```
import sys
print(sys.version)
```

```
3.12.7 | packaged by Anaconda, Inc. | (main, Oct  4 2024, 13:17:27)
[MSC v.1929 64 bit (AMD64)]
```

```
import pandas as pd
import numpy as np
import os
import matplotlib as plt
import seaborn as sns
```

```
df_purchase=pd.read_csv(r"C:\Users\lavan\Downloads\
QVI_purchase_behaviour.csv")
```

```
df_purchase.head()
```

```
   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
```

```
df_purchase.isnull().sum()
```

```
LYLTY_CARD_NBR      0
LIFESTAGE           0
PREMIUM_CUSTOMER    0
dtype: int64
```

```
df_purchase['LIFESTAGE'] =
df_purchase['LIFESTAGE'].str.lower().str.strip()
df_purchase['PREMIUM_CUSTOMER'] =
df_purchase['PREMIUM_CUSTOMER'].str.lower().str.strip()
```

```
df_purchase['LIFESTAGE'].unique()
```

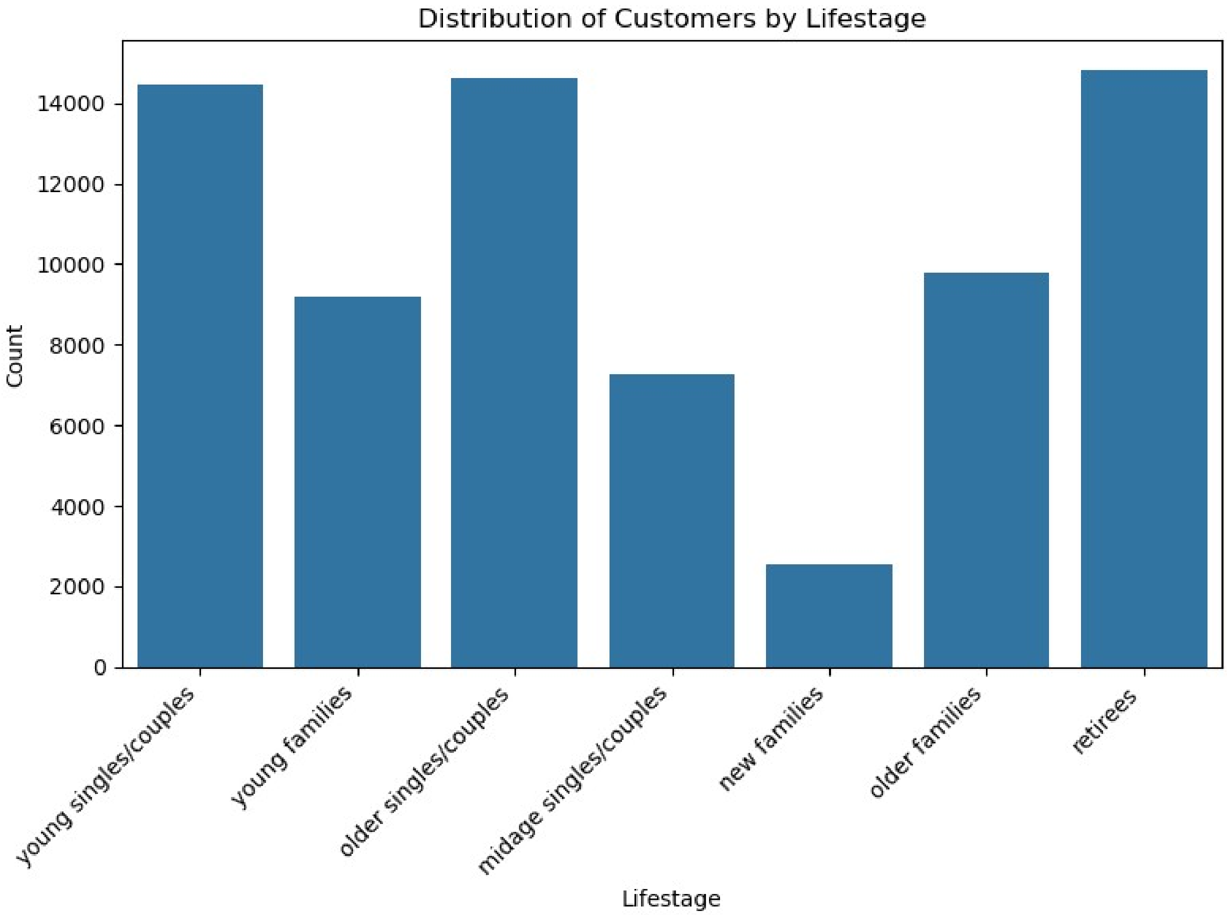
```
array(['young singles/couples', 'young families', 'older
singles/couples',
       'midage singles/couples', 'new families', 'older families',
       'retirees'], dtype=object)
```

```
lifestage_counts=df_purchase.groupby('LIFESTAGE').value_counts()
lifestage_counts
```

```
LIFESTAGE               LYLTY_CARD_NBR  PREMIUM_CUSTOMER
midage singles/couples  1005            mainstream          1
                        1023            premium             1
                        1026            premium             1
                        1052            budget              1
                        1053            mainstream          1
```

```
                                                           ..
young singles/couples   2330041        mainstream           1
                        2330311        budget               1
                        2330321        mainstream           1
                        2370181        mainstream           1
                        2373711        mainstream           1
Name: count, Length: 72637, dtype: int64
```

```
# 3. Plotting with Seaborn (more visually appealing)
plt.figure(figsize=(8, 6))
sns.countplot(x='LIFESTAGE', data=df_purchase)  # Easier syntax with
Seaborn
plt.xlabel('Lifestage')
plt.ylabel('Count')
plt.title('Distribution of Customers by Lifestage')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



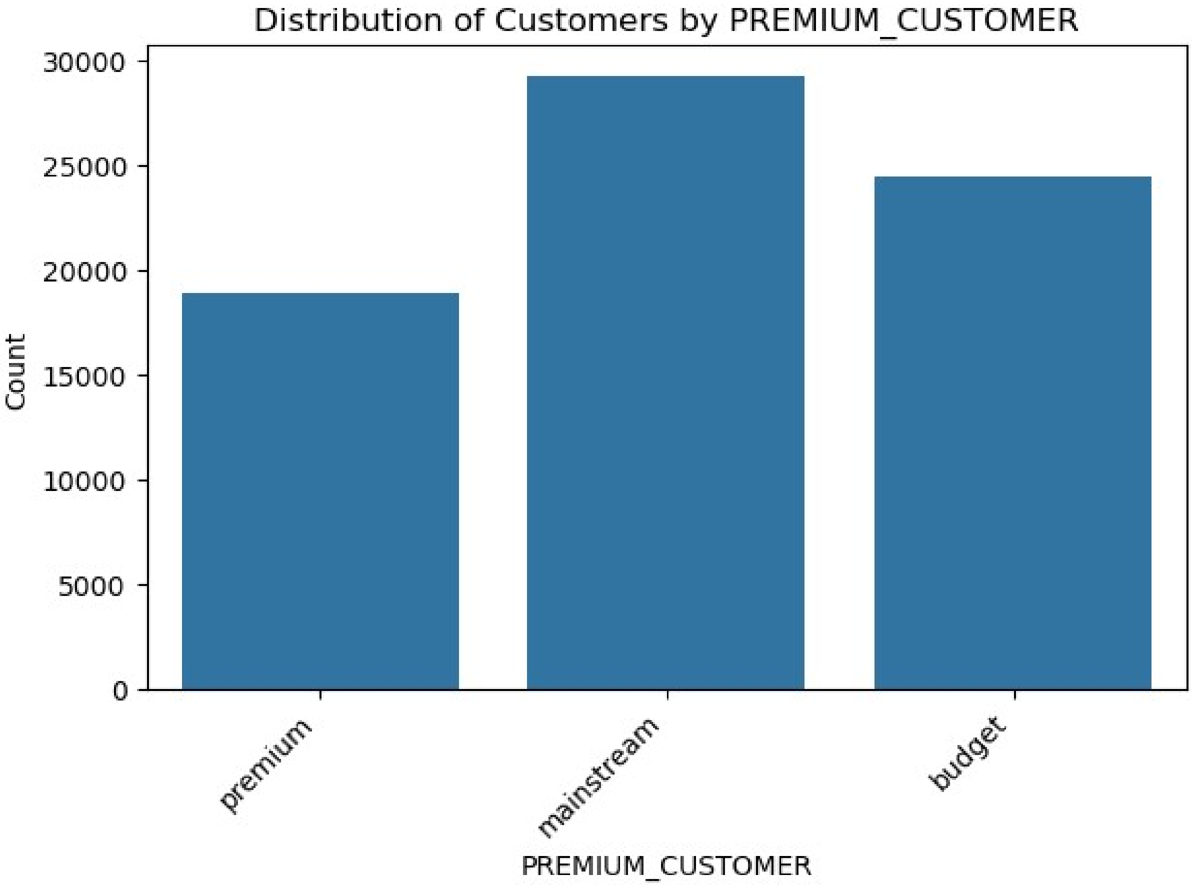
```
df_purchase.groupby('LIFESTAGE').size()
```

```
LIFESTAGE
midage singles/couples     7275
new families               2549
older families             9780
older singles/couples     14609
retirees                  14805
young families             9178
young singles/couples     14441
dtype: int64
```

```
#PREMIUM_CUSTOMER inspection

df_purchase.groupby('PREMIUM_CUSTOMER').size()
```

```
PREMIUM_CUSTOMER
budget        24470
mainstream    29245
premium       18922
dtype: int64
```

```
sns.countplot(x='PREMIUM_CUSTOMER', data=df_purchase)  # Easier syntax with Seaborn
plt.xlabel('PREMIUM_CUSTOMER')
plt.ylabel('Count')
plt.title('Distribution of Customers by PREMIUM_CUSTOMER')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



```
df_purchase.head(2)
```

```
   LYLTY_CARD_NBR               LIFESTAGE PREMIUM_CUSTOMER
0            1000  young singles/couples          premium
1            1002  young singles/couples       mainstream
```

QVI_transaction_data

```
#converted date column in excel

df_trans=pd.read_excel(r"C:\Users\lavan\Downloads\
QVI_transaction_data.xlsx")

df_trans.head()
```

```
        DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0 2018-10-17          1            1000       1         5
1 2019-05-14          1            1307     348        66
2 2019-05-20          1            1343     383        61
3 2018-08-17          2            2373     974        69
4 2018-08-18          2            2426    1038       108

                                  PROD_NAME  PROD_QTY  TOT_SALES
```

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

```
df_trans.DATE.isnull().sum()
```

```
0
```

```
#change date format from yymmdd to ddmmyy

df_trans.DATE=df_trans.DATE.dt.strftime('%d-%m-%Y')

df_trans.head()
```

```
         DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0  17-10-2018          1            1000       1         5
1  14-05-2019          1            1307     348        66
2  20-05-2019          1            1343     383        61
3  17-08-2018          2            2373     974        69
4  18-08-2018          2            2426    1038       108

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

Missing Values

#checking null values

```
df_trans.isnull().sum()
```

```
DATE              0
STORE_NBR         0
LYLTY_CARD_NBR    0
TXN_ID            0
PROD_NBR          0
PROD_NAME         0
PROD_QTY          0
TOT_SALES         0
dtype: int64
```

```
df_trans.dtypes
```

```
DATE               object
STORE_NBR           int64
LYLTY_CARD_NBR      int64
```

```
TXN_ID              int64
PROD_NBR            int64
PROD_NAME          object
PROD_QTY            int64
TOT_SALES         float64
dtype: object

#new column product weight from splitting product name

df_trans['PROD_WEIGHT']=df_trans['PROD_NAME'].str.extract(r'(\d+)g',
expand=False)

df_trans.head()

         DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0  17-10-2018          1            1000       1         5
1  14-05-2019          1            1307     348        66
2  20-05-2019          1            1343     383        61
3  17-08-2018          2            2373     974        69
4  18-08-2018          2            2426    1038       108

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

df_trans['PROD_NAME'] = df_trans['PROD_NAME'].apply(lambda x: x[:-4]
if len(x)>=5 else x)

df_trans.head(5)

         DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0  17-10-2018          1            1000       1         5
1  14-05-2019          1            1307     348        66
2  20-05-2019          1            1343     383        61
3  17-08-2018          2            2373     974        69
4  18-08-2018          2            2426    1038       108

                              PROD_NAME  PROD_QTY  TOT_SALES
PROD_WEIGHT
0    Natural Chip        Compny SeaSalt         2        6.0
175
1                  CCs Nacho Cheese             3        6.3
```

```
175
2    Smiths Crinkle Cut  Chips Chicken          2        2.9
170
3    Smiths Chip Thinly  S/Cream&Onion          5       15.0
175
4  Kettle Tortilla ChpsHny&Jlpno Chili          3       13.8
150
```

```
df_trans.duplicated().any()
```

```
True
```

```
df_trans.columns
```

```
Index(['DATE', 'STORE_NBR', 'LYLTY_CARD_NBR', 'TXN_ID', 'PROD_NBR',
       'PROD_NAME', 'PROD_QTY', 'TOT_SALES', 'PROD_WEIGHT'],
      dtype='object')
```

```
df_trans.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 264836 entries, 0 to 264835
Data columns (total 9 columns):
 #   Column          Non-Null Count   Dtype  
---  ------          --------------   -----  
 0   DATE            264836 non-null  object 
 1   STORE_NBR       264836 non-null  int64  
 2   LYLTY_CARD_NBR  264836 non-null  int64  
 3   TXN_ID          264836 non-null  int64  
 4   PROD_NBR        264836 non-null  int64  
 5   PROD_NAME       264836 non-null  object 
 6   PROD_QTY        264836 non-null  int64  
 7   TOT_SALES       264836 non-null  float64
 8   PROD_WEIGHT     258772 non-null  object 
dtypes: float64(1), int64(5), object(3)
memory usage: 18.2+ MB
```

```
df_trans.isnull().sum()/len(df_trans)
```

```
DATE              0.000000
STORE_NBR         0.000000
LYLTY_CARD_NBR    0.000000
TXN_ID            0.000000
PROD_NBR          0.000000
PROD_NAME         0.000000
PROD_QTY          0.000000
TOT_SALES         0.000000
PROD_WEIGHT       0.022897
dtype: float64
```

```
#inspecting the null product weight rows
#since product weight has 0.022897 missing values which has less
contribution hence deleting the rows

df_trans[df_trans['PROD_WEIGHT'].isna()]
```

```
              DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
9       18-08-2018          7            7150    6900        52
34      16-08-2018         51           51100   46802        48
35      19-08-2018         51           51100   46803        37
212     13-03-2019          1            1348     391        48
292     02-09-2018          5            5018    4465        52
...            ...        ...             ...     ...       ...
264573  24-03-2019        261          261035  259859        52
264635  01-01-2019        264          264268  263026        52
264705  25-06-2019        266          266088  263925        52
264733  11-05-2019        266          266432  264264        48
264745  03-07-2018        268          268200  264615        52

                                   PROD_NAME  PROD_QTY  TOT_SALES
PROD_WEIGHT
9          Grain Waves Sour    Cream&Chives          2        7.2
NaN
34       Red Rock Deli Sp    Salt & Truffle          1        2.7
NaN
35      Smiths Thinly       Swt Chli&S/Cream         1        3.0
NaN
212      Red Rock Deli Sp    Salt & Truffle          1        2.7
NaN
292        Grain Waves Sour    Cream&Chives          2        7.2
NaN
...                                      ...       ...        ...
...
264573     Grain Waves Sour    Cream&Chives          2        7.2
NaN
264635     Grain Waves Sour    Cream&Chives          1        3.6
NaN
264705     Grain Waves Sour    Cream&Chives          1        3.6
NaN
264733   Red Rock Deli Sp    Salt & Truffle          1        2.7
NaN
264745     Grain Waves Sour    Cream&Chives          1        3.6
NaN

[6064 rows x 9 columns]
```

```
df_trans.PROD_WEIGHT=df_trans['PROD_WEIGHT'].dropna()

df_trans.head()
```

```
         DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0  17-10-2018          1            1000       1         5   
1  14-05-2019          1            1307     348        66   
2  20-05-2019          1            1343     383        61   
3  17-08-2018          2            2373     974        69   
4  18-08-2018          2            2426    1038       108   

                               PROD_NAME  PROD_QTY  TOT_SALES  
PROD_WEIGHT  
0    Natural Chip        Compny SeaSalt         2        6.0  
175  
1                  CCs Nacho Cheese             3        6.3  
175  
2    Smiths Crinkle Cut  Chips Chicken         2        2.9  
170  
3    Smiths Chip Thinly  S/Cream&Onion         5       15.0  
175  
4  Kettle Tortilla ChpsHny&Jlpno Chili         3       13.8  
150  
```

```
df_cleaned = df_trans.dropna(subset=['PROD_WEIGHT'])
```

```
df_cleaned[df_cleaned['PROD_WEIGHT'].isna()]
```

```
Empty DataFrame
Columns: [DATE, STORE_NBR, LYLTY_CARD_NBR, TXN_ID, PROD_NBR, 
PROD_NAME, PROD_QTY, TOT_SALES, PROD_WEIGHT]
Index: []
```

```
df_cleaned.isnull().sum()
```

```
DATE              0
STORE_NBR         0
LYLTY_CARD_NBR    0
TXN_ID            0
PROD_NBR          0
PROD_NAME         0
PROD_QTY          0
TOT_SALES         0
PROD_WEIGHT       0
dtype: int64
```

```
df_cleaned.count()
```

```
DATE              258772
STORE_NBR         258772
LYLTY_CARD_NBR    258772
TXN_ID            258772
PROD_NBR          258772
PROD_NAME         258772
PROD_QTY          258772
```

```
TOT_SALES         258772
PROD_WEIGHT       258772
dtype: int64
```

```python
df_cleaned['PROD_NAME']=df_cleaned['PROD_NAME'].str.lower()
```

```
C:\Users\lavan\AppData\Local\Temp\ipykernel_9852\3163247834.py:1:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  df_cleaned['PROD_NAME']=df_cleaned['PROD_NAME'].str.lower()
```

```python
df_cleaned.head()
```

```
         DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0  17-10-2018          1            1000       1         5
1  14-05-2019          1            1307     348        66
2  20-05-2019          1            1343     383        61
3  17-08-2018          2            2373     974        69
4  18-08-2018          2            2426    1038       108

                              PROD_NAME  PROD_QTY  TOT_SALES
PROD_WEIGHT
0    natural chip        compny seasalt         2        6.0
175
1                   ccs nacho cheese            3        6.3
175
2    smiths crinkle cut  chips chicken          2        2.9
170
3    smiths chip thinly  s/cream&onion          5       15.0
175
4  kettle tortilla chpshny&jlpno chili          3       13.8
150
```

```python
df_cleaned.dtypes
```

```
DATE               object
STORE_NBR           int64
LYLTY_CARD_NBR      int64
TXN_ID              int64
PROD_NBR            int64
PROD_NAME          object
PROD_QTY            int64
TOT_SALES         float64
PROD_WEIGHT         int32
dtype: object
```

```
df_cleaned['PROD_NAME'].duplicated().any()
```

```
True
```

```
df_cleaned.PROD_WEIGHT=df_cleaned.PROD_WEIGHT.astype(int)
```

```
C:\Users\lavan\AppData\Local\Temp\ipykernel_9852\1397434523.py:1: 
SettingWithCopyWarning: 
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: 
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  df_cleaned.PROD_WEIGHT=df_cleaned.PROD_WEIGHT.astype(int)
```

Merge two excels

```
df_merged = df_cleaned.merge(df_purchase, on='LYLTY_CARD_NBR', 
how='inner')
```

```
df_merged.columns
```

```
Index(['DATE', 'STORE_NBR', 'LYLTY_CARD_NBR', 'TXN_ID', 'PROD_NBR',
       'PROD_NAME', 'PROD_QTY', 'TOT_SALES', 'PROD_WEIGHT', 
'LIFESTAGE',
       'PREMIUM_CUSTOMER'],
      dtype='object')
```

```
df_merged.isnull().sum()/len(df_merged)
```

```
DATE                0.0
STORE_NBR           0.0
LYLTY_CARD_NBR      0.0
TXN_ID              0.0
PROD_NBR            0.0
PROD_NAME           0.0
PROD_QTY            0.0
TOT_SALES           0.0
PROD_WEIGHT         0.0
LIFESTAGE           0.0
PREMIUM_CUSTOMER    0.0
dtype: float64
```

```
df_merged.duplicated().any()
```

```
True
```

```
df_merged.value_counts()
```

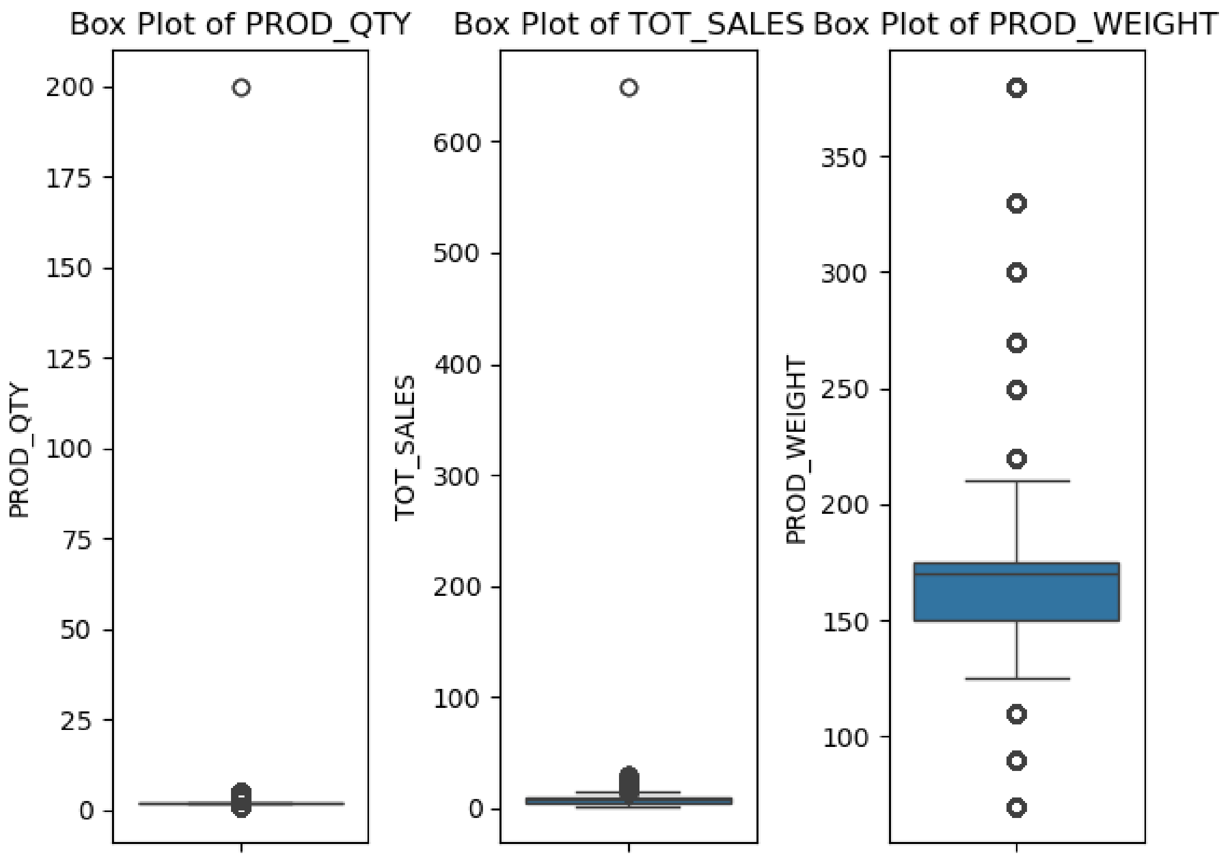
```
DATE        STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  PROD_NAME 
PROD_QTY  TOT_SALES  PROD_WEIGHT  LIFESTAGE
```

```
PREMIUM_CUSTOMER
01-10-2018  107        107024          108462  45        smiths thinly
cut   roast chicken     2         6.0        175           older
singles/couples  premium              2
01-01-2019  1          1211            245     30        doritos corn
chips   cheese supreme    1         4.4        170          older
singles/couples  premium              1
21-03-2019  212        212150          211306  4         dorito corn
chp     supreme          2         13.0        380           older
singles/couples  mainstream           1
            208        208218          207399  67        rrd chilli&
coconut           2         5.4        150         older families
budget              1
            209        209020          207604  61        smiths
crinkle cut  chips chicken     2         5.8        170             young
families         budget               1

..
11-02-2019  223        223006          222954  19        smiths
crinkle cut  snag&sauce        2         5.2        150             older
families         mainstream           1
                       223040          223174  32        kettle sea
salt     and vinegar       2         10.8       175             young
singles/couples  mainstream           1
                       223046          223207  34        pringles slt
vingar                    2         7.4        134          older
singles/couples  premium              1
                       223108          223566  38        infuzions
mango     chutny papadums   2         4.8        70             older
families         budget               1
31-12-2018  272        272322          270093  57        old el paso
salsa   dip tomato mild   2         10.2        300           young
singles/couples  mainstream           1
Name: count, Length: 258771, dtype: int64
```

##Check for and handle outliers in numerical columns (PROD_QTY, TOT_SALES, PROD_WEIGHT).

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

plt.subplot(1, 3, 1)  # 1 row, 3 columns, first plot
sns.boxplot(y=df_merged['PROD_QTY'])
plt.title('Box Plot of PROD_QTY')
plt.subplot(1, 3, 2)  # 1 row, 3 columns, second plot
sns.boxplot(y=df_merged['TOT_SALES'])
plt.title('Box Plot of TOT_SALES')

plt.subplot(1, 3, 3)  # 1 row, 3 columns, third plot
```

```
sns.boxplot(y=df_merged['PROD_WEIGHT'])
plt.title('Box Plot of PROD_WEIGHT')

plt.tight_layout() # Adjusts subplot params so that subplots are
nicely fit in the figure.
plt.show()
```



#prod_quantity and total_sales have outliers

```
# Calculate IQR and whisker bounds for PROD_QTY
q1 = df_merged['PROD_QTY'].quantile(0.25)
q3 = df_merged['PROD_QTY'].quantile(0.75)
iqr = q3 - q1
upper_bound = q3 + 1.5 * iqr
lower_bound = q1 - 1.5 * iqr

print(f"Q1: {q1}")
print(f"Q3: {q3}")
print(f"IQR: {iqr}")
print(f"Upper Bound: {upper_bound}")
print(f"Lower Bound: {lower_bound}")

# Print the actual values of the outliers
```

```
outliers_prod_qty = df_merged[(df_merged['PROD_QTY'] < lower_bound) |
(df_merged['PROD_QTY'] > upper_bound)]['PROD_QTY']
print("\nOutlier values for PROD_QTY")
print(outliers_prod_qty)
```

```
Q1: 2.0
Q3: 2.0
IQR: 0.0
Upper Bound: 2.0
Lower Bound: 2.0

Outlier values for PROD_QTY
1         3
3         5
4         3
5         1
6         1
         ..
258690    1
258691    1
258692    1
258760    1
258768    1
Name: PROD_QTY, Length: 28133, dtype: int64
```

```
# Calculate IQR and whisker bounds for PROD_weight
q1 = df_merged['PROD_WEIGHT'].quantile(0.25)
q3 = df_merged['PROD_WEIGHT'].quantile(0.75)
iqr = q3 - q1
upper_bound = q3 + 1.5 * iqr
lower_bound = q1 - 1.5 * iqr

print(f"Q1: {q1}")
print(f"Q3: {q3}")
print(f"IQR: {iqr}")
print(f"Upper Bound: {upper_bound}")
print(f"Lower Bound: {lower_bound}")

# Print the actual values of the outliers
outliers_prod_qty = df_merged[(df_merged['PROD_WEIGHT'] < lower_bound)
| (df_merged['PROD_WEIGHT'] > upper_bound)]['PROD_WEIGHT']
print("\nOutlier values for PROD_WEIGHT")
print(outliers_prod_qty)
```

```
Q1: 150.0
Q3: 175.0
IQR: 25.0
Upper Bound: 212.5
Lower Bound: 112.5
```

```
Outlier values for PROD_WEIGHT
5         300
6         330
9         330
11        270
15        220
         ... 
258754    110
258761    110
258762    110
258763    110
258765    110
Name: PROD_WEIGHT, Length: 72044, dtype: int32
```

```python
# Calculate IQR and whisker bounds for PROD_QTY
q1 = df_merged['TOT_SALES'].quantile(0.25)
q3 = df_merged['TOT_SALES'].quantile(0.75)
iqr = q3 - q1
upper_bound = q3 + 1.5 * iqr
lower_bound = q1 - 1.5 * iqr

print(f"Q1: {q1}")
print(f"Q3: {q3}")
print(f"IQR: {iqr}")
print(f"Upper Bound: {upper_bound}")
print(f"Lower Bound: {lower_bound}")

# Print the actual values of the outliers
outliers_prod_qty = df_merged[(df_merged['TOT_SALES'] < lower_bound) |
(df_merged['TOT_SALES'] > upper_bound)]['TOT_SALES']
print("\nOutlier values for TOT_SALES")
print(outliers_prod_qty)
```

```
Q1: 5.4
Q3: 9.2
IQR: 3.7999999999999999
Upper Bound: 14.899999999999999
Lower Bound: -0.29999999999999805
```

```
Outlier values for TOT_SALES
3         15.0
10        23.0
53        15.5
69        28.5
97        19.0
          ... 
252743    15.2
252796    21.6
252802    18.4
252807    16.5
```

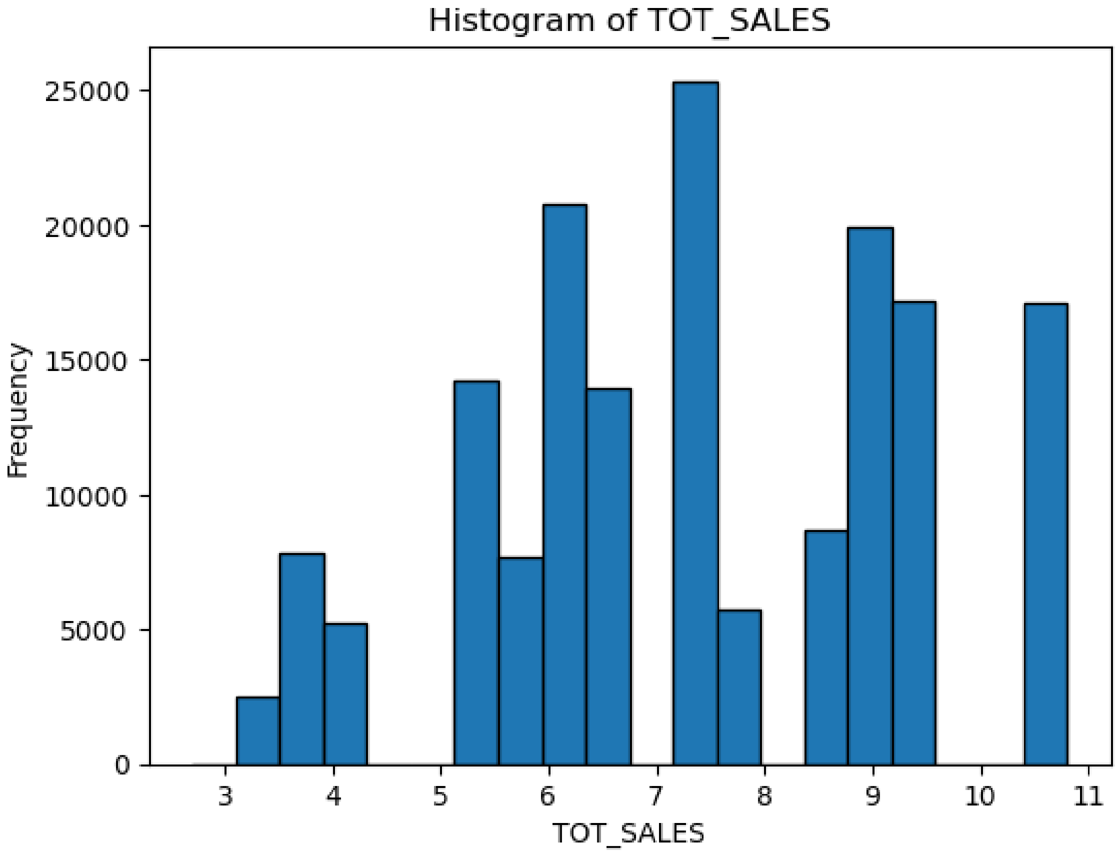
```
252866    18.5
Name: TOT_SALES, Length: 571, dtype: float64
```

```
columns_to_check = ['PROD_QTY', 'TOT_SALES', 'PROD_WEIGHT']
df_trans_filtered_multiple = df_merged.copy()

for col in columns_to_check:
    q1 = df_trans_filtered_multiple[col].quantile(0.25)
    q3 = df_trans_filtered_multiple[col].quantile(0.75)
    iqr = q3 - q1
    df_trans_filtered_multiple = df_trans_filtered_multiple[
        (df_trans_filtered_multiple[col] >= (q1 - 1.5 * iqr)) &
        (df_trans_filtered_multiple[col] <= (q3 + 1.5 * iqr))
    ]

print(df_trans_filtered_multiple.shape)
```

```
(166168, 11)
```

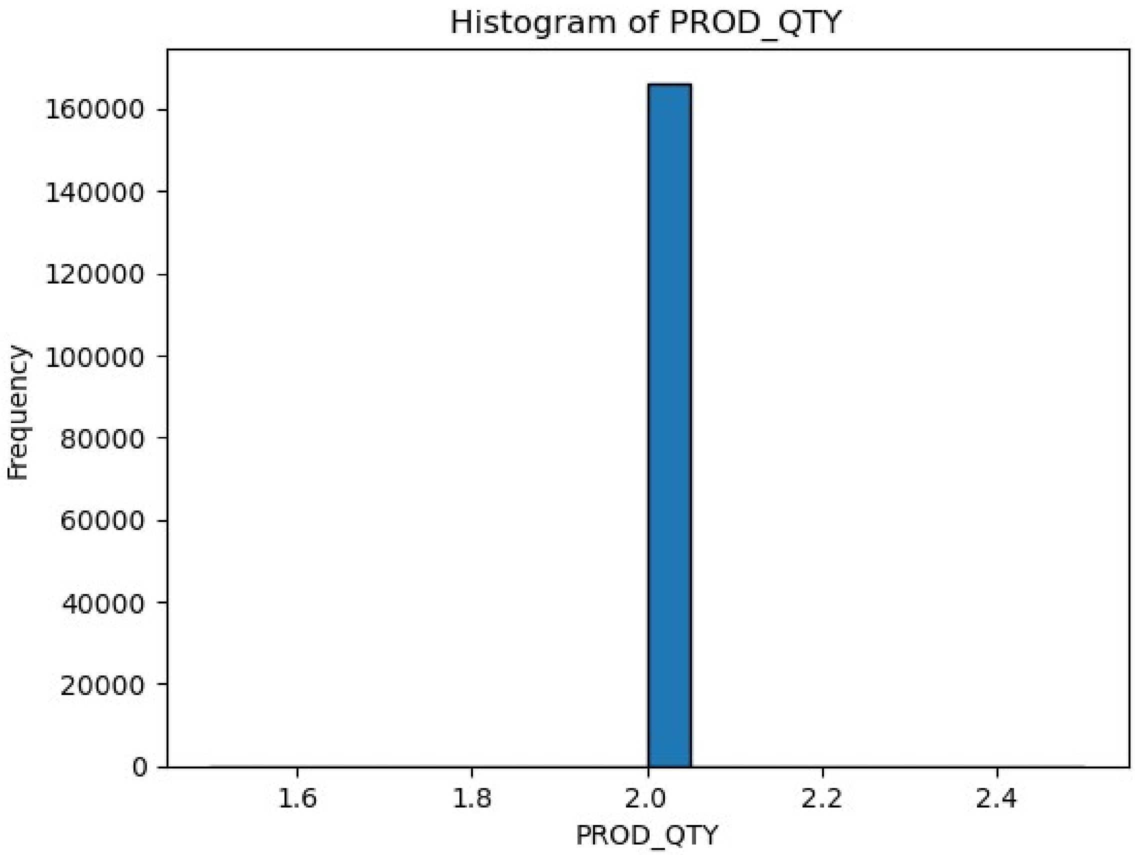
```
plt.hist(df_trans_filtered_multiple['TOT_SALES'], bins=20,
edgecolor='black')
plt.title('Histogram of TOT_SALES')
plt.xlabel('TOT_SALES')
plt.ylabel('Frequency')
```

```
Text(0, 0.5, 'Frequency')
```



```
plt.hist(df_trans_filtered_multiple['PROD_QTY'], bins=20,
edgecolor='black')  # Adjust bins as needed
plt.title('Histogram of PROD_QTY')
plt.xlabel('PROD_QTY')
plt.ylabel('Frequency')
```

```
Text(0, 0.5, 'Frequency')
```



```
df_trans_filtered_multiple.info
```

```
<bound method DataFrame.info of               DATE  STORE_NBR
LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0       17-10-2018          1             1000       1         5
2       20-05-2019          1             1343     383        61
23      15-08-2018         38            38142   34181       108
25      19-08-2018         39            39167   35638       111
31      20-05-2019         45            45127   41122        64
...            ...        ...              ...     ...       ...
258766  12-11-2018        272           272319  270087        44
258767  09-03-2019        272           272319  270088        89
258769  06-11-2018        272           272379  270187        51
258770  27-12-2018        272           272379  270188        42
258771  22-09-2018        272           272380  270189        74

                                   PROD_NAME  PROD_QTY  TOT_SALES  \
0         natural chip        compny seasalt         2        6.0
2         smiths crinkle cut  chips chicken          2        2.9
23      kettle tortilla chpshny&jlpno chili          2        9.2
25         smiths chip thinly  cut original          2        6.0
31      red rock deli sr    salsa & mzzrlla          2        5.4
...                                      ...       ...        ...
```

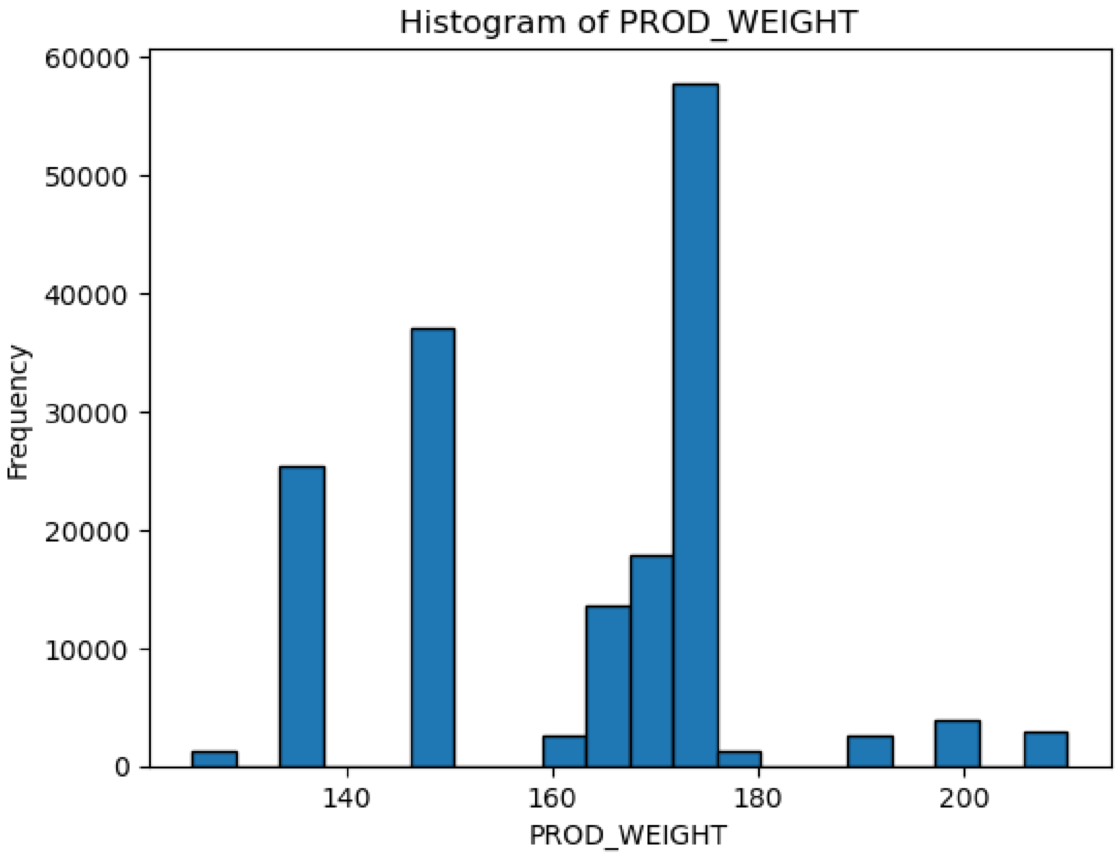
```
258766            thins chips light&  tangy          2        6.6
258767   kettle sweet chilli and sour cream          2       10.8
258769                  doritos mexicana             2        8.8
258770   doritos corn chip mexican jalapeno          2        7.8
258771             tostitos splash of  lime          2        8.8

        PROD_WEIGHT               LIFESTAGE PREMIUM_CUSTOMER
0               175   young singles/couples          premium
2               170  midage singles/couples           budget
23              150  midage singles/couples           budget
25              175  midage singles/couples           budget
31              150  midage singles/couples           budget
...             ...                     ...              ...
258766          175   young singles/couples          premium
258767          175   young singles/couples          premium
258769          170   young singles/couples          premium
258770          150   young singles/couples          premium
258771          175   young singles/couples          premium

[166168 rows x 11 columns]>
```

```
df_trans_filtered_multiple.dtypes
```

```
DATE                 object
STORE_NBR             int64
LYLTY_CARD_NBR        int64
TXN_ID                int64
PROD_NBR              int64
PROD_NAME            object
PROD_QTY              int64
TOT_SALES           float64
PROD_WEIGHT           int32
LIFESTAGE            object
PREMIUM_CUSTOMER     object
dtype: object
```

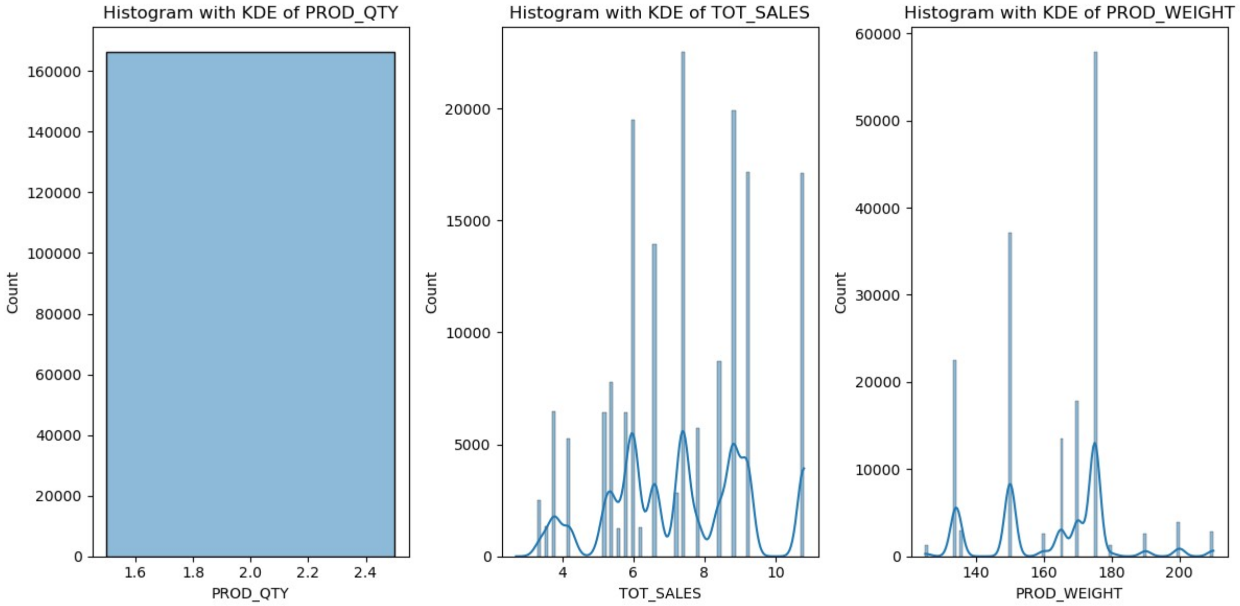
```
df_trans_filtered_multiple['PROD_WEIGHT'] =
df_trans_filtered_multiple['PROD_WEIGHT'].astype('Int64')


plt.hist(df_trans_filtered_multiple['PROD_WEIGHT'], bins=20,
edgecolor='black')
plt.title('Histogram of PROD_WEIGHT')
plt.xlabel('PROD_WEIGHT')
plt.ylabel('Frequency')
```

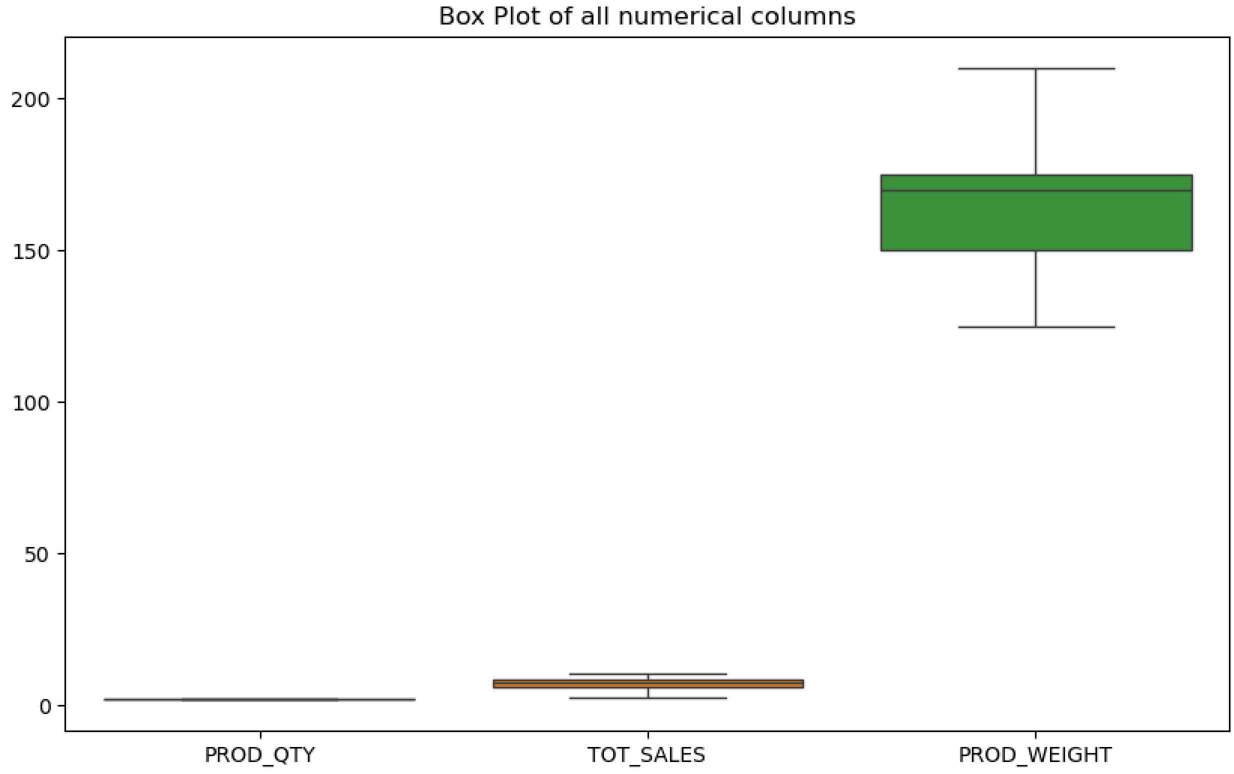
```
Text(0, 0.5, 'Frequency')
```



```
# 3. Combined Histogram and KDE (using Seaborn)
plt.figure(figsize=(12, 6))

plt.subplot(1, 3, 1)
sns.histplot(df_trans_filtered_multiple['PROD_QTY'], kde=True)
plt.title('Histogram with KDE of PROD_QTY')

plt.subplot(1, 3, 2)
sns.histplot(df_trans_filtered_multiple['TOT_SALES'], kde=True)
plt.title('Histogram with KDE of TOT_SALES')

plt.subplot(1, 3, 3)
sns.histplot(df_trans_filtered_multiple['PROD_WEIGHT'], kde=True)
plt.title('Histogram with KDE of PROD_WEIGHT')

plt.tight_layout()
plt.show()

# 4. Boxplot on one graph (using Seaborn)
plt.figure(figsize=(10, 6))
sns.boxplot(data=df_trans_filtered_multiple[['PROD_QTY','TOT_SALES','P
ROD_WEIGHT']])
```

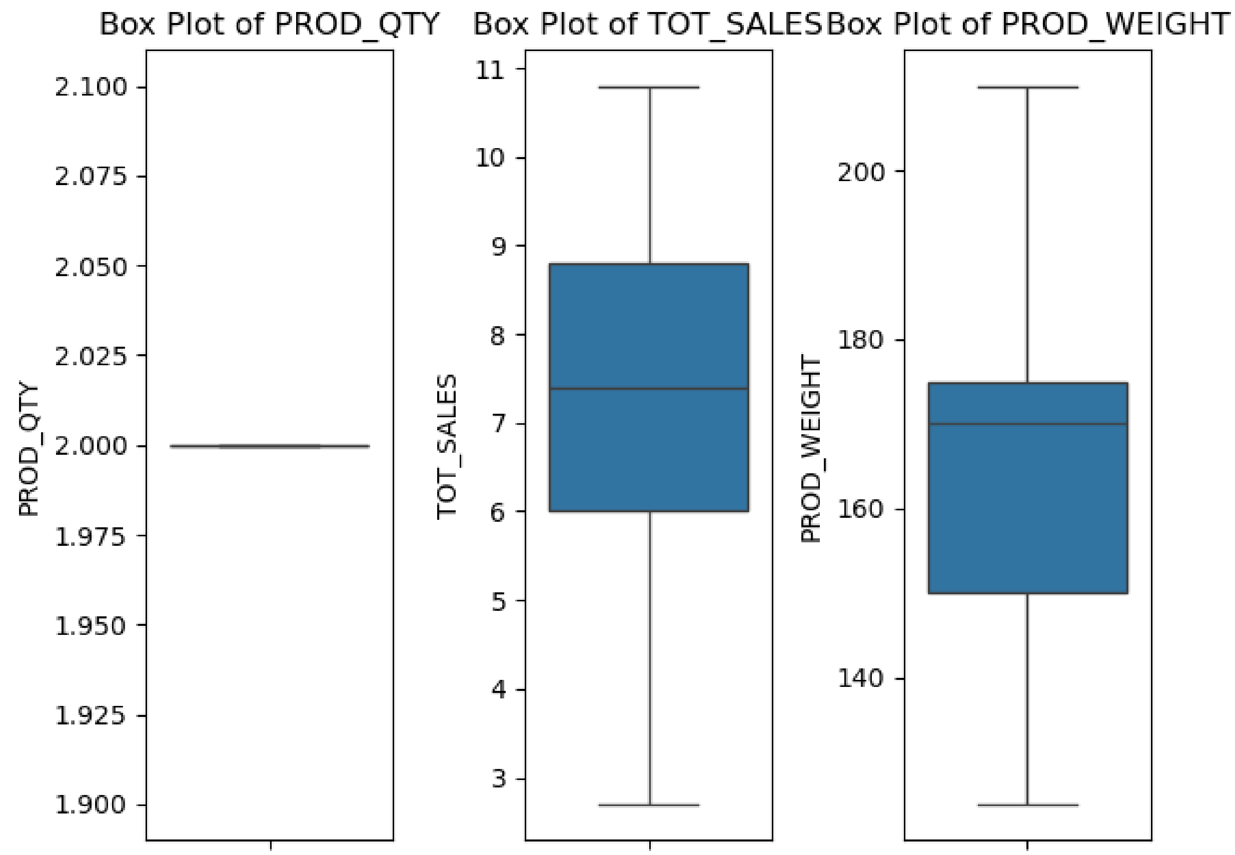
```
plt.title('Box Plot of all numerical columns')
plt.show()
```





```
df_trans_filtered_multiple.describe()
```

```
           STORE_NBR  LYLTY_CARD_NBR        TXN_ID       PROD_NBR
PROD_QTY  \
count  166168.000000    1.661680e+05  1.661680e+05  166168.000000
166168.0
mean      135.269956    1.356693e+05  1.353636e+05      60.103672
2.0
std        76.077349    7.907821e+04  7.752576e+04      32.420316
0.0
min         1.000000    1.000000e+03  1.000000e+00       1.000000
2.0
25%        70.000000    7.014200e+04  6.831375e+04      32.000000
2.0
50%       130.000000    1.301515e+05  1.342830e+05      62.000000
2.0
75%       203.000000    2.031432e+05  2.028705e+05      88.000000
2.0
max       272.000000    2.370961e+06  2.415841e+06     114.000000
2.0

           TOT_SALES  PROD_WEIGHT
count  166168.000000     166168.0
mean        7.338569   162.658316
std         1.948375    17.767177
min         2.700000        125.0
25%         6.000000        150.0
50%         7.400000        170.0
75%         8.800000        175.0
max        10.800000        210.0


plt.subplot(1, 3, 1)  # 1 row, 3 columns, first plot
sns.boxplot(y=df_trans_filtered_multiple['PROD_QTY'])
plt.title('Box Plot of PROD_QTY')
plt.subplot(1, 3, 2)  # 1 row, 3 columns, second plot
sns.boxplot(y=df_trans_filtered_multiple['TOT_SALES'])
plt.title('Box Plot of TOT_SALES')

plt.subplot(1, 3, 3)  # 1 row, 3 columns, third plot
sns.boxplot(y=df_trans_filtered_multiple['PROD_WEIGHT'])
plt.title('Box Plot of PROD_WEIGHT')

plt.tight_layout() # Adjusts subplot params so that subplots are
nicely fit in the figure.
plt.show()
```



```
df_trans_filtered_multiple.columns
```

```
Index(['DATE', 'STORE_NBR', 'LYLTY_CARD_NBR', 'TXN_ID', 'PROD_NBR',
       'PROD_NAME', 'PROD_QTY', 'TOT_SALES', 'PROD_WEIGHT',
'LIFESTAGE',
       'PREMIUM_CUSTOMER'],
      dtype='object')
```

```
df_trans_filtered_multiple.value_counts()
```

```
DATE        STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  PROD_NAME
PROD_QTY  TOT_SALES  PROD_WEIGHT  LIFESTAGE
PREMIUM_CUSTOMER
01-10-2018  107        107024          108462  45        smiths thinly
cut   roast chicken    2         6.0        175          older
singles/couples   premium             2
01-01-2019  3          3217            2038    50        tostitos
lightly    salted          2         8.8        175          retirees
budget              1
21-06-2019  241        241036          244747  50        tostitos
lightly    salted          2         8.8        175          older
singles/couples   premium             1
                       241123          245262  89        kettle sweet
chilli and sour cream   2         10.8       175          young
```

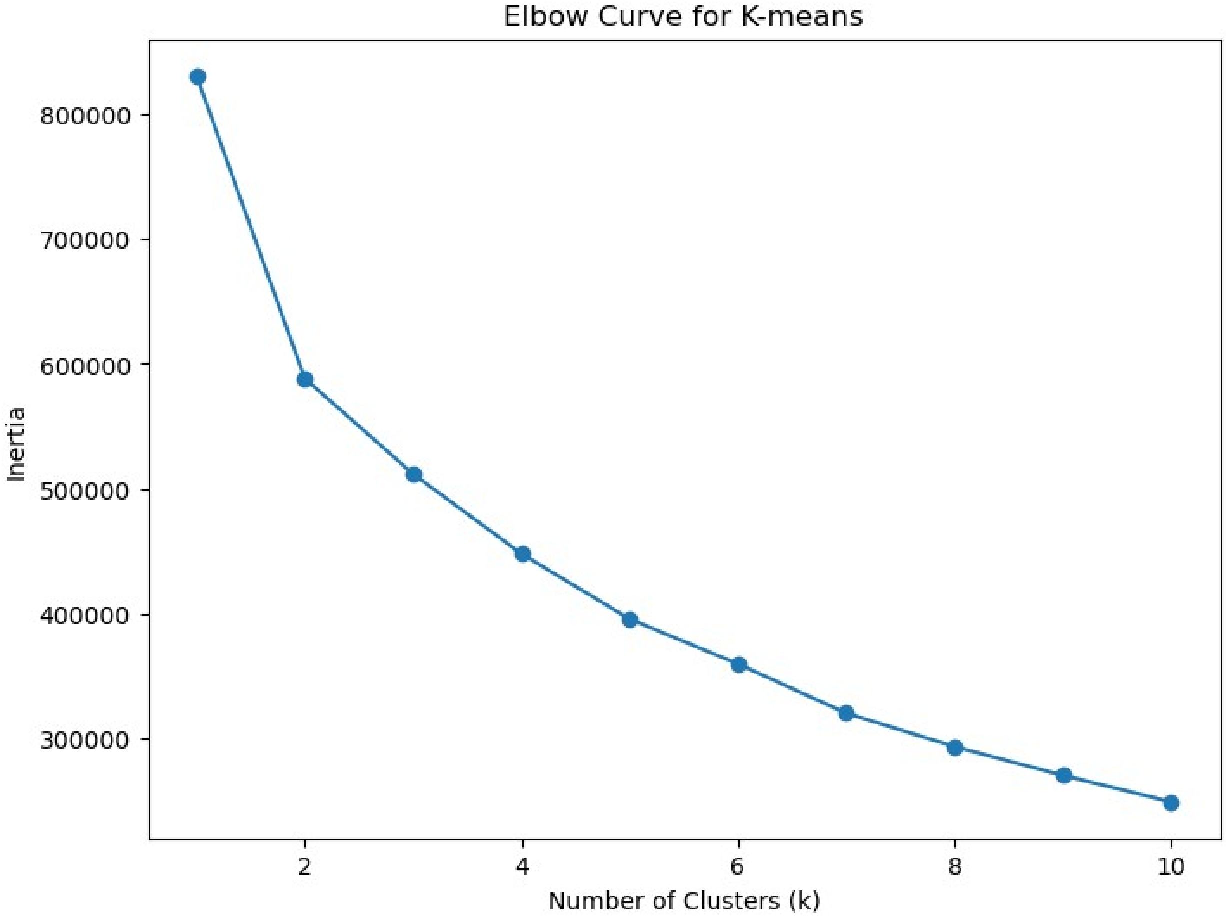
```
families          budget              1
                       241185          245619  66        ccs nacho
cheese                     2         4.2        175          older
families          budget              1

..
10-10-2018  261        261292          260940  60        kettle
tortilla chpsfeta&garlic      2         9.2        150          young
singles/couples   premium             1
                       261321          261054  112       tyrrells
crisps     ched & chives    2         8.4        165          midage
singles/couples  premium             1
            262        262135          262080  26        pringles
sweet&spcy bbq              2         7.4        134          young
families          budget              1
                       262168          262273  29        french fries
potato chips            2         6.0        175          older
singles/couples   budget              1
31-12-2018  272        272051          269702  24        grain waves
sweet chilli     2         7.2        210          young
singles/couples   mainstream          1
Name: count, Length: 166167, dtype: int64
```

```
df=df_trans_filtered_multiple.drop(columns='DATE')

from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
numerical_features=['STORE_NBR', 'LYLTY_CARD_NBR',
'PROD_NBR','PROD_QTY', 'TOT_SALES', 'PROD_WEIGHT']
df[numerical_features] = scaler.fit_transform(df[numerical_features])

# 5. Apply K-means
kmeans = KMeans(n_clusters=5, random_state=42, n_init=10) #n_init is
added to remove warning. It is recommended to set n_init to 'auto' or
a number >10
df['cluster'] = kmeans.fit_predict(df[numerical_features])

print(df.head())

#Analyze the clusters
print(df['cluster'].value_counts())
```

```
    STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0   -1.764919       -1.702994       1 -1.699670
2   -1.764919       -1.698656     383  0.027647
23  -1.278570       -1.233306   34181  1.477360
25  -1.265426       -1.220344   35638  1.569895
31  -1.186559       -1.144975   41122  0.120182
```

```
                               PROD_NAME  PROD_QTY  TOT_SALES  
PROD_WEIGHT  \
0     natural chip        compny seasalt       0.0  -0.687020   
0.694636   
2     smiths crinkle cut  chips chicken       0.0  -2.278094   
0.413217   
23  kettle tortilla chpshny&jlpno chili       0.0   0.955379    -
0.712457   
25     smiths chip thinly  cut original       0.0  -0.687020   
0.694636   
31  red rock deli sr    salsa & mzzrlla       0.0  -0.994970    -
0.712457   

                 LIFESTAGE PREMIUM_CUSTOMER  cluster  
0    young singles/couples          premium        0  
2   midage singles/couples           budget        0  
23  midage singles/couples           budget        4  
25  midage singles/couples           budget        0  
31  midage singles/couples           budget        3  
cluster
1    38191
0    34489
2    33704
3    31903
4    27881
Name: count, dtype: int64

#Elbow Method
inertia = []
for k in range(1, 11):  # Try k from 1 to 10 (adjust the range as 
needed)
    kmeans = KMeans(n_clusters=k, random_state=42, n_init=10)
    kmeans.fit(df[numerical_features]) #Fit only on numerical features
    inertia.append(kmeans.inertia_)

# Plot the elbow curve
plt.figure(figsize=(8, 6))
plt.plot(range(1, 11), inertia, marker='o')
plt.xlabel('Number of Clusters (k)')
plt.ylabel('Inertia')
plt.title('Elbow Curve for K-means')
plt.show()


#Apply KMeans with the optimal k (you need to determine this from the 
elbow curve)
optimal_k = 3 #Example: after looking at the elbow curve you see that 
k=3 is the optimal number. Change it as needed.
kmeans = KMeans(n_clusters=optimal_k, random_state=42, n_init=10)
df_trans['cluster'] = kmeans.fit_predict(df[numerical_features])
```

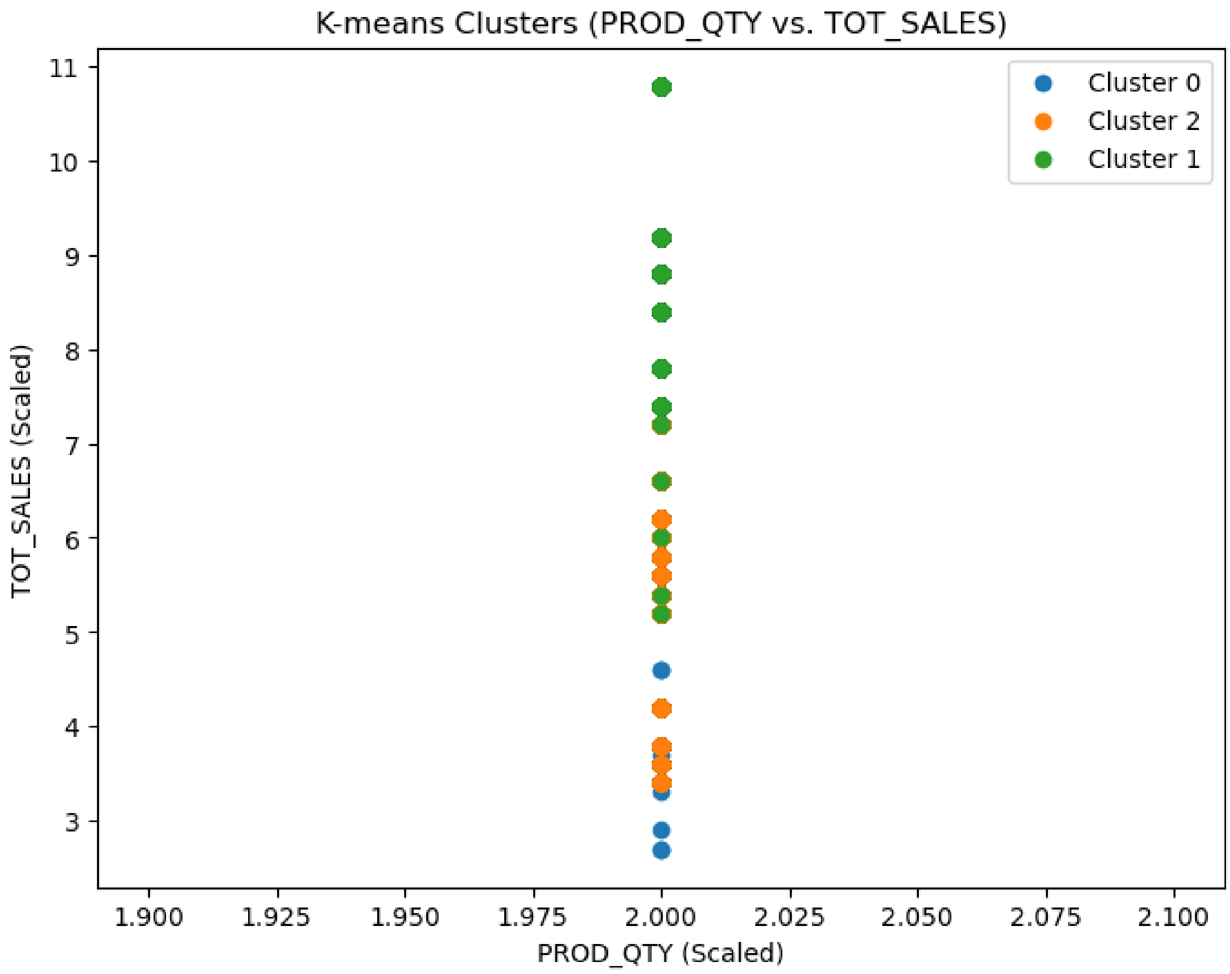
```
print(df.head())
print(df['cluster'].value_counts())
```



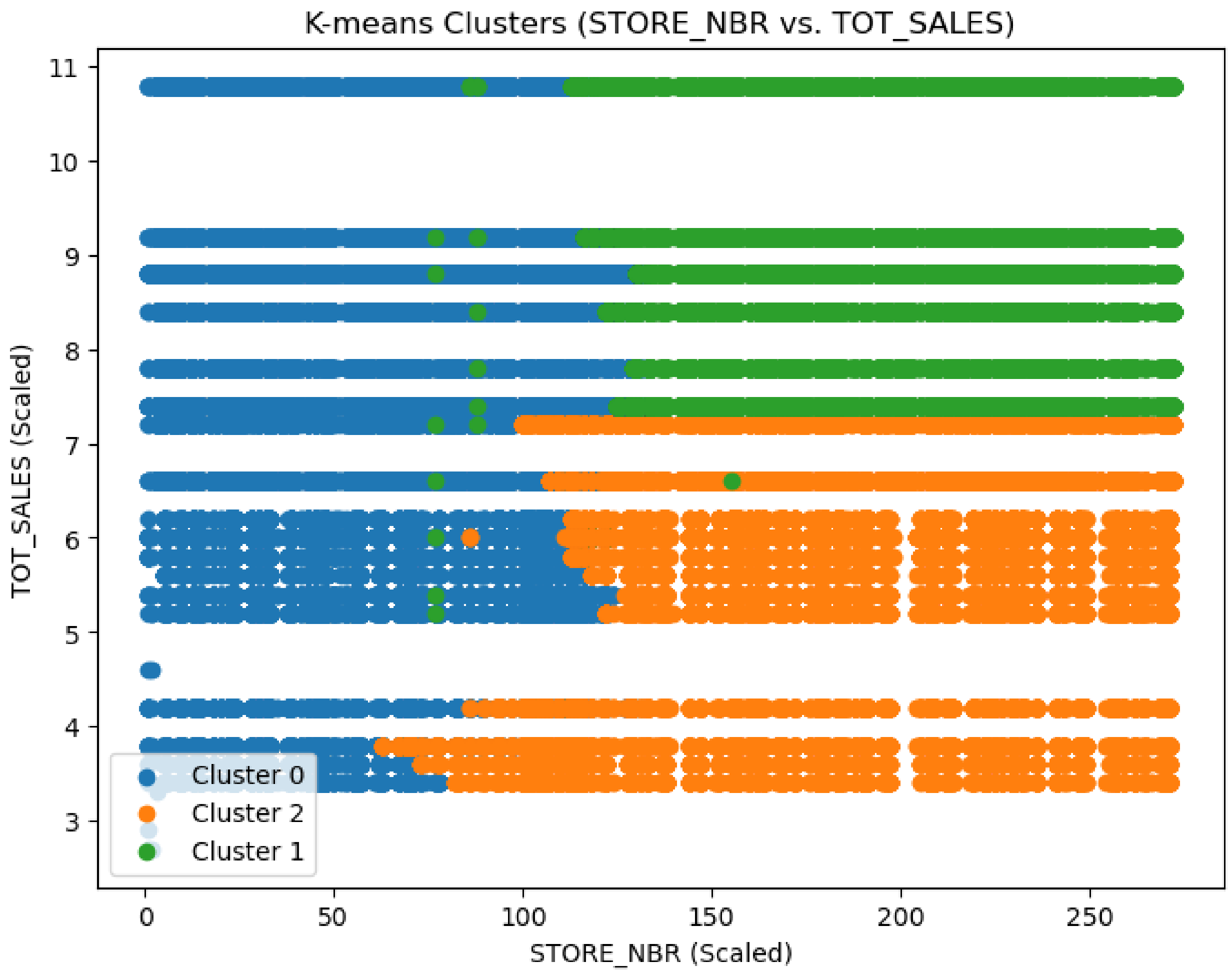
```
    STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0   -1.764919       -1.702994       1 -1.699670
2   -1.764919       -1.698656     383  0.027647
23  -1.278570       -1.233306   34181  1.477360
25  -1.265426       -1.220344   35638  1.569895
31  -1.186559       -1.144975   41122  0.120182

                               PROD_NAME  PROD_QTY  TOT_SALES
PROD_WEIGHT  \
0     natural chip        compny seasalt       0.0  -0.687020
0.694636
2     smiths crinkle cut  chips chicken        0.0  -2.278094
0.413217
23  kettle tortilla chpshny&jlpno chili        0.0   0.955379    -
0.712457
25     smiths chip thinly  cut original        0.0  -0.687020
0.694636
```

```
31  red rock deli sr    salsa & mzzrlla        0.0  -0.994970    -
0.712457

                 LIFESTAGE PREMIUM_CUSTOMER  cluster
0    young singles/couples          premium        0
2   midage singles/couples           budget        0
23  midage singles/couples           budget        4
25  midage singles/couples           budget        0
31  midage singles/couples           budget        3
cluster
1    38191
0    34489
2    33704
3    31903
4    27881
Name: count, dtype: int64
```

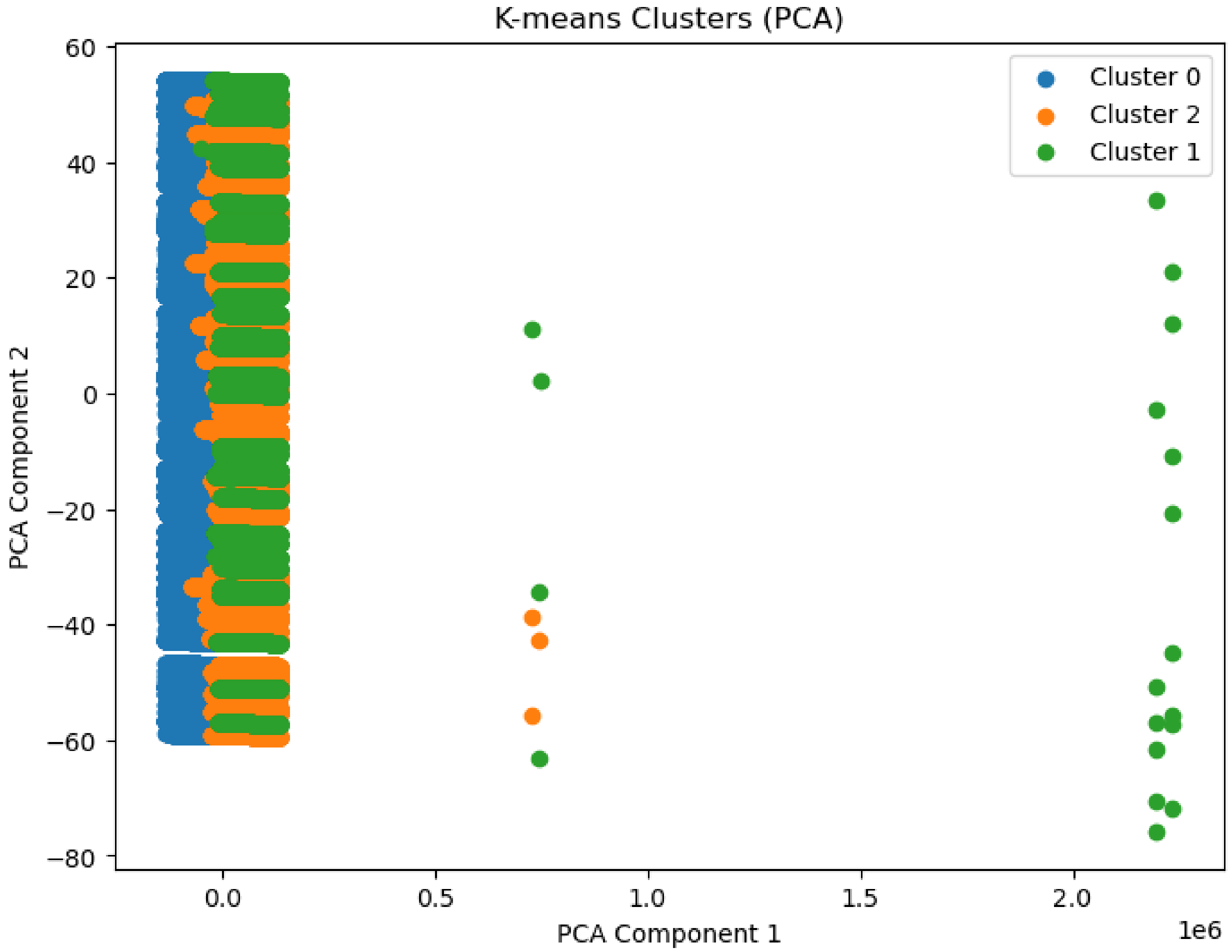
```
df=df_trans.copy()

plt.figure(figsize=(8, 6))

# Example 1: PROD_QTY vs. TOT_SALES
for cluster in df_trans['cluster'].unique():
    cluster_data = df_trans[df_trans['cluster'] == cluster]
    plt.scatter(cluster_data['PROD_QTY'], cluster_data['TOT_SALES'],
label=f'Cluster {cluster}')

plt.xlabel('PROD_QTY (Scaled)')
plt.ylabel('TOT_SALES (Scaled)')
plt.title('K-means Clusters (PROD_QTY vs. TOT_SALES)')
plt.legend()
plt.show()
```



```
plt.figure(figsize=(8, 6))
#df_trans[numerical_features]
for cluster in df_trans['cluster'].unique():
    cluster_data = df_trans[df_trans['cluster'] == cluster]
    plt.scatter(cluster_data['STORE_NBR'], cluster_data['TOT_SALES'],
label=f'Cluster {cluster}')

plt.xlabel('STORE_NBR (Scaled)')
plt.ylabel('TOT_SALES (Scaled)')
plt.title('K-means Clusters (STORE_NBR vs. TOT_SALES)')
plt.legend()
plt.show()
```



```
# If you have more than 2 important dimensions, you can use
dimensionality reduction (PCA or t-SNE) to project the data into 2D
space for visualization.
from sklearn.decomposition import PCA

pca = PCA(n_components=2)  # Reduce to 2 dimensions
df_trans['pca_1'], df_trans['pca_2'] =
zip(*pca.fit_transform(df_trans[numerical_features]))

plt.figure(figsize=(8, 6))
for cluster in df_trans['cluster'].unique():
    cluster_data = df_trans[df_trans['cluster'] == cluster]
    plt.scatter(cluster_data['pca_1'], cluster_data['pca_2'],
label=f'Cluster {cluster}')

plt.xlabel('PCA Component 1')
plt.ylabel('PCA Component 2')
plt.title('K-means Clusters (PCA)')
plt.legend()
plt.show()
```



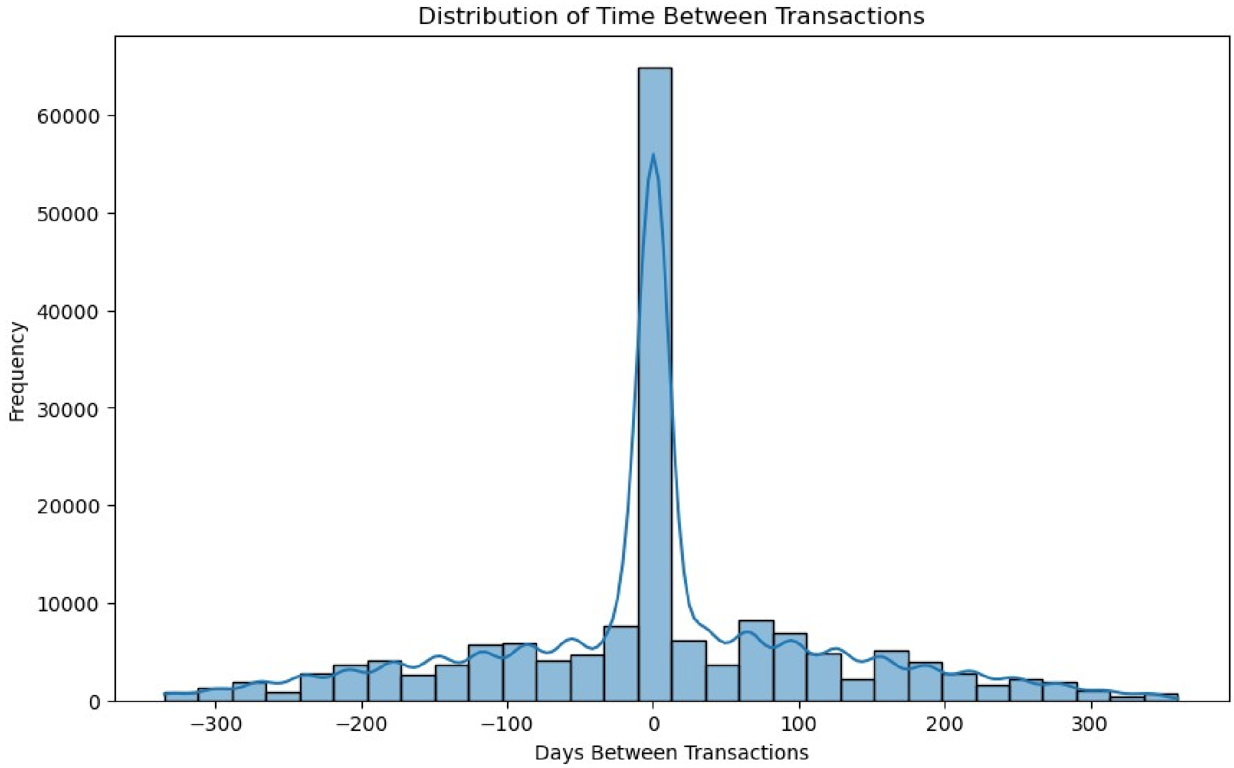
he PCA plot reveals three distinct clusters, indicating that customers can be segmented based on underlying patterns in their transaction data. Cluster 2 exhibits the highest variability along PCA Component 1, suggesting potential differences in purchasing behavior or product preferences.

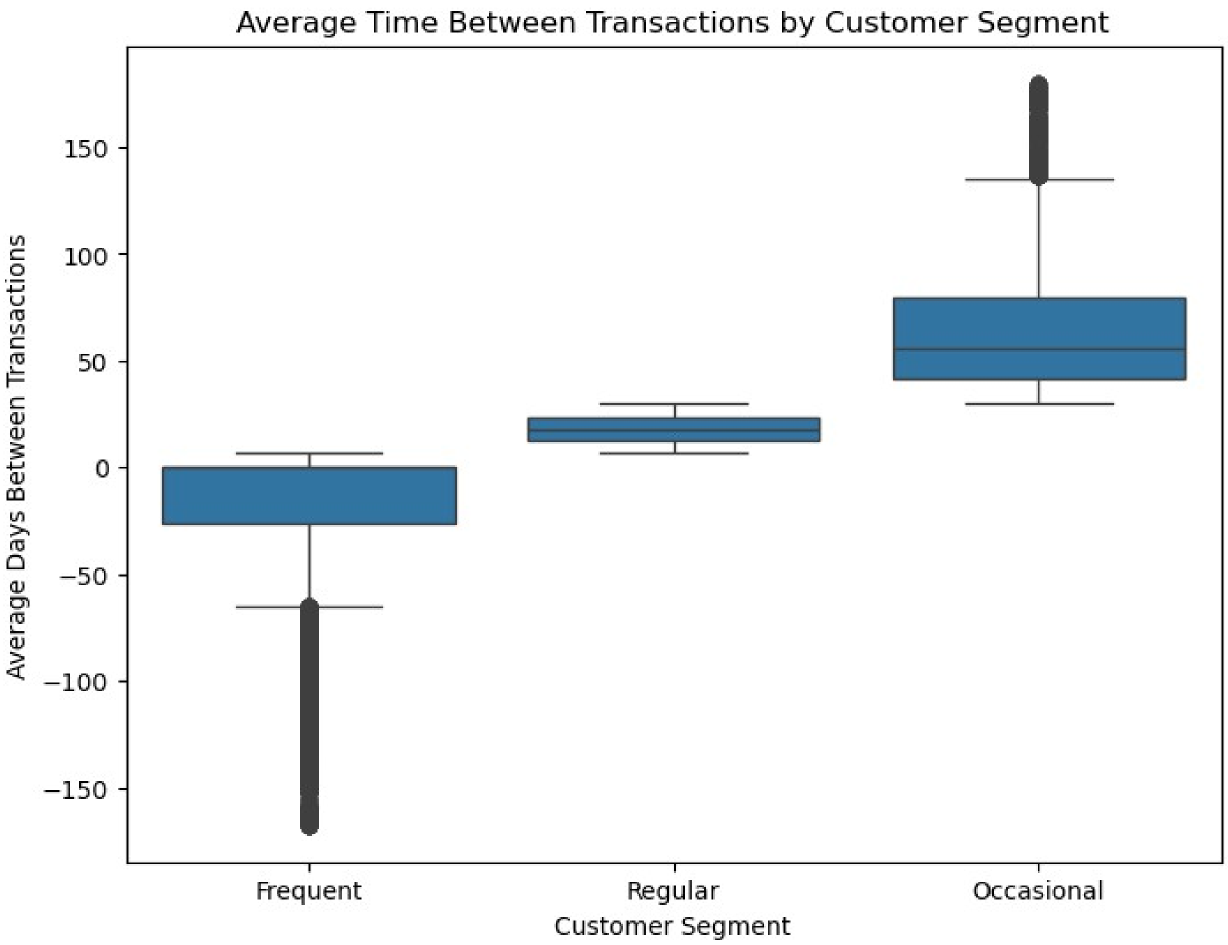
```
# 2. Sort the DataFrame by customer and transaction date
df = df_trans_filtered_multiple.sort_values(['LYLTY_CARD_NBR',
'DATE'])


# 1. Convert 'TRANSACTION_DATE' to datetime64
df['TRANSACTION_DATE'] = pd.to_datetime(df['DATE'])
```

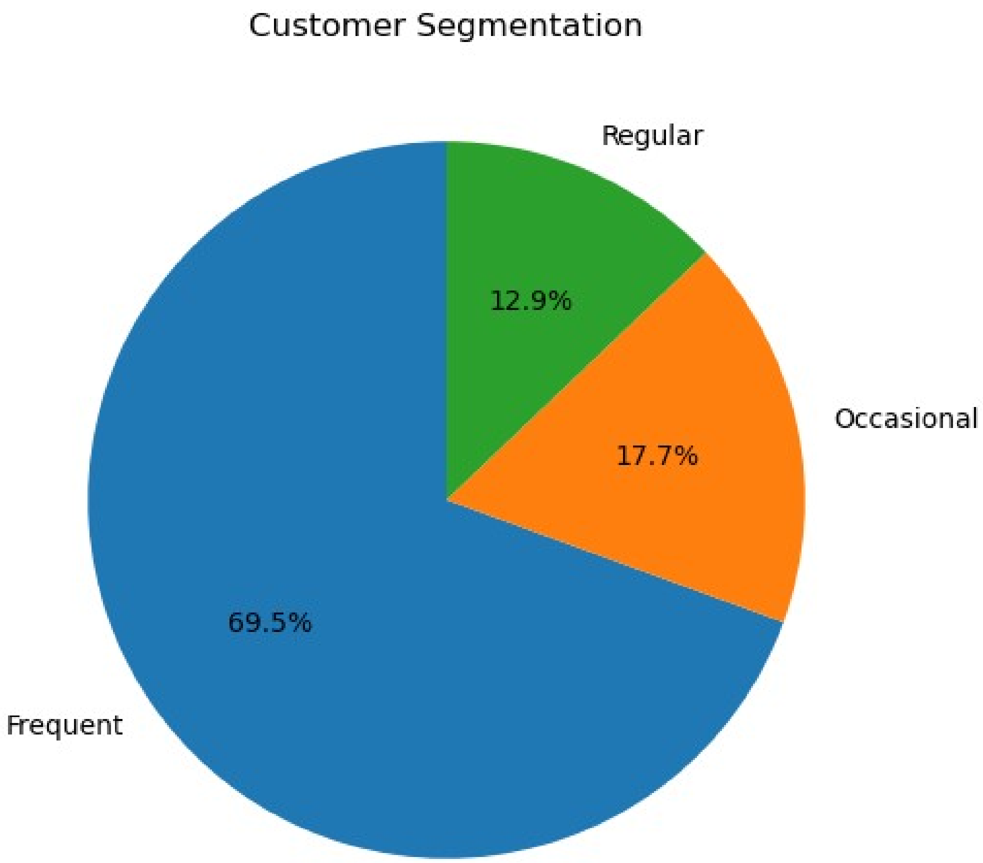
```
C:\Users\lavan\AppData\Local\Temp\ipykernel_9852\4285178013.py:2:
UserWarning: Parsing dates in %d-%m-%Y format when dayfirst=False (the
default) was specified. Pass `dayfirst=True` or specify a format to
```

```
silence this warning.
  df['TRANSACTION_DATE'] = pd.to_datetime(df['DATE'])

df.head()

              DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0       17-10-2018          1            1000       1         5
232980  09-09-2018          1            1010      10        51
97520   29-07-2018          1            1011      12        84
132579  07-03-2019          1            1013      19        91
181294  21-11-2018          1            1025      32        69

                                 PROD_NAME  PROD_QTY  TOT_SALES
PROD_WEIGHT  \
0       natural chip        compny seasalt         2        6.0
175
232980                doritos mexicana             2        8.8
170
97520    grnwves plus btroot & chilli jam          2        6.2
180
132579                ccs tasty cheese             2        4.2
175
181294  smiths chip thinly  s/cream&onion          2        6.0
175

                    LIFESTAGE PREMIUM_CUSTOMER TRANSACTION_DATE
0       young singles/couples          premium       2018-10-17
232980  young singles/couples       mainstream       2018-09-09
97520   older singles/couples       mainstream       2018-07-29
132579               retirees           budget       2019-03-07
181294         young families           budget       2018-11-21

# 3. Calculate the time difference between consecutive transactions
for each customer
df['TIME_BETWEEN_TRANSACTIONS'] = df.groupby('LYLTY_CARD_NBR')
['TRANSACTION_DATE'].diff()

# 4. Convert the time difference to days (or another appropriate unit)
df['TIME_BETWEEN_TRANSACTIONS_DAYS'] =
df['TIME_BETWEEN_TRANSACTIONS'].dt.days

# 5. Handle the first transaction for each customer (which will have a
NaN time difference)
df['TIME_BETWEEN_TRANSACTIONS_DAYS'] =
df['TIME_BETWEEN_TRANSACTIONS_DAYS'].fillna(0)  # Or another
appropriate value

# 6. Calculate purchase frequency metrics (e.g., average time between
transactions)
purchase_frequency = df.groupby('LYLTY_CARD_NBR')
['TIME_BETWEEN_TRANSACTIONS_DAYS'].mean().reset_index()
```

```
purchase_frequency.rename(columns={'TIME_BETWEEN_TRANSACTIONS_DAYS':
'AVG_TIME_BETWEEN_TRANSACTIONS_DAYS'}, inplace=True)

# 7. Customer Segmentation based on purchase frequency (example)
# Define your segmentation criteria (adjust as needed)
def segment_customer(days):
    if days <= 7:
        return 'Frequent'
    elif days <= 30:
        return 'Regular'
    else:
        return 'Occasional'

purchase_frequency['CUSTOMER_SEGMENT'] =
purchase_frequency['AVG_TIME_BETWEEN_TRANSACTIONS_DAYS'].apply(segment
_customer)

# 8. Visualization (example)
# a. Distribution of time between transactions
plt.figure(figsize=(10, 6))
sns.histplot(df['TIME_BETWEEN_TRANSACTIONS_DAYS'], bins=30, kde=True)
plt.title('Distribution of Time Between Transactions')
plt.xlabel('Days Between Transactions')
plt.ylabel('Frequency')
plt.show()

# b. Average time between transactions by customer segment
plt.figure(figsize=(8, 6))
sns.boxplot(x='CUSTOMER_SEGMENT',
y='AVG_TIME_BETWEEN_TRANSACTIONS_DAYS', data=purchase_frequency)
plt.title('Average Time Between Transactions by Customer Segment')
plt.xlabel('Customer Segment')
plt.ylabel('Average Days Between Transactions')
plt.show()

# c. Number of customers in each segment
segment_counts = purchase_frequency['CUSTOMER_SEGMENT'].value_counts()
plt.figure(figsize=(6, 6))
plt.pie(segment_counts, labels=segment_counts.index, autopct='%1.1f%
%', startangle=90)
plt.title('Customer Segmentation')
plt.show()

# 9. Merge the segment information back into your original DataFrame
(optional)
df = pd.merge(df, purchase_frequency, on='LYLTY_CARD_NBR', how='left')

# Now you have the customer segment information in your DataFrame 'df'
print(df.head())
print(purchase_frequency)
```




Average Time Between Transactions by Customer Segment
Average Days Between Transactions
150
100
50
0
−50
−100
−150
Frequent
Regular
Occasional
Customer Segment

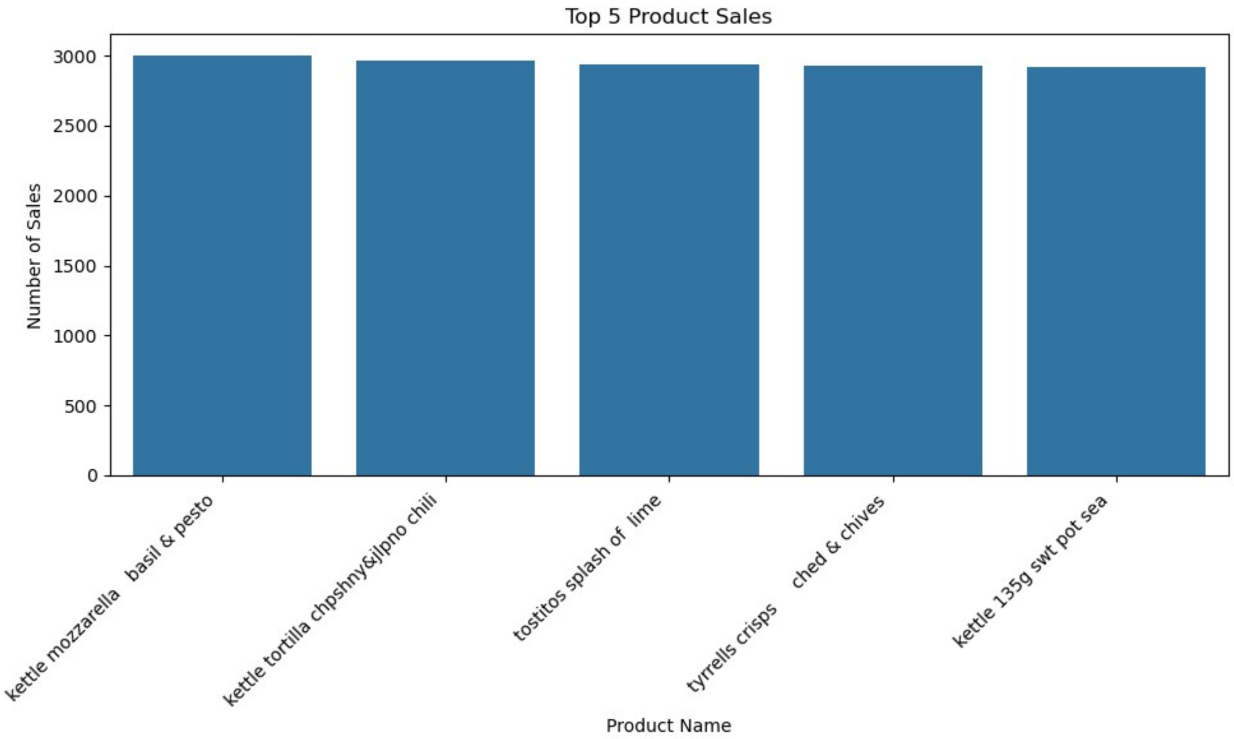


```
         DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0  17-10-2018          1            1000       1         5
1  09-09-2018          1            1010      10        51
2  29-07-2018          1            1011      12        84
3  07-03-2019          1            1013      19        91
4  21-11-2018          1            1025      32        69

                            PROD_NAME  PROD_QTY  TOT_SALES
PROD_WEIGHT  \
0  natural chip        compny seasalt         2        6.0
175
1                doritos mexicana         2        8.8
170
2   grnwves plus btroot & chilli jam         2        6.2
180
3                ccs tasty cheese         2        4.2
175
4  smiths chip thinly  s/cream&onion         2        6.0
175
```

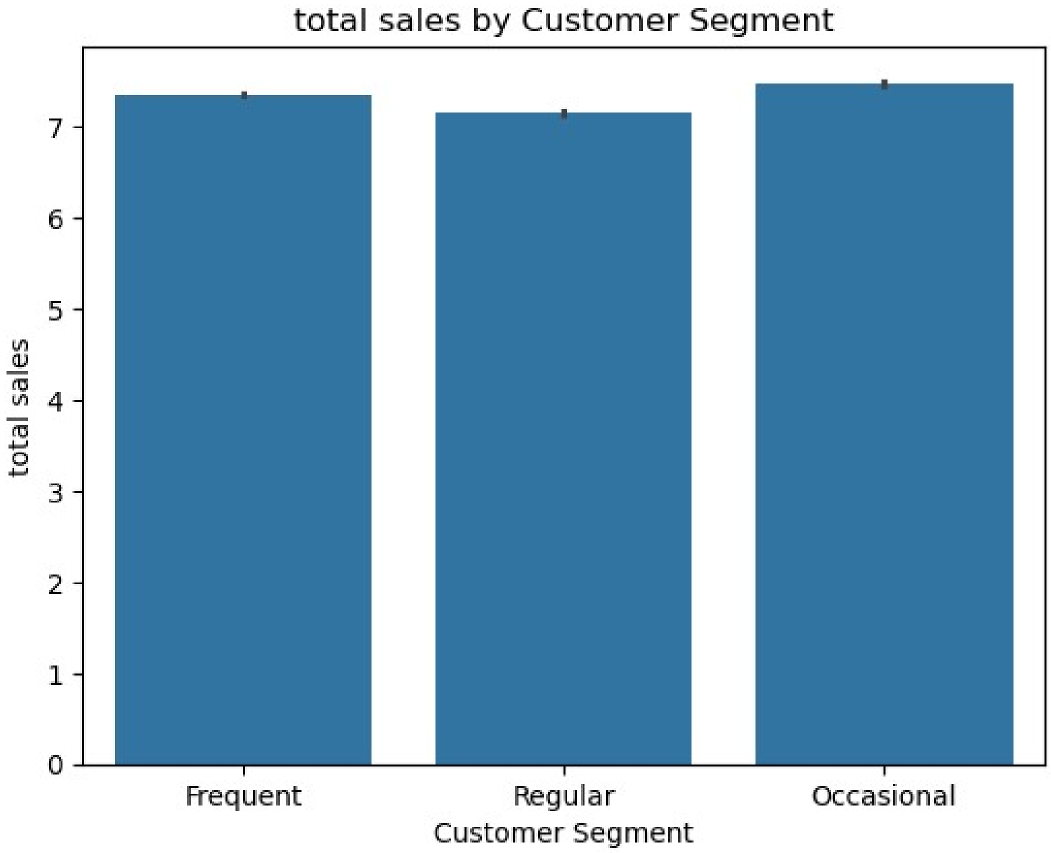
```
               LIFESTAGE PREMIUM_CUSTOMER TRANSACTION_DATE  \
0  young singles/couples          premium       2018-10-17
1  young singles/couples       mainstream       2018-09-09
2  older singles/couples       mainstream       2018-07-29
3                retirees           budget       2019-03-07
4          young families           budget       2018-11-21

  TIME_BETWEEN_TRANSACTIONS  TIME_BETWEEN_TRANSACTIONS_DAYS  \
0                       NaT                             0.0
1                       NaT                             0.0
2                       NaT                             0.0
3                       NaT                             0.0
4                       NaT                             0.0

   AVG_TIME_BETWEEN_TRANSACTIONS_DAYS CUSTOMER_SEGMENT
0                                 0.0         Frequent
1                                 0.0         Frequent
2                                 0.0         Frequent
3                                 0.0         Frequent
4                                 0.0         Frequent
       LYLTY_CARD_NBR  AVG_TIME_BETWEEN_TRANSACTIONS_DAYS
CUSTOMER_SEGMENT
0                1000                                 0.0
Frequent
1                1010                                 0.0
Frequent
2                1011                                 0.0
Frequent
3                1013                                 0.0
Frequent
4                1025                                 0.0
Frequent
...               ...                                 ...
...
56576         2370361                                 0.0
Frequent
56577         2370581                                 4.5
Frequent
56578         2370701                                 0.0
Frequent
56579         2370751                                 0.0
Frequent
56580         2370961                                 0.0
Frequent

[56581 rows x 3 columns]
```

```
top_5_products=df.PROD_NAME.value_counts().nlargest(5)
```

```python
# 2. Create a bar plot
plt.figure(figsize=(10, 6))  # Adjust figure size as needed
sns.barplot(x=top_5_products.index, y=top_5_products.values)
plt.title('Top 5 Product Sales')
plt.xlabel('Product Name')
plt.ylabel('Number of Sales')
plt.xticks(rotation=45, ha='right')  # Rotate x-axis labels for
readability if needed
plt.tight_layout()  # Adjust layout to prevent labels from overlapping
plt.show()
```



```python
#Analyze sales by customer segment.
#plt.figure(figsize=(8, 6))
sns.barplot(x='CUSTOMER_SEGMENT', y='TOT_SALES', data=df)
plt.title('total sales by Customer Segment')
plt.xlabel('Customer Segment')
plt.ylabel('total sales')
plt.show()
```



```
basket = df.groupby(['TXN_ID', 'PROD_NAME'])
['PROD_NAME'].count().unstack().fillna(0).astype(bool)

pip install mlxtend

Collecting mlxtend
  Downloading mlxtend-0.23.4-py3-none-any.whl.metadata (7.3 kB)
Requirement already satisfied: scipy>=1.2.1 in c:\users\lavan\
anaconda3\lib\site-packages (from mlxtend) (1.13.1)
Requirement already satisfied: numpy>=1.16.2 in c:\users\lavan\
anaconda3\lib\site-packages (from mlxtend) (1.26.4)
Requirement already satisfied: pandas>=0.24.2 in c:\users\lavan\
anaconda3\lib\site-packages (from mlxtend) (2.2.2)
Requirement already satisfied: scikit-learn>=1.3.1 in c:\users\lavan\
anaconda3\lib\site-packages (from mlxtend) (1.5.1)
Requirement already satisfied: matplotlib>=3.0.0 in c:\users\lavan\
anaconda3\lib\site-packages (from mlxtend) (3.9.2)
Requirement already satisfied: joblib>=0.13.2 in c:\users\lavan\
anaconda3\lib\site-packages (from mlxtend) (1.4.2)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\lavan\
anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend) (1.2.0)
Requirement already satisfied: cycler>=0.10 in c:\users\lavan\
anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend) (0.11.0)
```

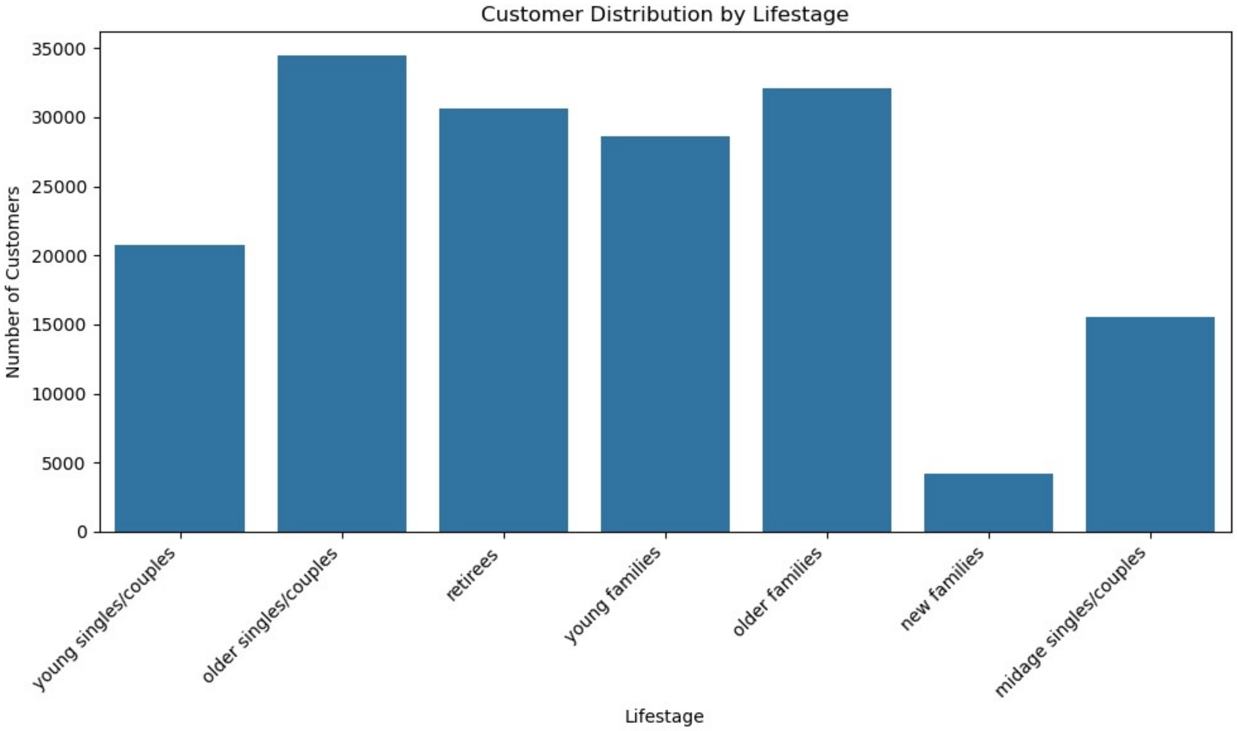
```
Requirement already satisfied: fonttools>=4.22.0 in c:\users\lavan\
anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend) (4.51.0)
Requirement already satisfied: kiwisolver>=1.3.1 in c:\users\lavan\
anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend) (1.4.4)
Requirement already satisfied: packaging>=20.0 in c:\users\lavan\
anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend) (24.1)
Requirement already satisfied: pillow>=8 in c:\users\lavan\anaconda3\
lib\site-packages (from matplotlib>=3.0.0->mlxtend) (11.0.0)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\lavan\
anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend) (3.1.2)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\lavan\
anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend)
(2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in c:\users\lavan\
anaconda3\lib\site-packages (from pandas>=0.24.2->mlxtend) (2024.1)
Requirement already satisfied: tzdata>=2022.7 in c:\users\lavan\
anaconda3\lib\site-packages (from pandas>=0.24.2->mlxtend) (2023.3)
Requirement already satisfied: threadpoolctl>=3.1.0 in c:\users\lavan\
anaconda3\lib\site-packages (from scikit-learn>=1.3.1->mlxtend)
(3.5.0)
Requirement already satisfied: six>=1.5 in c:\users\lavan\anaconda3\
lib\site-packages (from python-dateutil>=2.7->matplotlib>=3.0.0-
>mlxtend) (1.16.0)
Downloading mlxtend-0.23.4-py3-none-any.whl (1.4 MB)
   ---------------------------------------- 0.0/1.4 MB ? eta -:--:--
   ---------------------------------------- 1.4/1.4 MB 11.6 MB/s eta
0:00:00
Installing collected packages: mlxtend
Successfully installed mlxtend-0.23.4
Note: you may need to restart the kernel to use updated packages.

DEPRECATION: Loading egg at c:\users\lavan\anaconda3\lib\site-
packages\mask_rcnn-2.1-py3.12.egg is deprecated. pip 24.3 will enforce
this behaviour change. A possible replacement is to use pip for
package installation. Discussion can be found at
https://github.com/pypa/pip/issues/12330
```

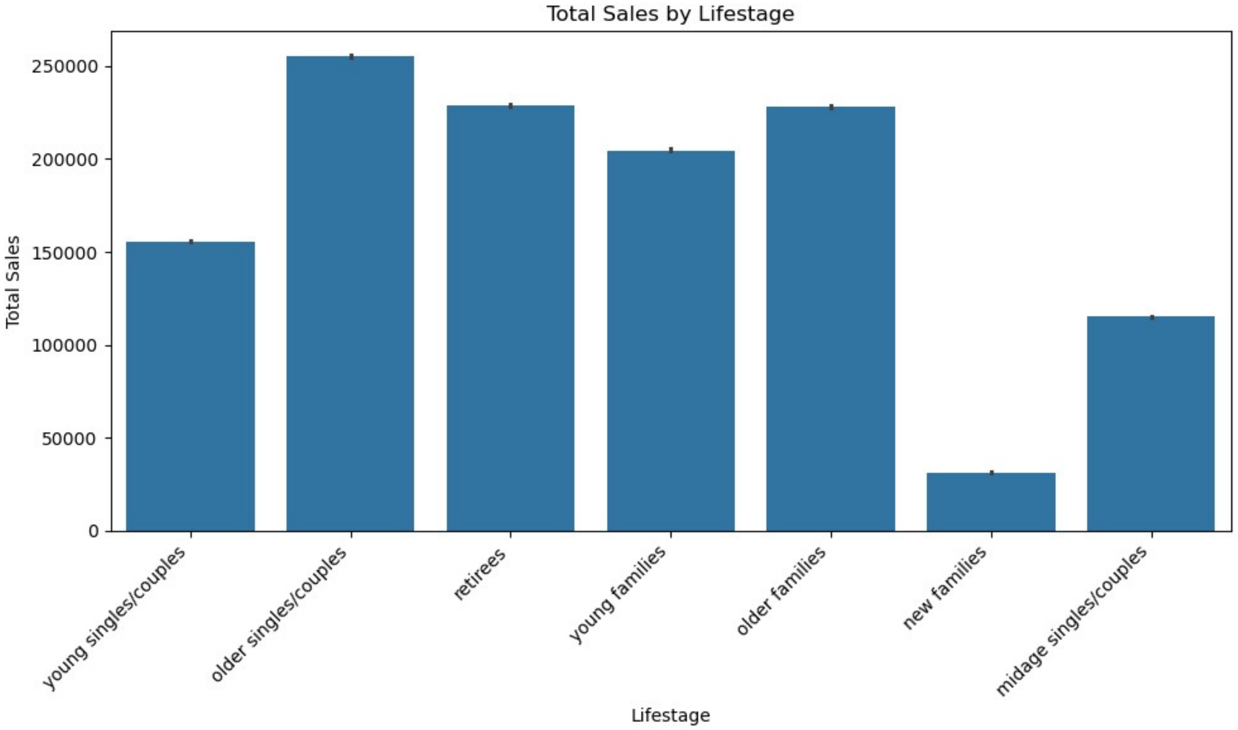
```python
# 2. Frequent Itemset Mining (Apriori Algorithm)
from mlxtend.frequent_patterns import apriori
# Find frequent itemsets (combinations of products)
frequent_itemsets = apriori(basket, min_support=0.2,
use_colnames=True)  # Adjust min_support as needed
```

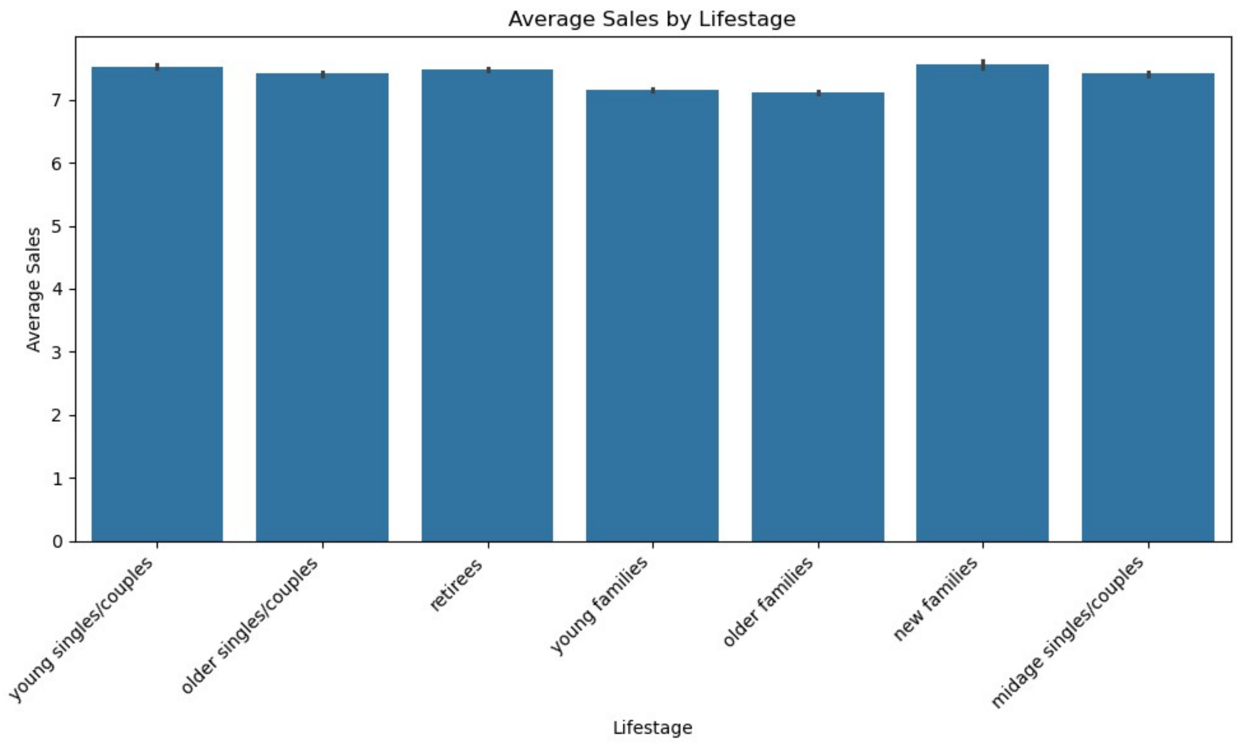
```python
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns



# 1. Basic Analysis
```

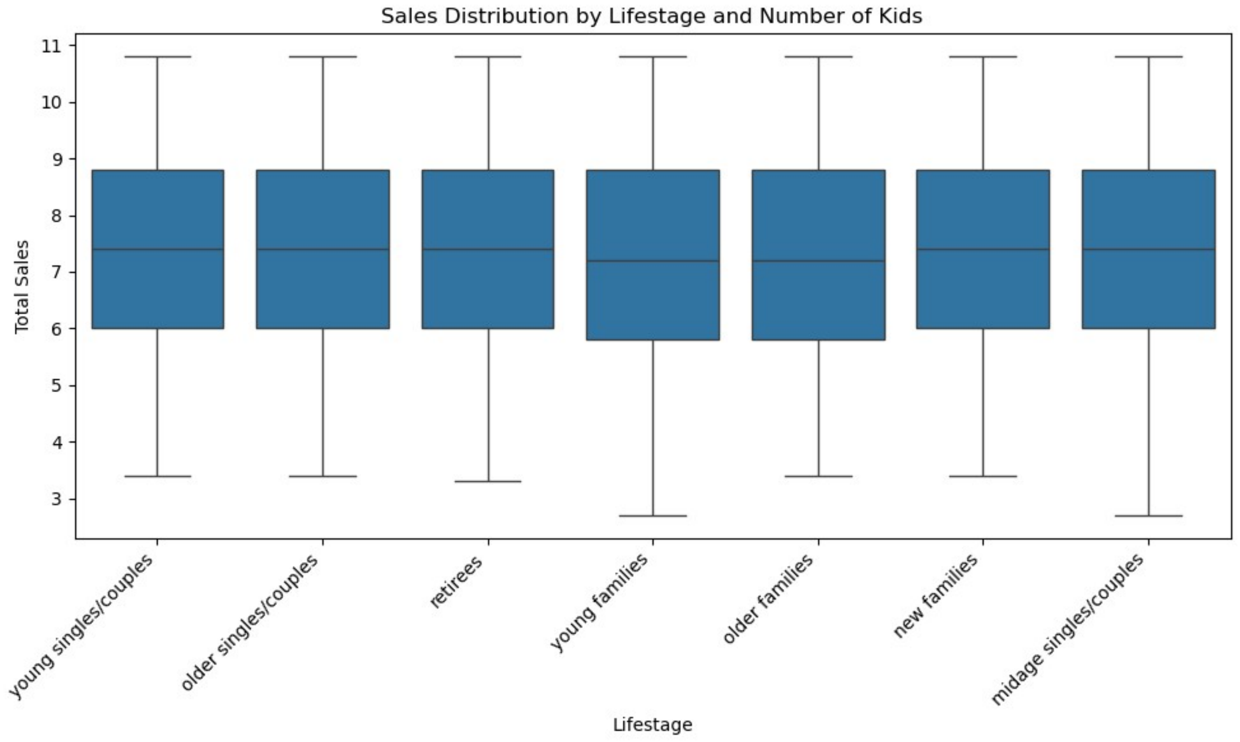
```python
print(df['LIFESTAGE'].value_counts())  # Count customers in each
lifestage

# 2. Grouping and Aggregation
sales_by_lifestage = df.groupby('LIFESTAGE')['TOT_SALES'].sum()
print("\nTotal Sales by Lifestage:\n", sales_by_lifestage)

avg_sales_by_lifestage = df.groupby('LIFESTAGE')['TOT_SALES'].mean()
print("\nAverage Sales by Lifestage:\n", avg_sales_by_lifestage)

# 3. Visualization
plt.figure(figsize=(10, 6))
sns.countplot(x='LIFESTAGE', data=df, order=df['LIFESTAGE'].unique())
# Preserve original order if needed
plt.title('Customer Distribution by Lifestage')
plt.xlabel('Lifestage')
plt.ylabel('Number of Customers')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()

plt.figure(figsize=(10, 6))
sns.barplot(x='LIFESTAGE', y='TOT_SALES', data=df, estimator=sum)  #
Total sales
plt.title('Total Sales by Lifestage')
plt.xlabel('Lifestage')
plt.ylabel('Total Sales')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()

plt.figure(figsize=(10, 6))
sns.barplot(x='LIFESTAGE', y='TOT_SALES', data=df, estimator='mean')
# Average sales
plt.title('Average Sales by Lifestage')
plt.xlabel('Lifestage')
plt.ylabel('Average Sales')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()


# 4. Combining with other attributes (e.g., NUM_KIDS)
plt.figure(figsize=(10, 6))
sns.boxplot(x='LIFESTAGE', y='TOT_SALES', data=df)  # Sales by
lifestage and number of kids
plt.title('Sales Distribution by Lifestage and Number of Kids')
plt.xlabel('Lifestage')
plt.ylabel('Total Sales')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()


# 5. Advanced Analysis (Example: Customer Segmentation)
# You might want to create new customer segments based on LIFESTAGE
and other factors
df['SEGMENT'] = df.apply(lambda row: 'Family with Young Kids' if
'Young families' in row['LIFESTAGE'] and row['NUM_KIDS'] > 0 else
'Other', axis=1)
print("\nCustomer Segments:\n", df['SEGMENT'].value_counts())


# ... (Further analysis and modeling) ...
```

```
LIFESTAGE
older singles/couples     34458
older families            32086
retirees                  30605
young families            28612
young singles/couples     20709
midage singles/couples    15548
new families               4150
Name: count, dtype: int64

Total Sales by Lifestage:
 LIFESTAGE
midage singles/couples    115259.7
new families               31346.8
older families            228355.6
older singles/couples     255214.0
retirees                  228754.5
young families            204742.7
young singles/couples     155762.0
Name: TOT_SALES, dtype: float64

Average Sales by Lifestage:
 LIFESTAGE
midage singles/couples    7.413153
new families              7.553446
older families            7.116986
older singles/couples     7.406524
retirees                  7.474416
young families            7.155833
young singles/couples     7.521464
Name: TOT_SALES, dtype: float64
```


Customer Distribution by Lifestage
Number of Customers
35000
30000
25000
20000
15000
10000
5000
0
young singles/couples
older singles/couples
retirees
young families
older families
new families
midage singles/couples
Lifestage


Total Sales by Lifestage
Total Sales
250000
200000
150000
100000
50000
0
young singles/couples
older singles/couples
retirees
young families
older families
new families
midage singles/couples
Lifestage





```
Customer Segments:
 SEGMENT
```

```
Other    166168
Name: count, dtype: int64
```

```
# 1. Basic Analysis
print(df['PREMIUM_CUSTOMER'].value_counts())  # Count customers in
each segment

# 2. Grouping and Aggregation
sales_by_premium = df.groupby('PREMIUM_CUSTOMER')['TOT_SALES'].sum()
print("\nTotal Sales by Premium Segment:\n", sales_by_premium)

avg_sales_by_premium = df.groupby('PREMIUM_CUSTOMER')
['TOT_SALES'].mean()
print("\nAverage Sales by Premium Segment:\n", avg_sales_by_premium)
```

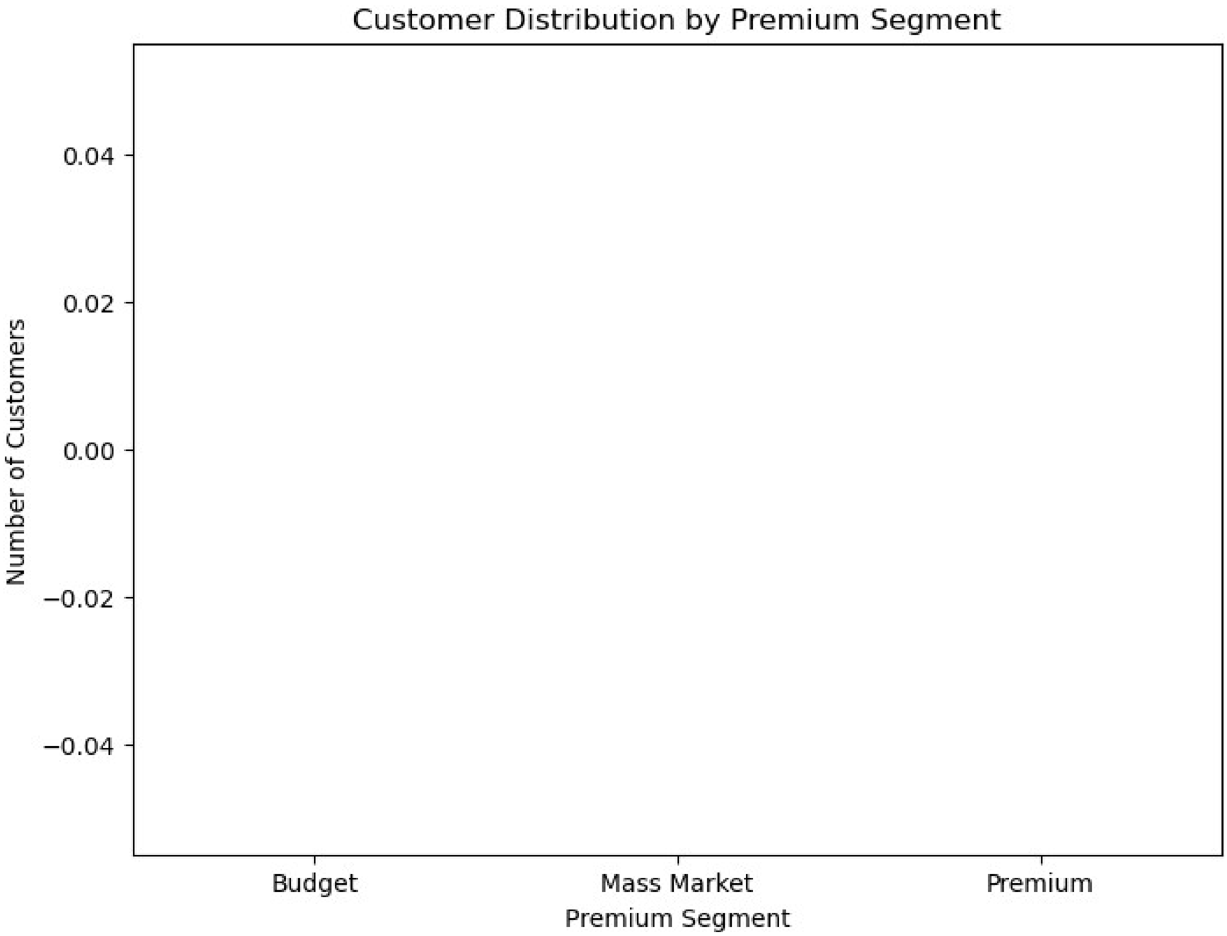
```
PREMIUM_CUSTOMER
mainstream    63353
budget        58980
premium       43835
Name: count, dtype: int64

Total Sales by Premium Segment:
 PREMIUM_CUSTOMER
budget        429657.4
mainstream    469610.7
premium       320167.2
Name: TOT_SALES, dtype: float64

Average Sales by Premium Segment:
 PREMIUM_CUSTOMER
budget        7.284798
mainstream    7.412604
premium       7.303917
Name: TOT_SALES, dtype: float64
```

```
df.head(2)
```

```
         DATE  STORE_NBR  LYLTY_CARD_NBR  TXN_ID  PROD_NBR  \
0  17-10-2018          1            1000       1         5
1  09-09-2018          1            1010      10        51

                            PROD_NAME  PROD_QTY  TOT_SALES
PROD_WEIGHT  \
0  natural chip        compny seasalt         2        6.0
175
1                doritos mexicana             2        8.8
170

               LIFESTAGE PREMIUM_CUSTOMER TRANSACTION_DATE  \
0  young singles/couples          premium       2018-10-17
1  young singles/couples       mainstream       2018-09-09
```

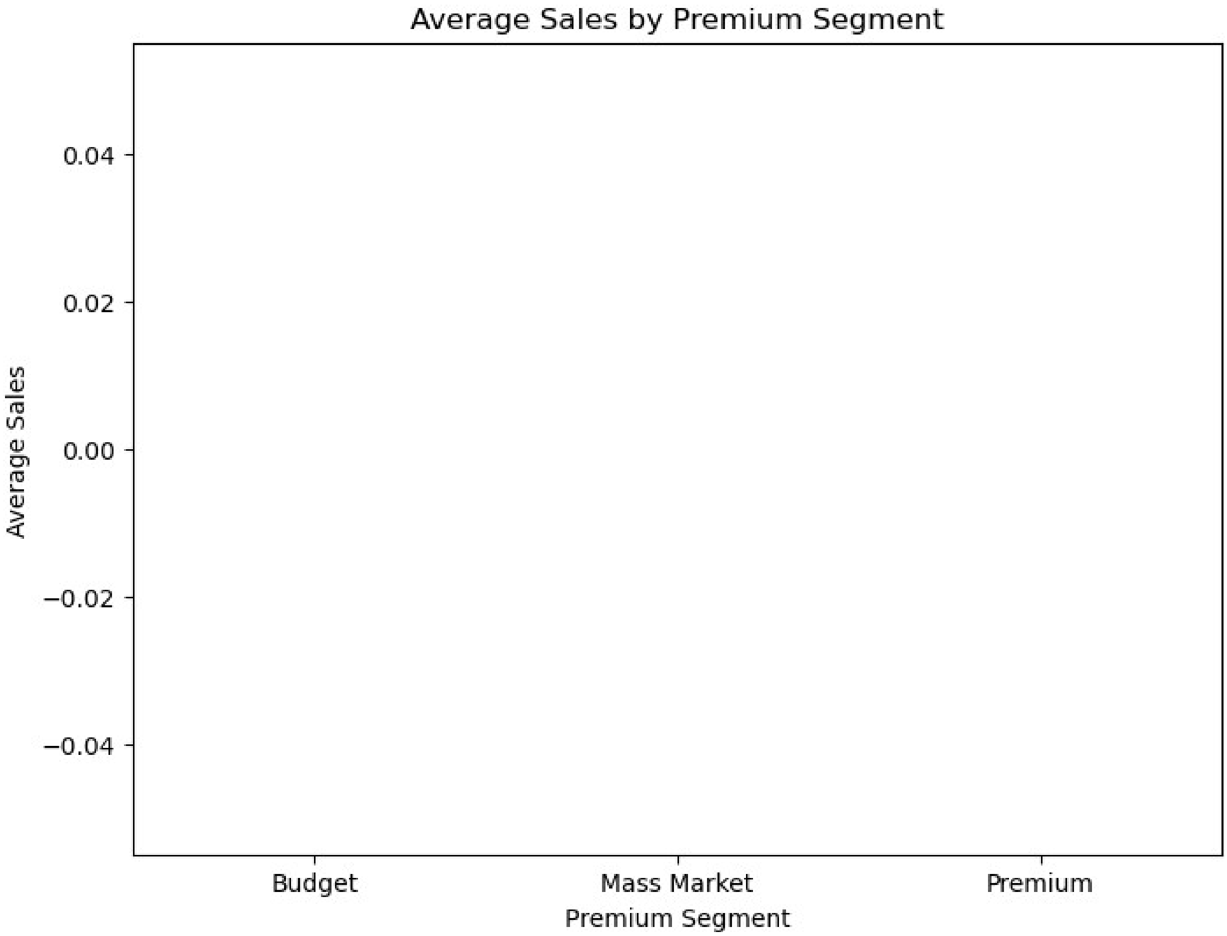
```
  TIME_BETWEEN_TRANSACTIONS  TIME_BETWEEN_TRANSACTIONS_DAYS  \
0                       NaT                             0.0   
1                       NaT                             0.0   

   AVG_TIME_BETWEEN_TRANSACTIONS_DAYS CUSTOMER_SEGMENT SEGMENT
0                                 0.0         Frequent   Other
1                                 0.0         Frequent   Other
```

```
plt.figure(figsize=(8, 6))
sns.countplot(x='PREMIUM_CUSTOMER', data=df, order=['Budget', 'Mass
Market', 'Premium']) #Order for better visualization
plt.title('Customer Distribution by Premium Segment')
plt.xlabel('Premium Segment')
plt.ylabel('Number of Customers')
plt.show()
```

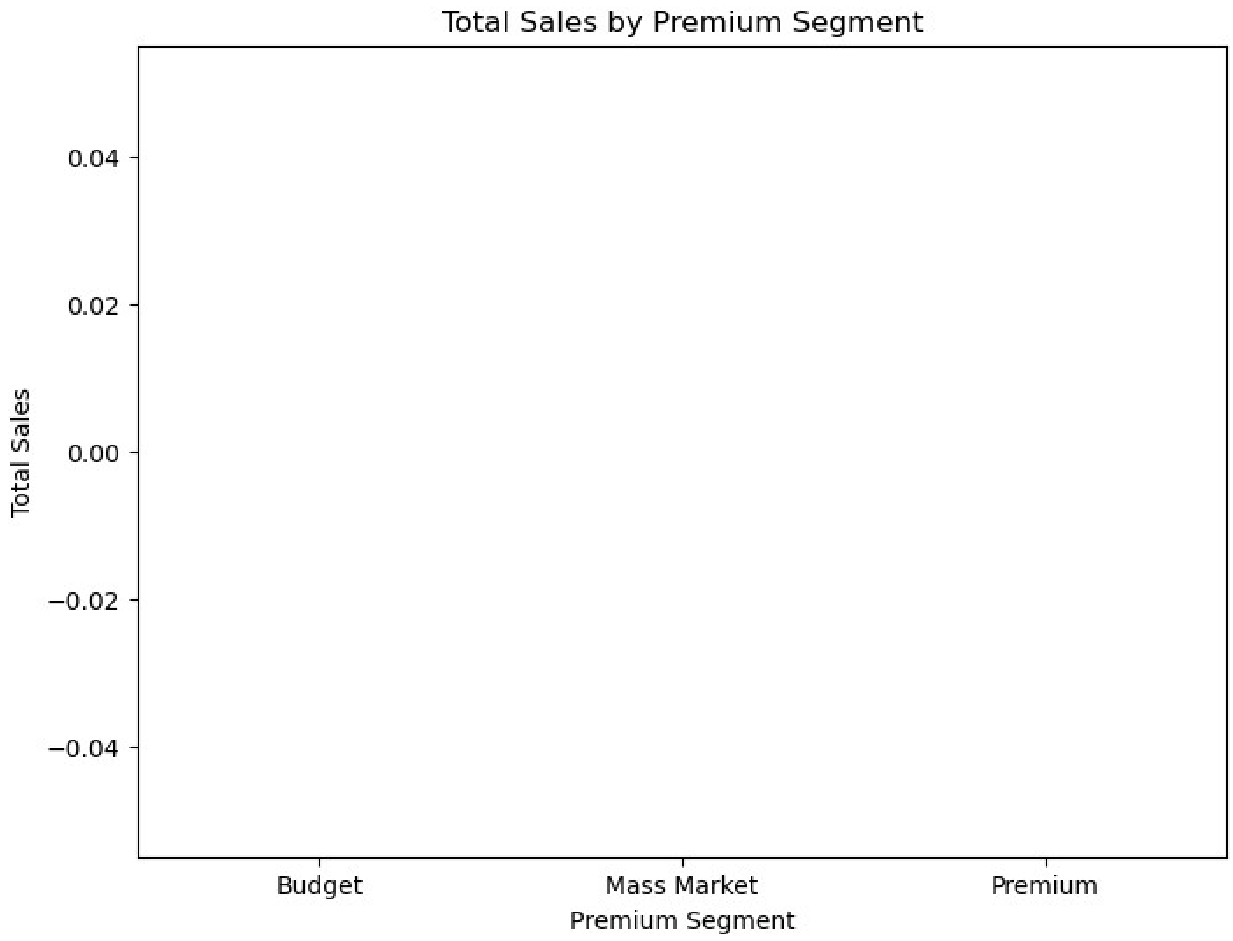


```
plt.figure(figsize=(8, 6))
sns.barplot(x='PREMIUM_CUSTOMER', y='TOT_SALES', data=df,
estimator='mean', order=['Budget', 'Mass Market', 'Premium'])
```

```
plt.title('Average Sales by Premium Segment')
plt.xlabel('Premium Segment')
plt.ylabel('Average Sales')
plt.show()


plt.show()
```



```
plt.figure(figsize=(8, 6))
sns.barplot(x='PREMIUM_CUSTOMER', y='TOT_SALES', data=df,
estimator=sum, order=['Budget', 'Mass Market', 'Premium'])
plt.title('Total Sales by Premium Segment')
plt.xlabel('Premium Segment')
plt.ylabel('Total Sales')
plt.show()
```



```
# Calculate the percentage of customers in each segment
customer_percentage =
df['PREMIUM_CUSTOMER'].value_counts(normalize=True) * 100
print("\nCustomer Percentage by Premium Segment:\n",
customer_percentage)
```

```
Customer Percentage by Premium Segment:
 PREMIUM_CUSTOMER
mainstream    38.125873
budget        35.494199
premium       26.379929
Name: proportion, dtype: float64
```