In [1]:
```
# Import Libraries

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
```

In [2]:
```
# Set the random seed for reproducibility
np.random.seed(42)

# Create a synthetic dataset
data = {
    'product_id': range(1, 21),
    'product_name': [f'Product {i}' for i in range(1, 21)],
    'category': np.random.choice(['Electronics', 'Clothing', 'Home', 'Sports'], 20)
    'units_sold': np.random.poisson(lam=20, size=20),  # Poisson distribution for s
    'sale_date': pd.date_range(start='2023-01-01', periods=20, freq='D')
}

sales_data = pd.DataFrame(data)

# Display the first few rows of the dataset
print("Sales Data:")
print(sales_data)
```

```
Sales Data:
    product_id product_name     category  units_sold  sale_date
0            1    Product 1         Home          25 2023-01-01
1            2    Product 2       Sports          15 2023-01-02
2            3    Product 3  Electronics          17 2023-01-03
3            4    Product 4         Home          19 2023-01-04
4            5    Product 5         Home          21 2023-01-05
5            6    Product 6       Sports          17 2023-01-06
6            7    Product 7  Electronics          19 2023-01-07
7            8    Product 8  Electronics          16 2023-01-08
8            9    Product 9         Home          21 2023-01-09
9           10   Product 10     Clothing          21 2023-01-10
10          11   Product 11         Home          17 2023-01-11
11          12   Product 12         Home          22 2023-01-12
12          13   Product 13         Home          14 2023-01-13
13          14   Product 14         Home          17 2023-01-14
14          15   Product 15       Sports          17 2023-01-15
15          16   Product 16  Electronics          21 2023-01-16
16          17   Product 17       Sports          21 2023-01-17
17          18   Product 18       Sports          13 2023-01-18
18          19   Product 19       Sports          18 2023-01-19
19          20   Product 20         Home          25 2023-01-20
```

In [3]:
```
# Save the DataFrame as a CSV file
sales_data.to_csv('sales_data.csv', index=False)
```

In [4]:
```
# path location
import os
```

```
os.getcwd()
```

Out[4]: 'C:\\Users\\Windows10 Pro'

In [5]:
```
# Descriptive statistics
descriptive_stats = sales_data['units_sold'].describe()

# Display descriptive statistics
print("\nDescriptive Statistics for Units Sold:")
print(descriptive_stats)

# Additional statistics
mean_sales = sales_data['units_sold'].mean()
median_sales = sales_data['units_sold'].median()
mode_sales = sales_data['units_sold'].mode()[0]
variance_sales = sales_data['units_sold'].var()
std_deviation_sales = sales_data['units_sold'].std()

# Group by category and calculate total and average sales
category_stats = sales_data.groupby('category')['units_sold'].agg(['sum', 'mean', '
category_stats.columns = ['Category', 'Total Units Sold', 'Average Units Sold', 'St

# Display the results
print("\nStatistical Analysis:")
print(f"Mean Units Sold: {mean_sales}")
print(f"Median Units Sold: {median_sales}")
print(f"Mode Units Sold: {mode_sales}")
print(f"Variance of Units Sold: {variance_sales}")
print(f"Standard Deviation of Units Sold: {std_deviation_sales}")
print("\nCategory Statistics:")
print(category_stats)
```

```
Descriptive Statistics for Units Sold:
count    20.000000
mean     18.800000
std       3.302312
min      13.000000
25%      17.000000
50%      18.500000
75%      21.000000
max      25.000000
Name: units_sold, dtype: float64

Statistical Analysis:
Mean Units Sold: 18.8
Median Units Sold: 18.5
Mode Units Sold: 17
Variance of Units Sold: 10.90526315789474
Standard Deviation of Units Sold: 3.3023117899275864

Category Statistics:
      Category  Total Units Sold  Average Units Sold  Std Dev of Units Sold
0     Clothing                21           21.000000                    NaN
1  Electronics                73           18.250000               2.217356
2         Home               181           20.111111               3.723051
3       Sports               101           16.833333               2.714160
```

In [6]:
```
# Inferriential Statistics

# Confidence Interval for the mean of units sold
confidence_level = 0.95
degrees_freedom = len(sales_data['units_sold']) - 1
sample_mean = mean_sales
sample_standard_error = std_deviation_sales / np.sqrt(len(sales_data['units_sold']))

# t-score for the confidence level
t_score = stats.t.ppf((1 + confidence_level) / 2, degrees_freedom)
margin_of_error = t_score * sample_standard_error

confidence_interval = (sample_mean - margin_of_error, sample_mean + margin_of_error
print("\nConfidence Interval for the Mean of Units Sold:")
print(confidence_interval)
```

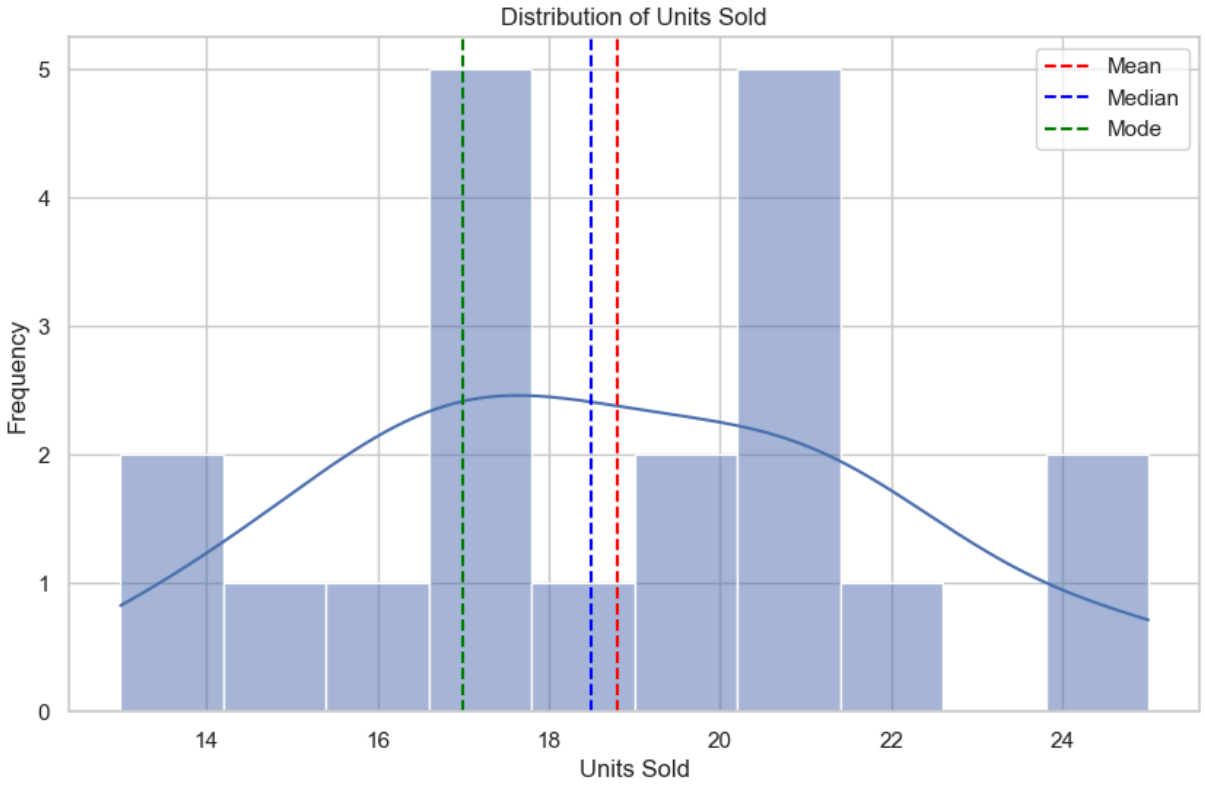
```
Confidence Interval for the Mean of Units Sold:
(17.254470507823573, 20.34552949217643)
```

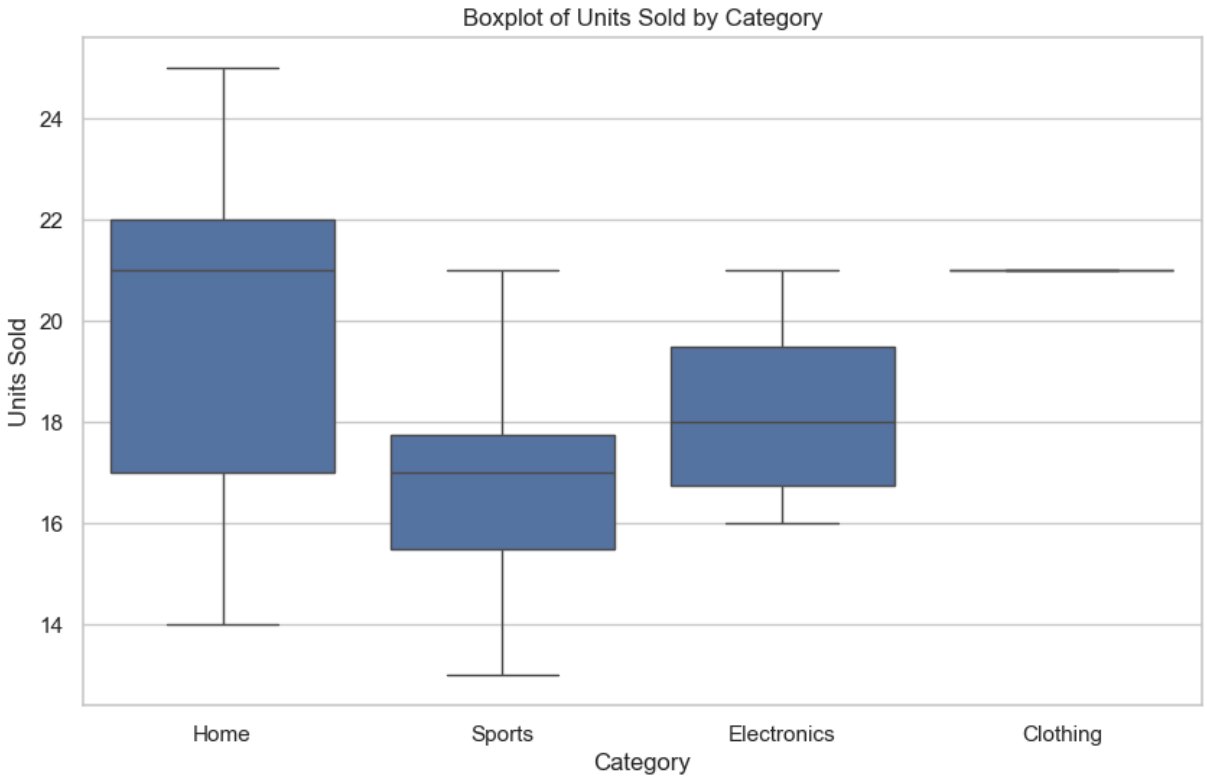
In [8]:
```
# Hypothesis Testing (t-test)
# Null hypothesis: Mean units sold is equal to 20
# Alternative hypothesis: Mean units sold is not equal to 20

t_statistic, p_value = stats.ttest_1samp(sales_data['units_sold'], 20)

print("\nHypothesis Testing (t-test):")
print(f"T-statistic: {t_statistic}, P-value: {p_value}")

if p_value < 0.05:
    print("Reject the null hypothesis: The mean units sold is significantly differe
else:
    print("Fail to reject the null hypothesis: The mean units sold is not significa
```

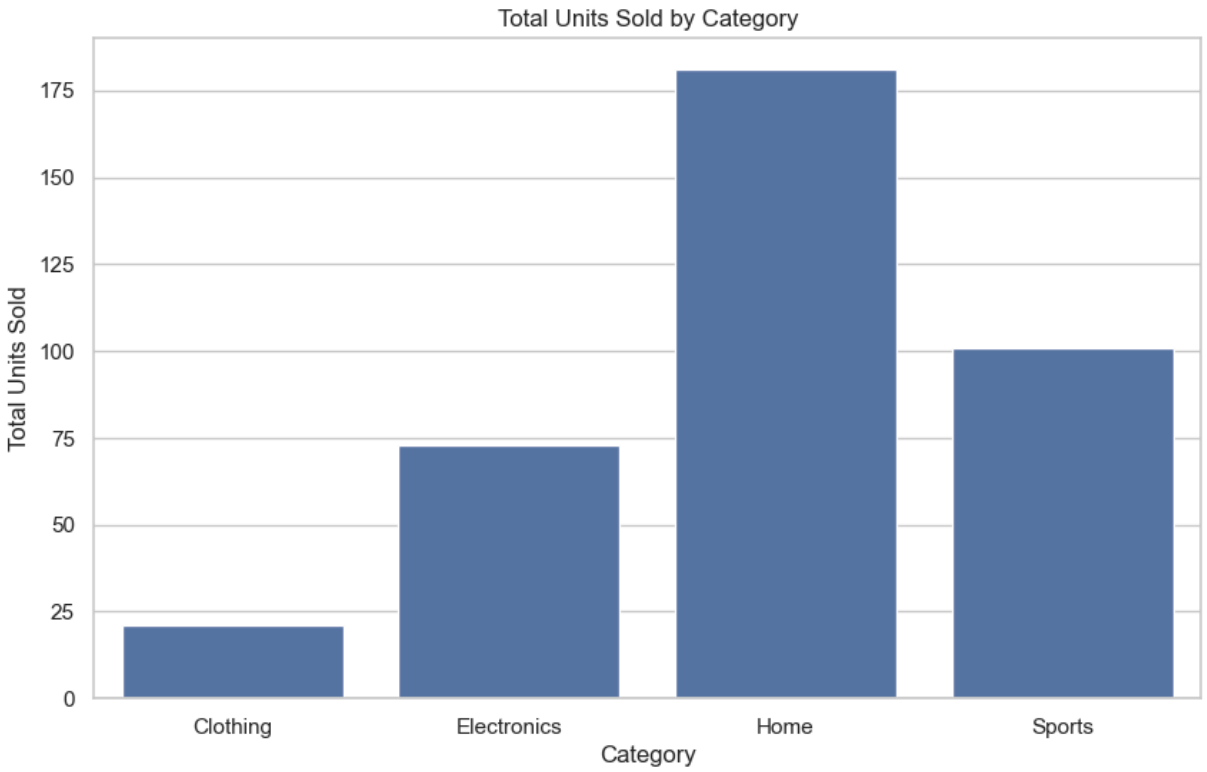
```
Hypothesis Testing (t-test):
T-statistic: -1.6250928099424466, P-value: 0.12061572226781002
Fail to reject the null hypothesis: The mean units sold is not significantly differe
nt from 20.
```

In [9]:
```
# Visualizations
sns.set(style="whitegrid")

# Plot distribution of units sold
plt.figure(figsize=(10, 6))
sns.histplot(sales_data['units_sold'], bins=10, kde=True)
plt.title('Distribution of Units Sold')
plt.xlabel('Units Sold')
plt.ylabel('Frequency')
plt.axvline(mean_sales, color='red', linestyle='--', label='Mean')
plt.axvline(median_sales, color='blue', linestyle='--', label='Median')
plt.axvline(mode_sales, color='green', linestyle='--', label='Mode')
plt.legend()
plt.show()

# Boxplot for units sold by category
plt.figure(figsize=(10, 6))
sns.boxplot(x='category', y='units_sold', data=sales_data)
```

```
plt.title('Boxplot of Units Sold by Category')
plt.xlabel('Category')
plt.ylabel('Units Sold')
plt.show()

# Bar plot for total units sold by category
plt.figure(figsize=(10, 6))
sns.barplot(x='Category', y='Total Units Sold', data=category_stats)
plt.title('Total Units Sold by Category')
plt.xlabel('Category')
plt.ylabel('Total Units Sold')
plt.show()
```




Boxplot of Units Sold by Category
Units Sold
24
22
20
18
16
14
Home
Sports
Electronics
Clothing
Category


Total Units Sold by Category
Total Units Sold
175
150
125
100
75
50
25
0
Clothing
Electronics
Home
Sports
Category

In [ ]: