```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
df = pd.read_csv(r"C:\Users\mosta\Downloads\quantium\
QVI_transaction_data.csv")
df2 = pd.read_csv(r"C:\Users\mosta\Downloads\quantium\
QVI_purchase_behaviour.csv")
df2
```

```
       LYLTY_CARD_NBR               LIFESTAGE PREMIUM_CUSTOMER
0                1000   YOUNG SINGLES/COUPLES          Premium
1                1002   YOUNG SINGLES/COUPLES       Mainstream
2                1003          YOUNG FAMILIES           Budget
3                1004   OLDER SINGLES/COUPLES       Mainstream
4                1005  MIDAGE SINGLES/COUPLES       Mainstream
...               ...                     ...              ...
72632         2370651  MIDAGE SINGLES/COUPLES       Mainstream
72633         2370701          YOUNG FAMILIES       Mainstream
72634         2370751          YOUNG FAMILIES          Premium
72635         2370961          OLDER FAMILIES           Budget
72636         2373711   YOUNG SINGLES/COUPLES       Mainstream

[72637 rows x 3 columns]
```

```
#DATA_cleaning
df.dropna(inplace=True)
df['DATE'] = pd.to_datetime(df['DATE'])
df["PACK_SIZE"] = df["PROD_NAME"].str.extract(r'(\
d{2,3})g').astype(float)
df["BRAND"] = df["PROD_NAME"].str.split().str[0]
# Merge transaction data with purchase behavior data on LYLTY_CARD_NBR
merged_data = df.merge(df2, on="LYLTY_CARD_NBR", how="left")
merged_data.head()
```

```
                        DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID
PROD_NBR  \
0 1970-01-01 00:00:00.000043390          1            1000       1
5
1 1970-01-01 00:00:00.000043599          1            1307     348
66
2 1970-01-01 00:00:00.000043605          1            1343     383
61
3 1970-01-01 00:00:00.000043329          2            2373     974
69
4 1970-01-01 00:00:00.000043330          2            2426    1038
108

                                PROD_NAME  PROD_QTY  TOT_SALES
PACK_SIZE  \
```

```
0    Natural Chip        Compny SeaSalt175g         2        6.0
175.0
1                  CCs Nacho Cheese    175g         3        6.3
175.0
2    Smiths Crinkle Cut  Chips Chicken 170g         2        2.9
170.0
3    Smiths Chip Thinly  S/Cream&Onion 175g         5       15.0
175.0
4  Kettle Tortilla ChpsHny&Jlpno Chili 150g         3       13.8
150.0

     BRAND                LIFESTAGE PREMIUM_CUSTOMER
0  Natural   YOUNG SINGLES/COUPLES          Premium
1      CCs  MIDAGE SINGLES/COUPLES           Budget
2   Smiths  MIDAGE SINGLES/COUPLES           Budget
3   Smiths  MIDAGE SINGLES/COUPLES           Budget
4   Kettle  MIDAGE SINGLES/COUPLES           Budget
```

```
df.sort_values(by=['TOT_SALES'], ascending=False, inplace=True)
df.head(20)
```

```
                                  DATE  STORE_NBR  LYLTY_CARD_NBR
TXN_ID  \
69762  1970-01-01 00:00:00.000043331        226          226000
226201
69763  1970-01-01 00:00:00.000043605        226          226000
226210
150683 1970-01-01 00:00:00.000043605        118          118021
120799
5179   1970-01-01 00:00:00.000043327         94           94148
93390
55558  1970-01-01 00:00:00.000043599        190          190113
190914
171815 1970-01-01 00:00:00.000043329         24           24095
20797
69496  1970-01-01 00:00:00.000043327         49           49303
45789
117850 1970-01-01 00:00:00.000043604        194          194308
194516
184969 1970-01-01 00:00:00.000043605         44           44350
40394
204362 1970-01-01 00:00:00.000043332        222          222005
221532
32248  1970-01-01 00:00:00.000043601         66           66014
63251
185344 1970-01-01 00:00:00.000043602        180          180233
182542
81301  1970-01-01 00:00:00.000043326        243          243345
247084
72     1970-01-01 00:00:00.000043331         96           96203
```

```
96025
135445 1970-01-01 00:00:00.000043326        154          154199
154279
135346 1970-01-01 00:00:00.000043327        101          101110
100677
117918 1970-01-01 00:00:00.000043605        221          221351
221349
17110  1970-01-01 00:00:00.000043328        172          172239
174254
117917 1970-01-01 00:00:00.000043330        221          221184
220787
81110  1970-01-01 00:00:00.000043329        181          181129
183109

        PROD_NBR                                    PROD_NAME
PROD_QTY  \
69762          4          Dorito Corn Chp     Supreme 380g       200

69763          4          Dorito Corn Chp     Supreme 380g       200

150683        14    Smiths Crnkle Chip  Orgnl Big Bag 380g         5

5179          14    Smiths Crnkle Chip  Orgnl Big Bag 380g         5

55558         14    Smiths Crnkle Chip  Orgnl Big Bag 380g         5

171815        14    Smiths Crnkle Chip  Orgnl Big Bag 380g         5

69496         14    Smiths Crnkle Chip  Orgnl Big Bag 380g         5

117850        14    Smiths Crnkle Chip  Orgnl Big Bag 380g         5

184969        14    Smiths Crnkle Chip  Orgnl Big Bag 380g         5

204362         7         Smiths Crinkle      Original 330g         5

32248         23                      Cheezels Cheese 330g         5

185344        23                      Cheezels Cheese 330g         5

81301         16  Smiths Crinkle Chips Salt & Vinegar 330g         5

72             7         Smiths Crinkle      Original 330g         5

135445        20          Doritos Cheese      Supreme 330g         5

135346        16  Smiths Crinkle Chips Salt & Vinegar 330g         5

117918        23                      Cheezels Cheese 330g         5

17110          7         Smiths Crinkle      Original 330g         5
```

```
117917         16  Smiths Crinkle Chips Salt & Vinegar 330g          5

81110          23                      Cheezels Cheese 330g          5


        TOT_SALES  PACK_SIZE     BRAND
69762       650.0      380.0    Dorito
69763       650.0      380.0    Dorito
150683       29.5      380.0    Smiths
5179         29.5      380.0    Smiths
55558        29.5      380.0    Smiths
171815       29.5      380.0    Smiths
69496        29.5      380.0    Smiths
117850       29.5      380.0    Smiths
184969       29.5      380.0    Smiths
204362       28.5      330.0    Smiths
32248        28.5      330.0  Cheezels
185344       28.5      330.0  Cheezels
81301        28.5      330.0    Smiths
72           28.5      330.0    Smiths
135445       28.5      330.0   Doritos
135346       28.5      330.0    Smiths
117918       28.5      330.0  Cheezels
17110        28.5      330.0    Smiths
117917       28.5      330.0    Smiths
81110        28.5      330.0  Cheezels
```

```
# Calculate Q1 (25th percentile) and Q3 (75th percentile)
Q1 = df["TOT_SALES"].quantile(0.25)
Q3 = df["TOT_SALES"].quantile(0.75)
IQR = Q3 - Q1  # Interquartile Range

# Define the outlier thresholds
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

# Find outliers
outliers = df[(df["TOT_SALES"] < lower_bound) | (df["TOT_SALES"] >
upper_bound)]
print("Outliers detected using IQR method:")
print(outliers)
```

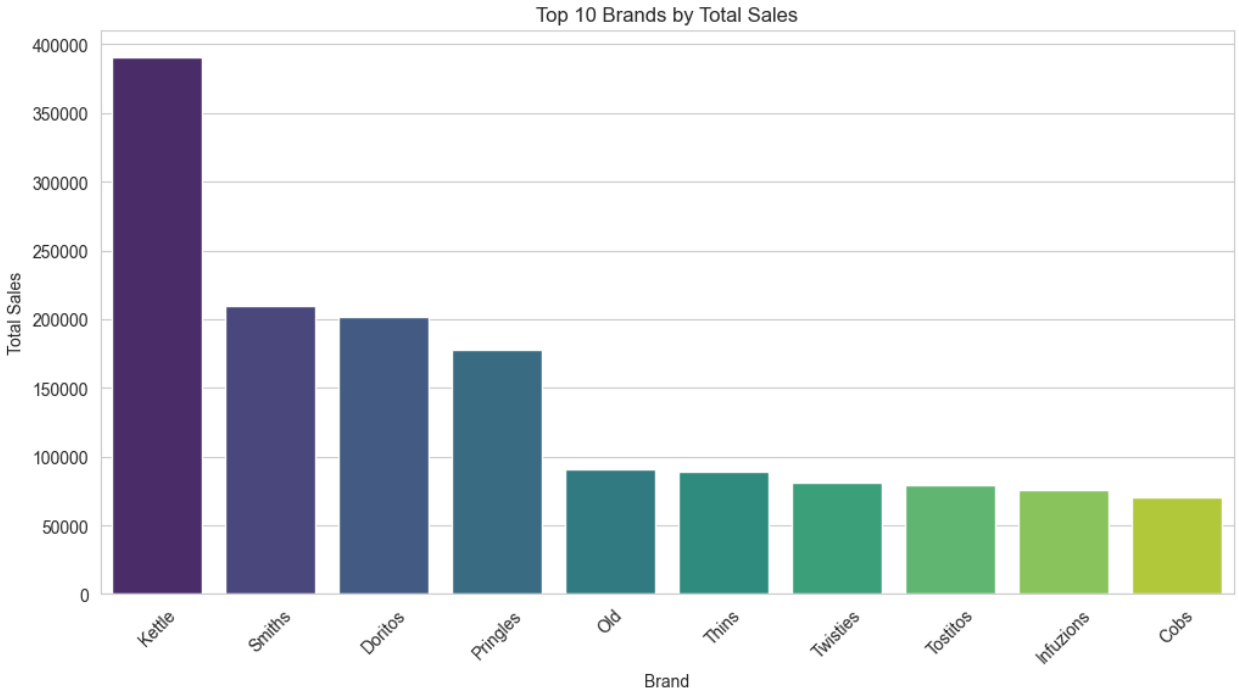
```
Outliers detected using IQR method:
                                DATE  STORE_NBR  LYLTY_CARD_NBR
TXN_ID  \
69762  1970-01-01 00:00:00.000043331        226          226000
226201
69763  1970-01-01 00:00:00.000043605        226          226000
226210
```

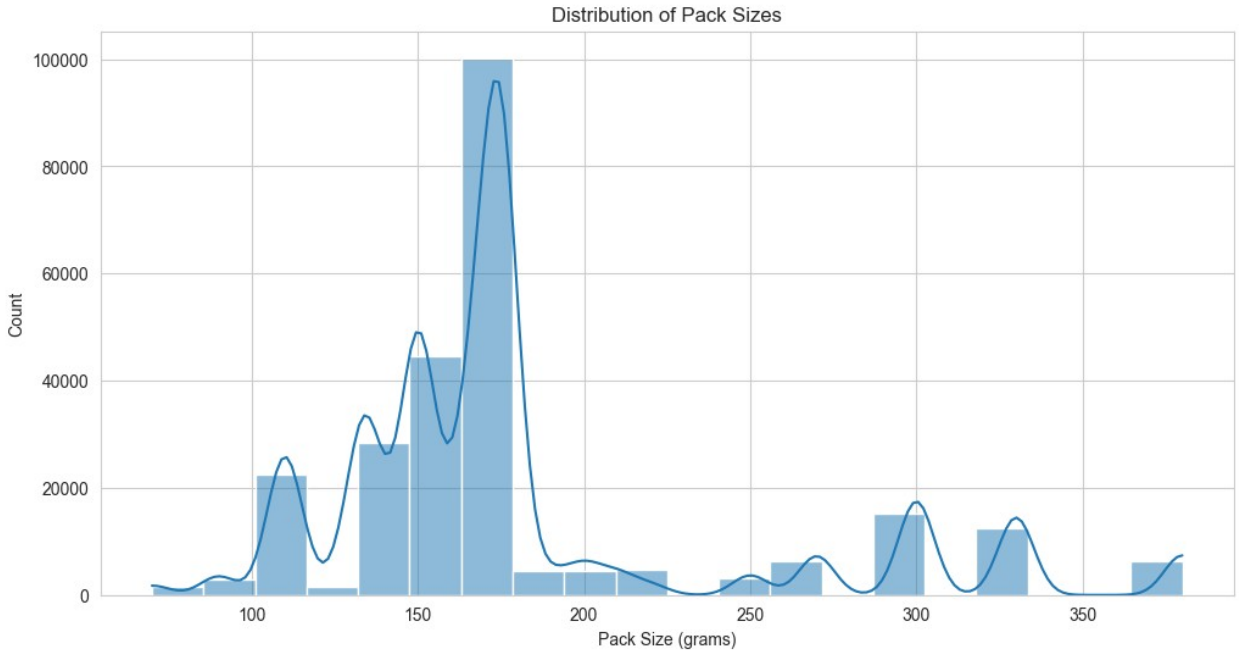
```
150683 1970-01-01 00:00:00.000043605        118          118021
120799
5179   1970-01-01 00:00:00.000043327         94           94148
93390
55558  1970-01-01 00:00:00.000043599        190          190113
190914
...                              ...        ...             ...     ..
.
185364 1970-01-01 00:00:00.000043328        191          191130
192521
228562 1970-01-01 00:00:00.000043602         74           74436
73279
184900 1970-01-01 00:00:00.000043601         22           22404
18630
32825  1970-01-01 00:00:00.000043604        247          247073
249037
3      1970-01-01 00:00:00.000043329          2            2373
974

        PROD_NBR                                PROD_NAME  PROD_QTY
TOT_SALES  \
69762          4        Dorito Corn Chp     Supreme 380g       200
650.0
69763          4        Dorito Corn Chp     Supreme 380g       200
650.0
150683        14  Smiths Crnkle Chip  Orgnl Big Bag 380g         5
29.5
5179          14  Smiths Crnkle Chip  Orgnl Big Bag 380g         5
29.5
55558         14  Smiths Crnkle Chip  Orgnl Big Bag 380g         5
29.5
...          ...                                   ...       ...
...
185364        97               RRD Salt & Vinegar  165g         5
15.0
228562        80  Natural ChipCo Sea  Salt & Vinegr 175g         5
15.0
184900        98  NCC Sour Cream &    Garden Chives 175g         5
15.0
32825         85        RRD Honey Soy       Chicken 165g         5
15.0
3             69  Smiths Chip Thinly  S/Cream&Onion 175g         5
15.0

        PACK_SIZE    BRAND
69762       380.0   Dorito
69763       380.0   Dorito
150683      380.0   Smiths
5179        380.0   Smiths
```

```
55558       380.0   Smiths
...           ...      ...
185364      165.0      RRD
228562      175.0  Natural
184900      175.0      NCC
32825       165.0      RRD
3           175.0   Smiths

[578 rows x 10 columns]
```

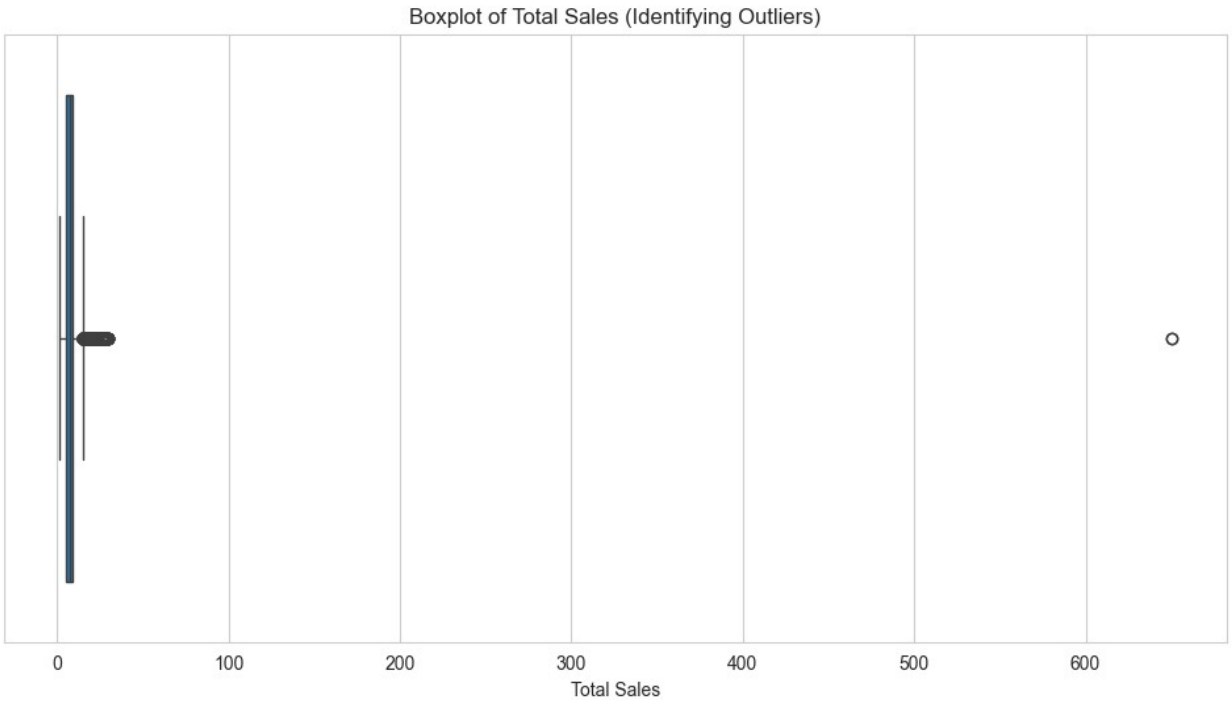
```
df ['PROD_NAME'] = df['PROD_NAME'].str.strip().copy()
df['PROD_NAME'] = df['PROD_NAME'].str.replace('\'', '')
df['PROD_NAME'] = df['PROD_NAME'].str.replace('\"', '')


# Set style
sns.set_style("whitegrid")

# 1. Sales Trend Over Time
plt.figure(figsize=(12, 6))
merged_data.groupby("DATE")["TOT_SALES"].sum().plot()
plt.title("Total Sales Over Time")
plt.xlabel("Date")
plt.ylabel("Total Sales")
plt.show()

# 2. Top 10 Brands by Total Sales
top_brands = merged_data.groupby("BRAND")
["TOT_SALES"].sum().sort_values(ascending=False).head(10)
plt.figure(figsize=(12, 6))
sns.barplot(x=top_brands.index, y=top_brands.values,
palette="viridis")
plt.title("Top 10 Brands by Total Sales")
plt.xlabel("Brand")
plt.ylabel("Total Sales")
plt.xticks(rotation=45)
plt.show()

# 3. Pack Size Distribution
plt.figure(figsize=(12, 6))
sns.histplot(merged_data["PACK_SIZE"], bins=20, kde=True)
plt.title("Distribution of Pack Sizes")
plt.xlabel("Pack Size (grams)")
plt.ylabel("Count")
plt.show()
```


```
C:\Users\mosta\AppData\Local\Temp\ipykernel_5464\1133544630.py:15:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.barplot(x=top_brands.index, y=top_brands.values,
palette="viridis")
```






```
# Identify outliers in TOTAL SALES using IQR method
Q1 = merged_data["TOT_SALES"].quantile(0.25)
Q3 = merged_data["TOT_SALES"].quantile(0.75)
IQR = Q3 - Q1

# Define outlier boundaries
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

# Filter outliers
outliers = merged_data[(merged_data["TOT_SALES"] < lower_bound) |
(merged_data["TOT_SALES"] > upper_bound)]

# Plot the distribution with outliers
plt.figure(figsize=(12, 6))
sns.boxplot(x=merged_data["TOT_SALES"])
plt.title("Boxplot of Total Sales (Identifying Outliers)")
plt.xlabel("Total Sales")
plt.show()

# Display summary of outliers
outliers.describe()
```

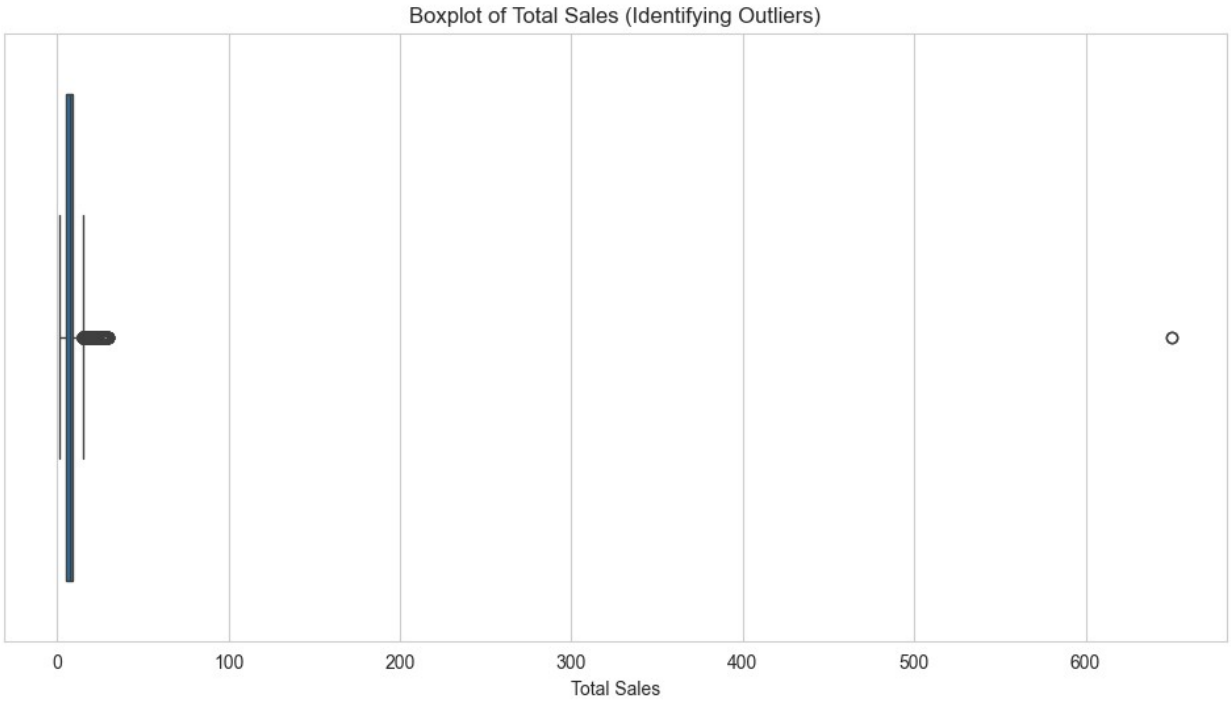



| | DATE | STORE_NBR | LYLTY_CARD_NBR | \ |
|---|---|---|---|---|
| count | 578 | 578.000000 | 578.000000 | |
| mean | 1970-01-01 00:00:00.000043462 | 136.937716 | 137108.588235 | |
| min | 1970-01-01 00:00:00.000043300 | 2.000000 | 2373.000000 | |
| 25% | 1970-01-01 00:00:00.000043329 | 71.250000 | 71357.000000 | |
| 50% | 1970-01-01 00:00:00.000043332 | 131.000000 | 131416.000000 | |
| 75% | 1970-01-01 00:00:00.000043602 | 206.500000 | 206678.000000 | |
| max | 1970-01-01 00:00:00.000043605 | 272.000000 | 272037.000000 | |
| std | NaN | 76.267882 | 76265.095826 | |

| | TXN_ID | PROD_NBR | PROD_QTY | TOT_SALES | PACK_SIZE |
|---|---|---|---|---|---|
| count | 578.000000 | 578.000000 | 578.000000 | 578.000000 | 571.000000 |
| mean | 136860.384083 | 53.557093 | 5.122837 | 21.899740 | 202.591944 |
| min | 974.000000 | 2.000000 | 3.000000 | 15.000000 | 110.000000 |
| 25% | 69988.750000 | 23.000000 | 4.000000 | 16.800000 | 150.000000 |
| 50% | 135758.000000 | 50.000000 | 5.000000 | 18.500000 | 175.000000 |
| 75% | 205112.250000 | 84.000000 | 5.000000 | 22.000000 | 270.000000 |
| max | 269678.000000 | 114.000000 | 200.000000 | 650.000000 | 380.000000 |
| std | 77537.789198 | 33.483140 | 11.514310 | 37.227518 | 78.630425 |

```
import matplotlib.pyplot as plt
import seaborn as sns

# Identify outliers in TOTAL SALES using IQR method
Q1 = merged_data["TOT_SALES"].quantile(0.25)
Q3 = merged_data["TOT_SALES"].quantile(0.75)
IQR = Q3 - Q1
```

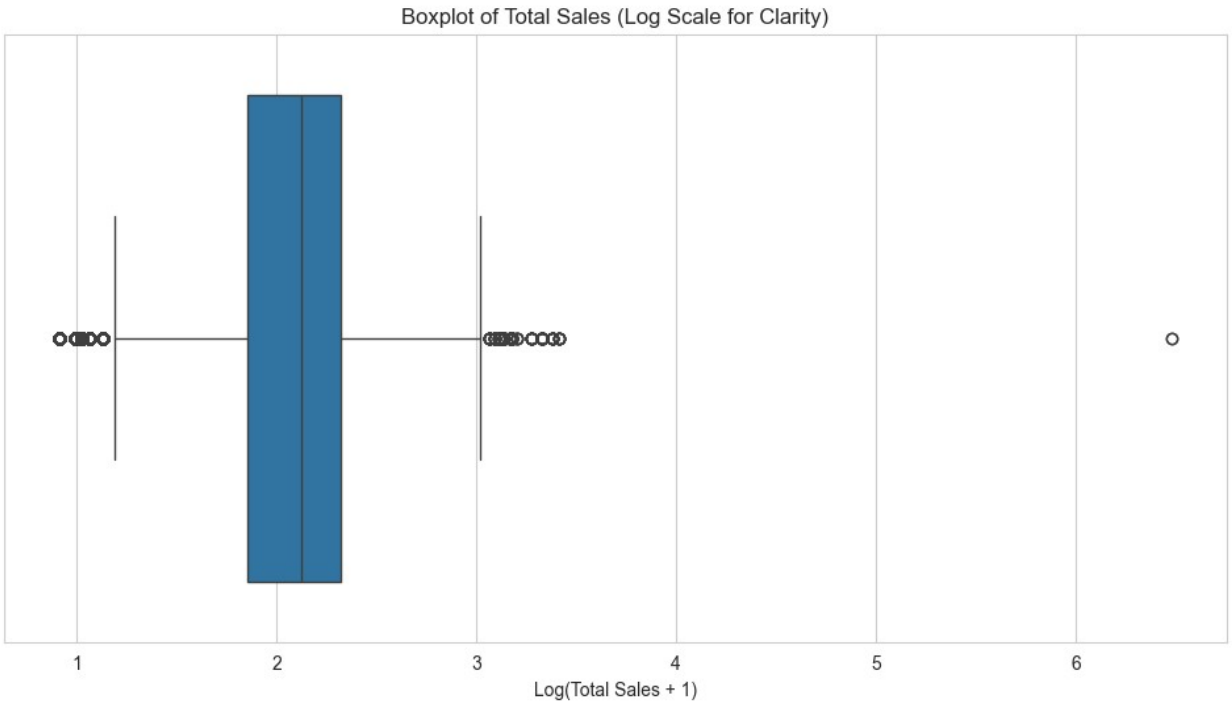
```
# Define outlier boundaries
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

# Filter outliers
outliers = merged_data[(merged_data["TOT_SALES"] < lower_bound) |
(merged_data["TOT_SALES"] > upper_bound)]

# Plot the distribution with outliers
plt.figure(figsize=(12, 6))
sns.boxplot(x=merged_data["TOT_SALES"])
plt.title("Boxplot of Total Sales (Identifying Outliers)")
plt.xlabel("Total Sales")
plt.show()

# Display summary of outliers
print(outliers.describe())
```

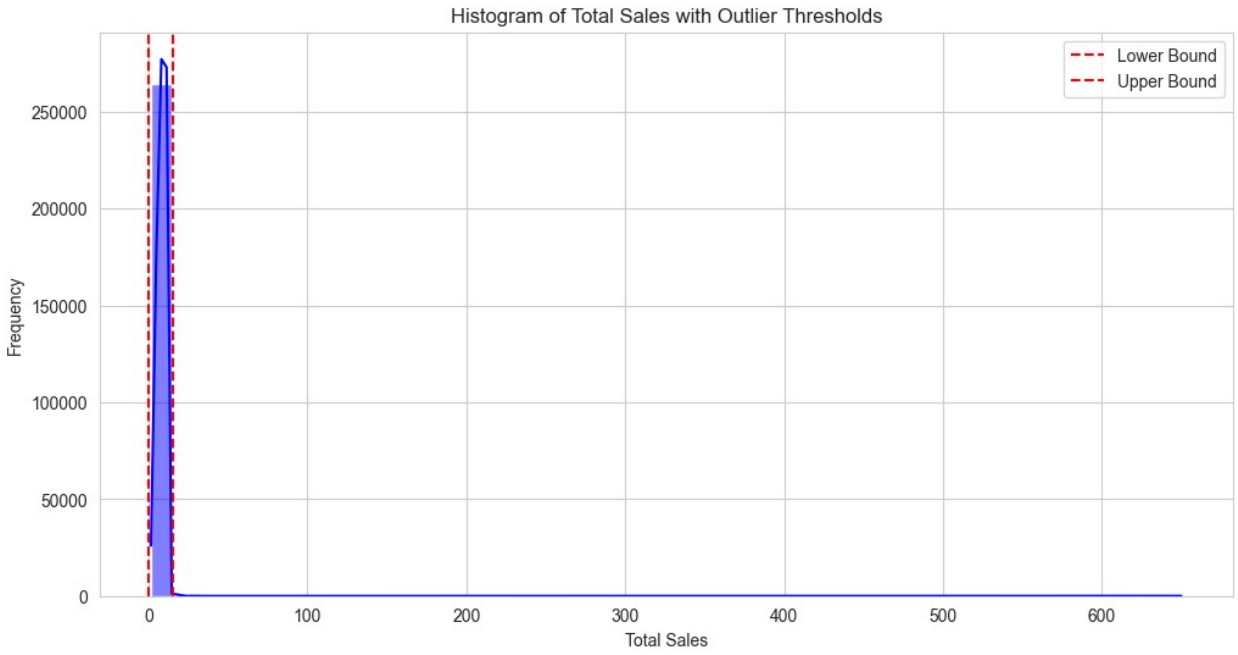


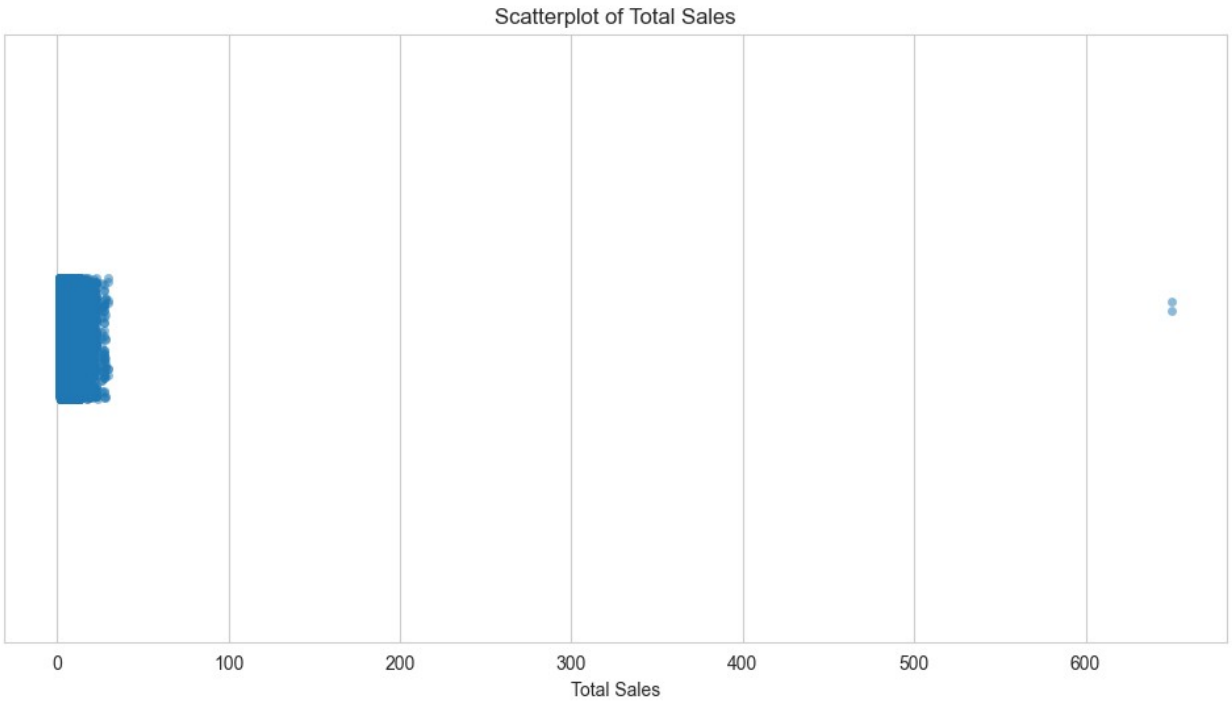

```
                                DATE   STORE_NBR  LYLTY_CARD_NBR  \
count                            578  578.000000      578.000000
mean   1970-01-01 00:00:00.000043462  136.937716   137108.588235
min    1970-01-01 00:00:00.000043300    2.000000     2373.000000
25%    1970-01-01 00:00:00.000043329   71.250000    71357.000000
50%    1970-01-01 00:00:00.000043332  131.000000   131416.000000
75%    1970-01-01 00:00:00.000043602  206.500000   206678.000000
max    1970-01-01 00:00:00.000043605  272.000000   272037.000000
std                              NaN   76.267882    76265.095826
```

| | TXN_ID | PROD_NBR | PROD_QTY | TOT_SALES | PACK_SIZE |
|---|---|---|---|---|---|
| count | 578.000000 | 578.000000 | 578.000000 | 578.000000 | 571.000000 |
| mean | 136860.384083 | 53.557093 | 5.122837 | 21.899740 | 202.591944 |
| min | 974.000000 | 2.000000 | 3.000000 | 15.000000 | 110.000000 |
| 25% | 69988.750000 | 23.000000 | 4.000000 | 16.800000 | 150.000000 |
| 50% | 135758.000000 | 50.000000 | 5.000000 | 18.500000 | 175.000000 |
| 75% | 205112.250000 | 84.000000 | 5.000000 | 22.000000 | 270.000000 |
| max | 269678.000000 | 114.000000 | 200.000000 | 650.000000 | 380.000000 |
| std | 77537.789198 | 33.483140 | 11.514310 | 37.227518 | 78.630425 |

```
plt.figure(figsize=(12, 6))

# Boxplot with log scale
sns.boxplot(x=np.log1p(merged_data["TOT_SALES"]))  # Using log
transformation
plt.title("Boxplot of Total Sales (Log Scale for Clarity)")
plt.xlabel("Log(Total Sales + 1)")
plt.show()

# Histogram with KDE to see distribution
plt.figure(figsize=(12, 6))
sns.histplot(merged_data["TOT_SALES"], bins=50, kde=True,
color="blue")
plt.axvline(lower_bound, color="red", linestyle="dashed", label="Lower
Bound")
plt.axvline(upper_bound, color="red", linestyle="dashed", label="Upper
Bound")
plt.title("Histogram of Total Sales with Outlier Thresholds")
plt.xlabel("Total Sales")
plt.ylabel("Frequency")
plt.legend()
plt.show()

# Swarmplot (shows individual points clearly, may need sampling for
large data)
plt.figure(figsize=(12, 6))
sns.stripplot(x=merged_data["TOT_SALES"], jitter=True, alpha=0.5)
plt.title("Scatterplot of Total Sales")
plt.xlabel("Total Sales")
plt.show()
```


Boxplot of Total Sales (Log Scale for Clarity)
1
2
3
4
5
6
Log(Total Sales + 1)


Histogram of Total Sales with Outlier Thresholds
Lower Bound
Upper Bound
250000
200000
150000
100000
50000
0
Frequency
0
100
200
300
400
500
600
Total Sales


Scatterplot of Total Sales
0
100
200
300
400
500
600
Total Sales