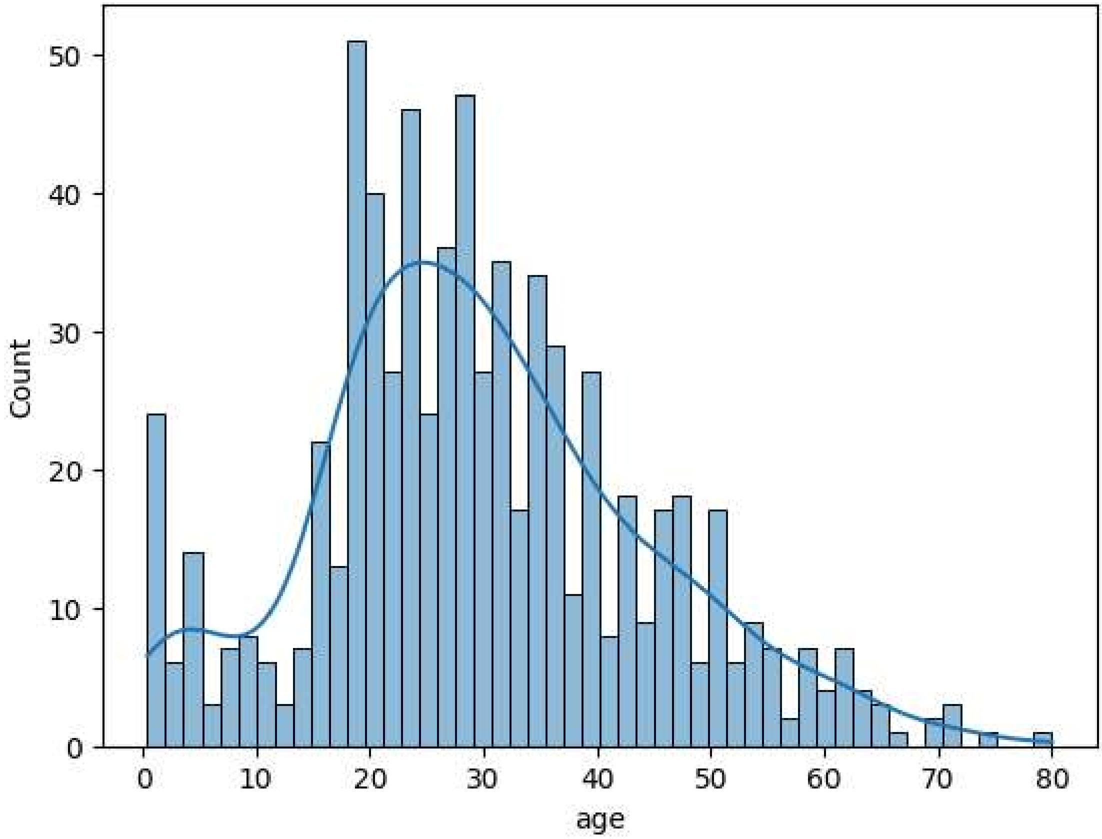
Out[43]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who	adul
0	0	3	male	22.0	1	0	7.2500	S	Third	man	
1	1	1	female	38.0	1	0	71.2833	C	First	woman	
2	1	3	female	26.0	0	0	7.9250	S	Third	woman	
3	1	1	female	35.0	1	0	53.1000	S	First	woman	
4	0	3	male	35.0	0	0	8.0500	S	Third	man	

In [44]:

```
sns.histplot(data= df_01, x = 'age', kde=True, bins=50)
```

Out[44]: <Axes: xlabel='age', ylabel='Count'>



In [45]:

```
df_01
```

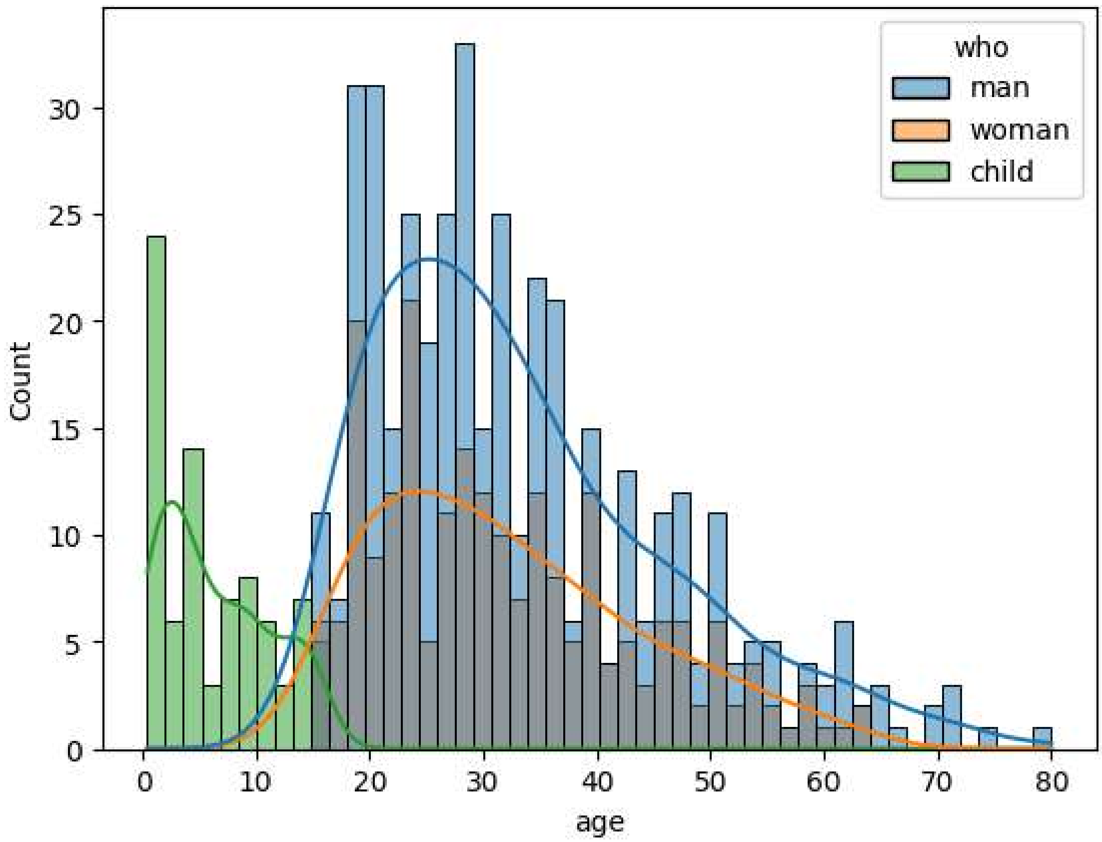
Out[45]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who
0	0	3	male	22.0	1	0	7.2500	S	Third	man
1	1	1	female	38.0	1	0	71.2833	C	First	woman
2	1	3	female	26.0	0	0	7.9250	S	Third	woman
3	1	1	female	35.0	1	0	53.1000	S	First	woman
4	0	3	male	35.0	0	0	8.0500	S	Third	man
...	...	...	...	...	...	...	...	...	...	...
886	0	2	male	27.0	0	0	13.0000	S	Second	man
887	1	1	female	19.0	0	0	30.0000	S	First	woman
888	0	3	female	NaN	1	2	23.4500	S	Third	woman
889	1	1	male	26.0	0	0	30.0000	C	First	man
890	0	3	male	32.0	0	0	7.7500	Q	Third	man

891 rows × 15 columns

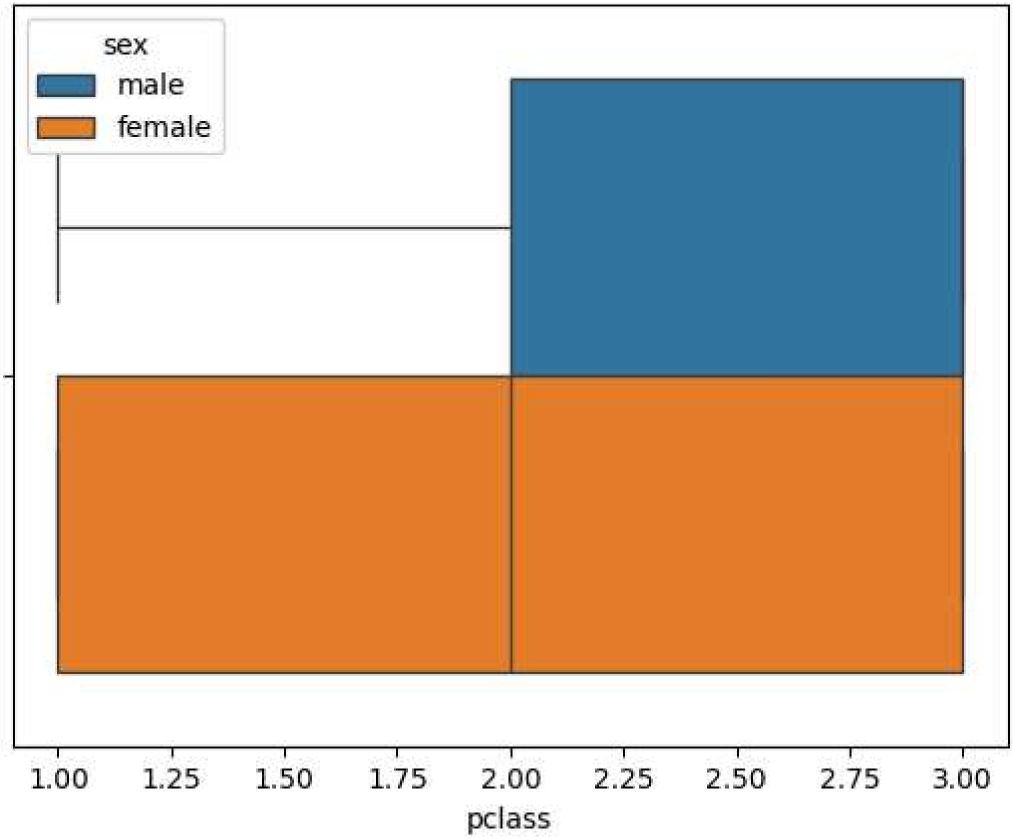
In [46]:
```
sns.histplot(data= df_01, x = 'age', kde=True, bins=50, hue='who')
```

Out[46]: <Axes: xlabel='age', ylabel='Count'>



In [47]:
```
sns.boxplot(data=df_01,x="pclass",hue="sex")
```

Out[47]: <Axes: xlabel='pclass'>

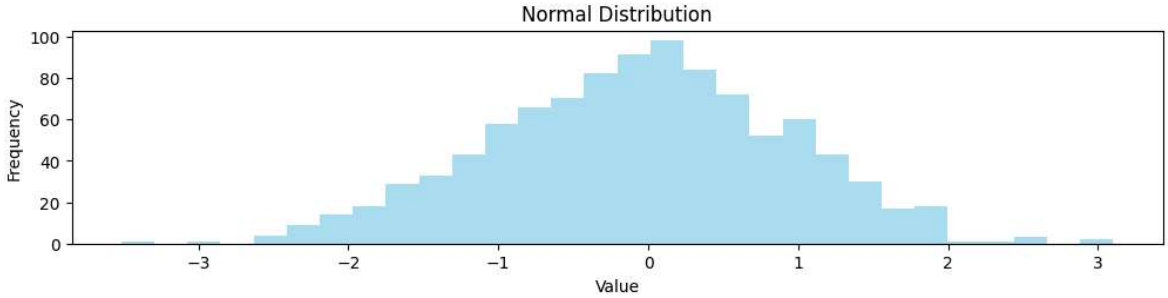


In [48]:
```
import numpy as np
import matplotlib.pyplot as plt
```

In [49]:
```
# Generating example datasets with different distributions
np.random.seed(0)  # For reproducibility
np.random.rand(3)  # above line preserves the random values so that it wount cha


# Normal distribution data
normal_data = np.random.normal(loc=0, scale=1, size=1000)

# Uniform distribution data
uniform_data = np.random.uniform(low=-2, high=2, size=1000)

# Exponential distribution data
exponential_data = np.random.exponential(scale=1, size=1000)
```

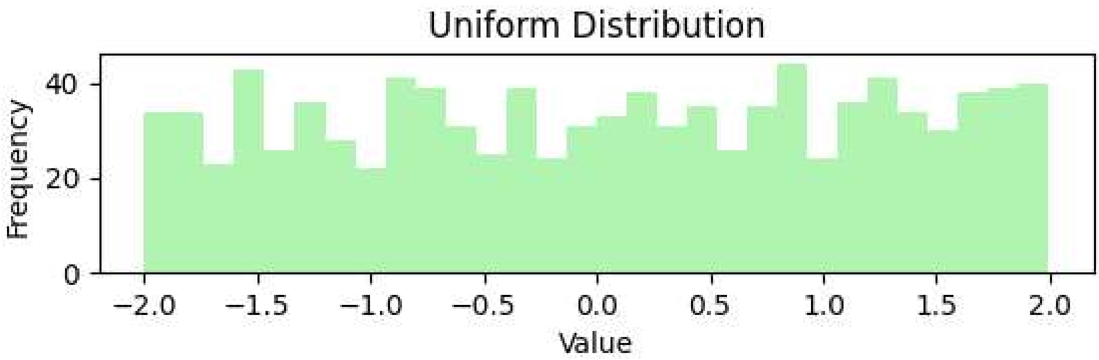
In [50]:
```
# Plotting the distributions
plt.figure(figsize=(12, 8))

# Normal Distribution Plot
plt.subplot(3, 1, 1)
plt.hist(normal_data, bins=30, color='skyblue', alpha=0.7)
plt.title('Normal Distribution')
plt.xlabel('Value')
plt.ylabel('Frequency')
```

Out[50]: Text(0, 0.5, 'Frequency')



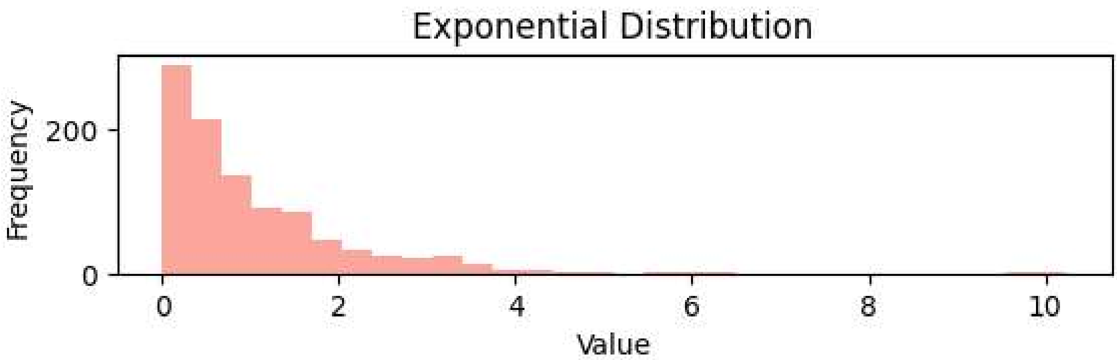
In [51]:
```
# Uniform Distribution Plot
plt.subplot(3, 1, 2)
plt.hist(uniform_data, bins=30, color='lightgreen', alpha=0.7)
plt.title('Uniform Distribution')
plt.xlabel('Value')
plt.ylabel('Frequency')
```

Out[51]:
```
Text(0, 0.5, 'Frequency')
```



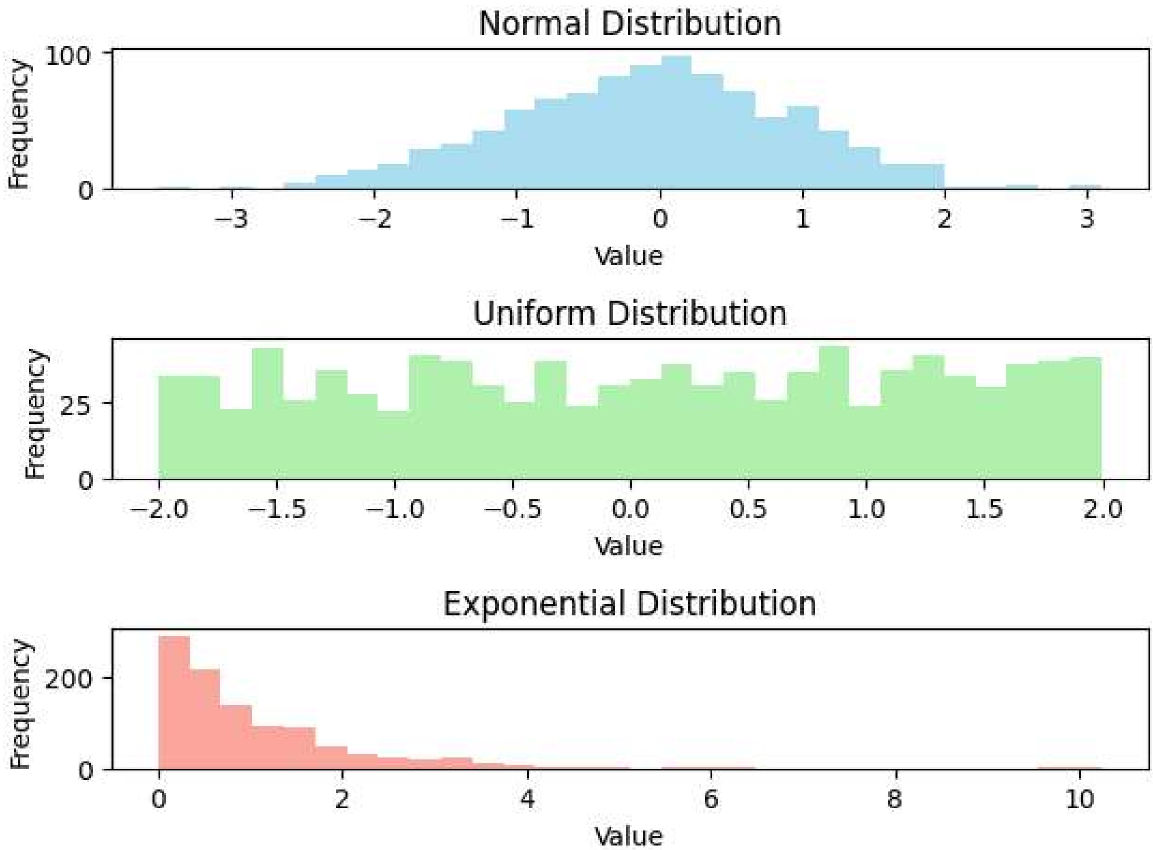
In [52]:
```
# Exponential Distribution Plot
plt.subplot(3, 1, 3)
plt.hist(exponential_data, bins=30, color='salmon', alpha=0.7)
plt.title('Exponential Distribution')
plt.xlabel('Value')
plt.ylabel('Frequency')
```

Out[52]:
```
Text(0, 0.5, 'Frequency')
```



In [53]:
```
# Normal Distribution Plot
plt.subplot(3, 1, 1)
plt.hist(normal_data, bins=30, color='skyblue', alpha=0.7)
plt.title('Normal Distribution')
plt.xlabel('Value')
plt.ylabel('Frequency')

# Uniform Distribution Plot
```

```
plt.subplot(3, 1, 2)
plt.hist(uniform_data, bins=30, color='lightgreen', alpha=0.7)
plt.title('Uniform Distribution')
plt.xlabel('Value')
plt.ylabel('Frequency')

# Exponential Distribution Plot
plt.subplot(3, 1, 3)
plt.hist(exponential_data, bins=30, color='salmon', alpha=0.7)
plt.title('Exponential Distribution')
plt.xlabel('Value')
plt.ylabel('Frequency')

plt.tight_layout()
plt.show()
```



In [71]:
```
df[["age"]].mean()
```

Out[71]:
```
age    29.699118
dtype: float64
```

In [72]:
```
df[["age"]].median()
```

Out[72]:
```
age    28.0
dtype: float64
```

In [73]:
```
df[["age"]].mode()
```

Out[73]:

	age
0	24.0

In [74]:
```
df[["age"]].mode()
```

Out[74]:

	age
0	24.0

In [61]:
```
df_01.head()
```

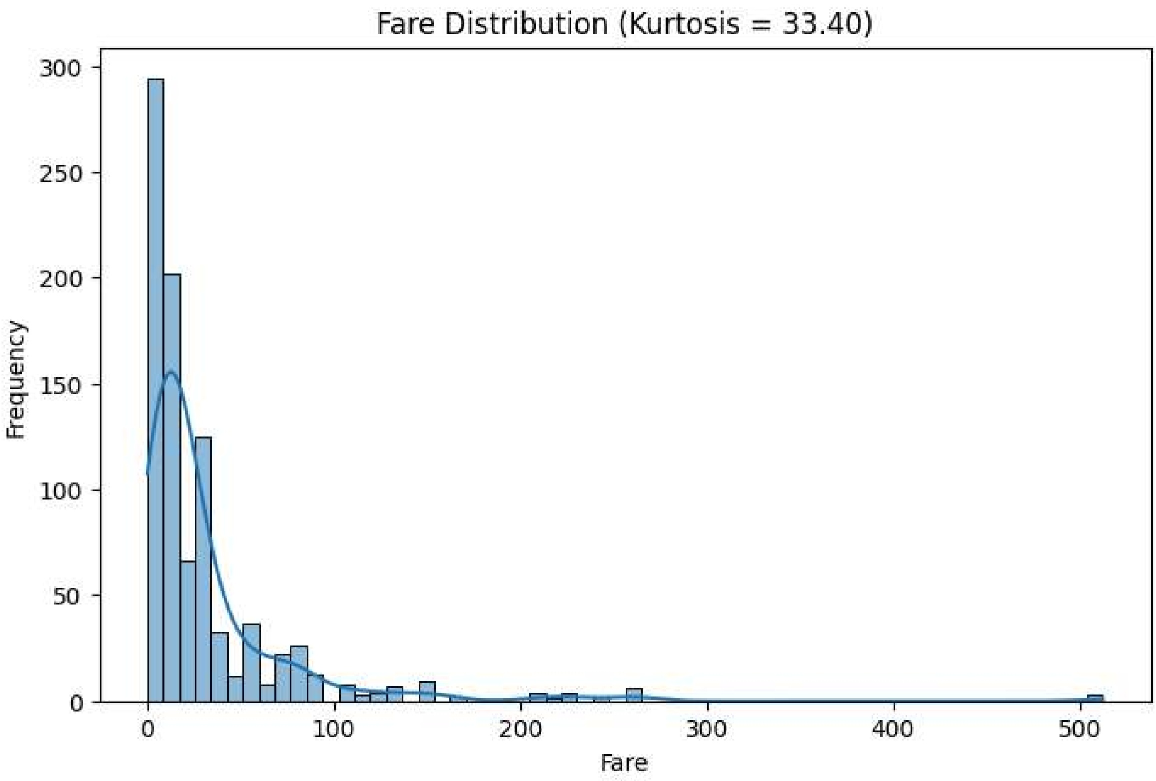
Out[61]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who	adul
0	0	3	male	22.0	1	0	7.2500	S	Third	man	
1	1	1	female	38.0	1	0	71.2833	C	First	woman	
2	1	3	female	26.0	0	0	7.9250	S	Third	woman	
3	1	1	female	35.0	1	0	53.1000	S	First	woman	
4	0	3	male	35.0	0	0	8.0500	S	Third	man	

Kurtosis

In [62]:
```
from scipy import stats
import seaborn as sns
import matplotlib.pyplot as plt
```

In [65]:
```
kurt_fare = df_01['fare'].kurtosis()

plt.figure(figsize=(8,5))
sns.histplot(df_01['fare'], kde=True,bins=60)
plt.title(f"Fare Distribution (Kurtosis = {kurt_fare:.2f})")
plt.xlabel("Fare")
plt.ylabel("Frequency")
plt.show()
```



📌 Shapiro–Wilk Test — Definition

Definition: The Shapiro–Wilk test checks whether a numerical dataset is drawn from a normal (Gaussian) distribution.

Null Hypothesis (H_0): Data is normally distributed

Alternative Hypothesis (H_1): Data is NOT normally distributed

Decision Rule

If p-value > 0.05 → Fail to reject H_0 → Data is normal

If p-value ≤ 0.05 → Reject H_0 → Data is not normal

📌 Best for small to medium datasets (n < 5000)

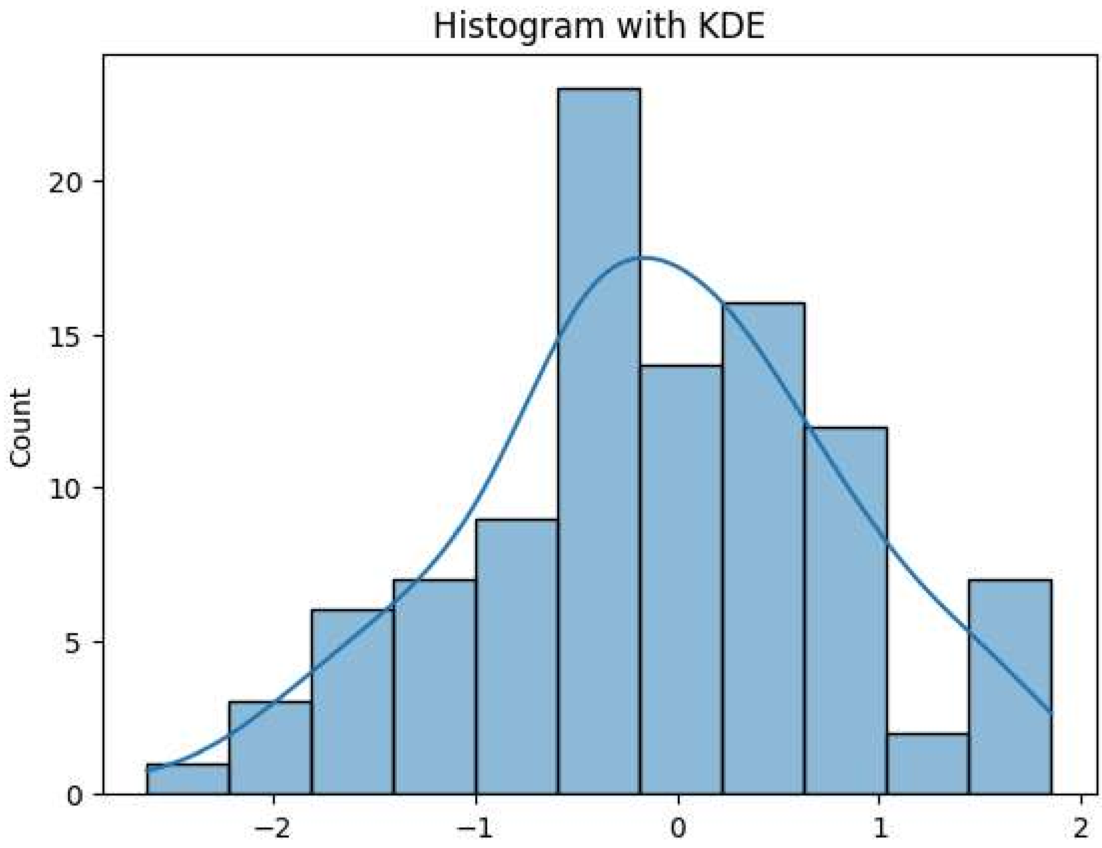
In [66]:
```
import numpy as np
import pandas as pd
from scipy.stats import shapiro
import seaborn as sns
import matplotlib.pyplot as plt
```

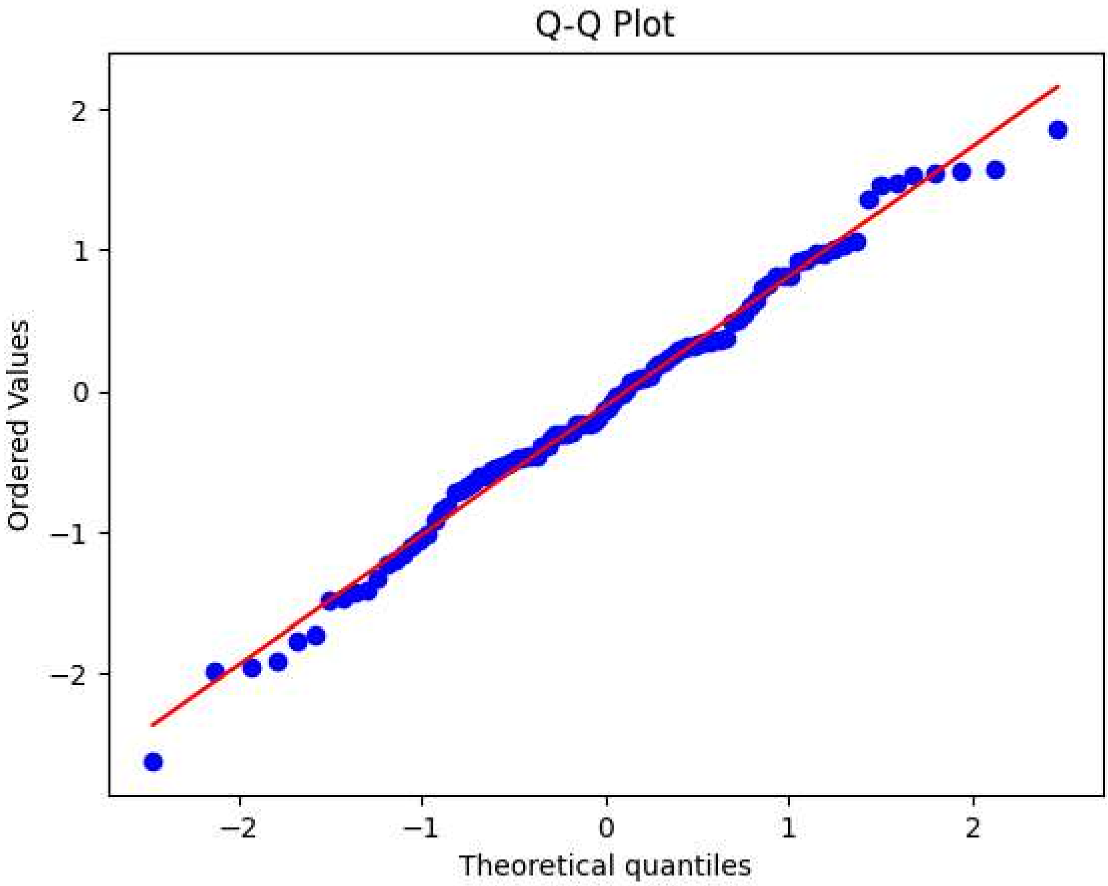
In [67]:
```
# Generate sample data
np.random.seed(42)
data = np.random.normal(loc=0, scale=1, size=100)

# Shapiro-Wilk test
stat, p_value = shapiro(data)

print("Test Statistic:", stat)
print("P-value:", p_value)
```

```
if p_value > 0.05:
    print("Data is normally distributed")
else:
    print("Data is NOT normally distributed")
```

```
Test Statistic: 0.9898833815158516
P-value: 0.6551676754214818
Data is normally distributed
```

In [68]:
```
sns.histplot(data, kde=True)
plt.title("Histogram with KDE")
plt.show()

import scipy.stats as stats
stats.probplot(data, plot=plt)
plt.title("Q-Q Plot")
plt.show()
```





In [69]:
```
# Load dataset
df = sns.load_dataset("titanic")

# Drop missing values
age_data = df['age'].dropna()

# Shapiro-Wilk test
stat, p_value = shapiro(age_data)

print("Statistic:", stat)
print("P-value:", p_value)

if p_value > 0.05:
    print("Age is normally distributed")
else:
    print("Age is NOT normally distributed")
```

```
Statistic: 0.9814577414504954
P-value: 7.337348958673592e-08
Age is NOT normally distributed
```

Categorical Data

| ├── Nominal (No order)

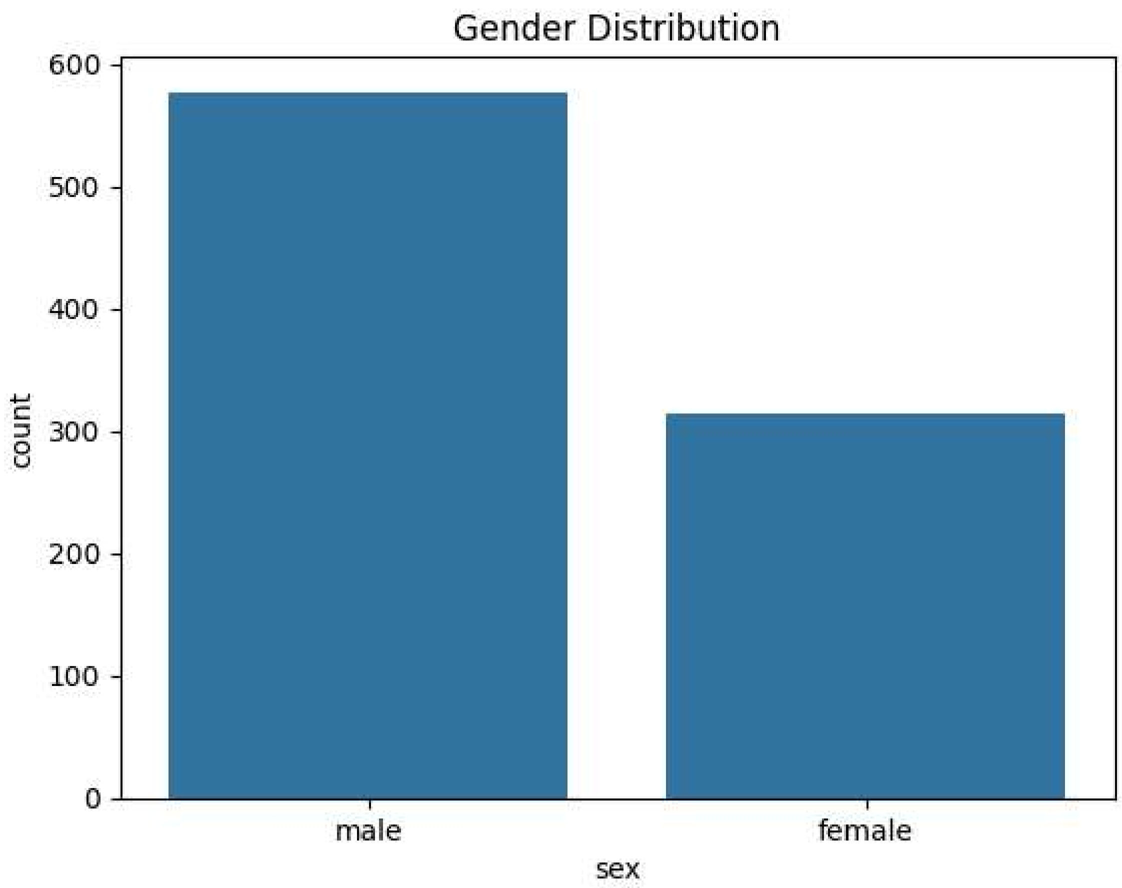
| ├── Gender | ├── Country | └── Color

| └── Ordinal (Order matters)

```
├── Low < Medium < High
├── Education level
└── Rating (1-5)
```

Categorical Encoding │ ├── Label Encoding (Ordinal only) ├── One-Hot Encoding (Nominal) ├── Target Encoding └── Frequency Encoding

In [70]:
```
import seaborn as sns
import matplotlib.pyplot as plt

df = sns.load_dataset("titanic")

# Count plot
sns.countplot(x='sex', data=df)
plt.title("Gender Distribution")
plt.show()

# Percentage
df['sex'].value_counts(normalize=True) * 100
```



Out[70]:
```
sex
male      64.758698
female    35.241302
Name: proportion, dtype: float64
```