Step 1:Import Libraries

In [2]:

```
%pip install scipy

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

```
Requirement already satisfied: scipy in c:\users\hp\anaconda3\lib\site-packages
(1.15.3)
Requirement already satisfied: numpy<2.5,>=1.23.5 in c:\users\hp\anaconda3\lib\si
te-packages (from scipy) (2.1.3)
Note: you may need to restart the kernel to use updated packages.
```

Step 2: Create the Dataset

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(['Electronic','Clothing','Home','Sports'],20),
    'units_sold':np.random.poisson(lam=20,size=20),  #Poissions Distribution for
    'Sale_date':pd.date_range(start='2023-01-01',periods=20,freq='D')
    }
sales_data=pd.DataFrame(data)

#Displays 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     Product1        Home          25 2023-01-01
1            2     Product2      Sports          15 2023-01-02
2            3     Product3  Electronic          17 2023-01-03
3            4     Product4        Home          19 2023-01-04
4            5     Product5        Home          21 2023-01-05
5            6     Product6      Sports          17 2023-01-06
6            7     Product7  Electronic          19 2023-01-07
7            8     Product8  Electronic          16 2023-01-08
8            9     Product9        Home          21 2023-01-09
9           10    Product10    Clothing          21 2023-01-10
10          11    Product11        Home          17 2023-01-11
11          12    Product12        Home          22 2023-01-12
12          13    Product13        Home          14 2023-01-13
13          14    Product14        Home          17 2023-01-14
14          15    Product15      Sports          17 2023-01-15
15          16    Product16  Electronic          21 2023-01-16
16          17    Product17      Sports          21 2023-01-17
17          18    Product18      Sports          13 2023-01-18
18          19    Product19      Sports          18 2023-01-19
19          20    Product20        Home          25 2023-01-20
```

In [3]:

```python
#Save the dataframe as a csv file
sales_data.to_csv('sales_data.csv',index=False)
```

In [4]:

```python
#Path Location
import os
os.getcwd()
```

Out[4]:

```
'c:\\Users\\HP\\VSCODE_PROJECT\\Statistics'
```

Step 3: Descriptive Statistics

In [5]:

```python
#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()
meadian_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 total and average sales
category_stats=sales_data.groupby('category')['units_sold'].agg(['sum','mean','s
category_stats.columns=['Category','Total units Sold','Average Units sold','Std

#Display the results
print("\nStatistical Analysis:")
print(f"Mean Unit Sold: {mean_sales}")
print(f"Median Unit Sold: {meadian_sales}")
print(f"Mode Unit Sold: {mode_sales}")
print(f"Variance Unit Sold: {variance_sales}")
print(f"Standard Deviation of Unit 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 Unit Sold: 18.8
Median Unit Sold: 18.5
Mode Unit Sold: 17
Variance Unit Sold: 10.905263157894737
Standard Deviation of Unit Sold: 3.302311789927586

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

Step 4:Inferential Statistics

In [6]:

```
# 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_er
print("\nConfidence Interval for the Mean of Units sold:")
print(confidence_interval)
```

```
Confidence Interval for the Mean of Units sold:
(np.float64(17.254470507823573), np.float64(20.34552949217643))
```

step 4: Hypothsis Testing

In [7]:

```
# 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)
```

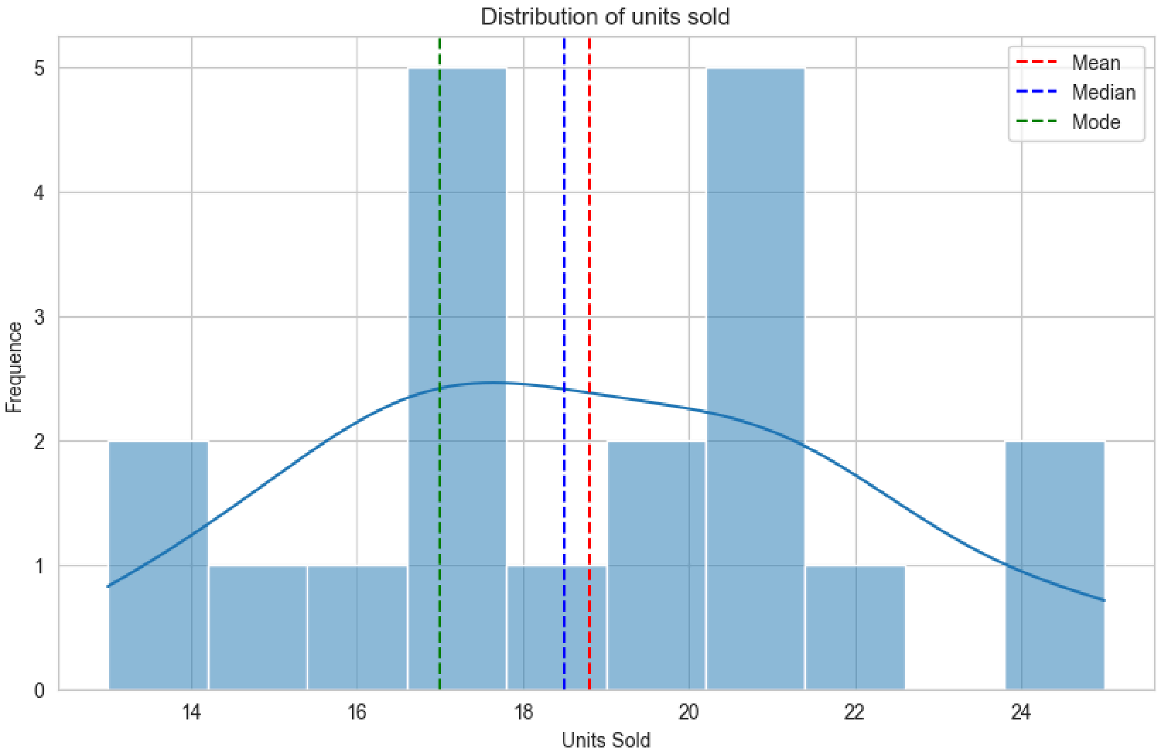
```
print("\nHypothesis testing (t-test):")
print(f"T-ststistics:{t_statistic},p-value:{p_value}")

if p_value < 0.05:
    print("Reject the null hypothesis:  The mean units sold id significantly dif
else:
    print("Fail to reject the null hypothesis: the mean units sold id not signif
```

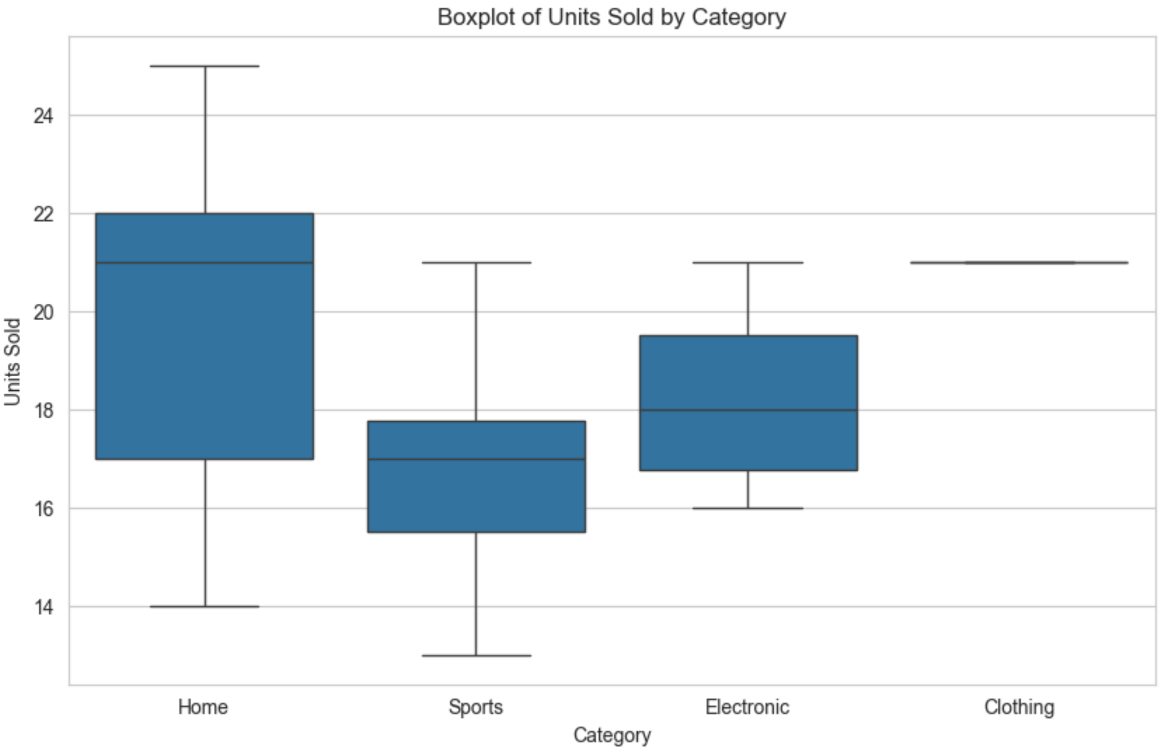
```
Hypothesis testing (t-test):
T-ststistics:-1.6250928099424466,p-value:0.12061572226781002
Fail to reject the null hypothesis: the mean units sold id not significantly diff
erent from 20.
```

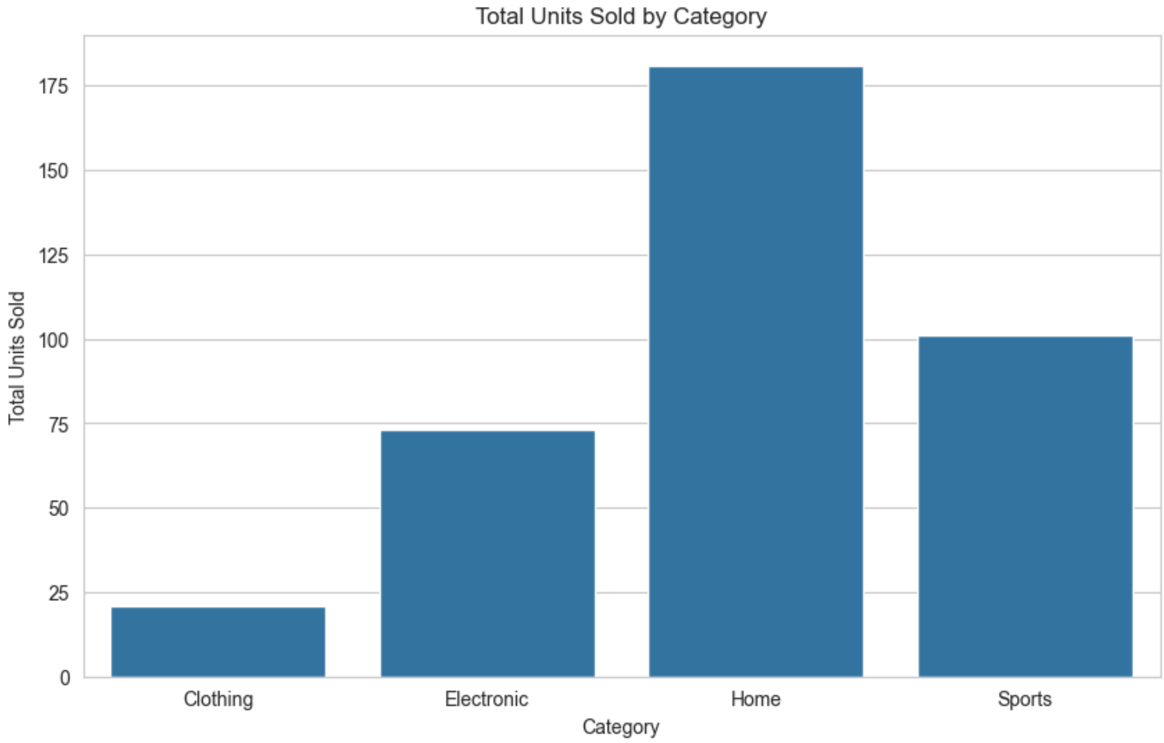
Step 5: Visualizations

In [10]:

```
# 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('Frequence')
plt.axvline(mean_sales, color='red', linestyle='--', label='Mean')
plt.axvline(meadian_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()
```


Distribution of units sold
Mean
Median
Mode
Frequence
0
1
2
3
4
5
14
16
18
20
22
24
Units Sold


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


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

```
In [ ]:
```