Import Libraries

```
# Import necesaary libraries
import pandas as pd

trxn = pd.read_csv(r'E:/Internship
Studio/Project/Retail_data_Transactions.csv', header=0, encoding='utf-
8')

trxn

       customer_id trans_date  tran_amount
0           CS5295  11-Feb-13           35
1           CS4768  15-Mar-15           39
2           CS2122  26-Feb-13           52
3           CS1217  16-Nov-11           99
4           CS1850  20-Nov-13           78
...            ...        ...          ...
124995      CS8433  26-Jun-11           64
124996      CS7232  19-Aug-14           38
124997      CS8731  28-Nov-14           42
124998      CS8133  14-Dec-13           13
124999      CS7996  13-Dec-14           36

[125000 rows x 3 columns]

response = pd.read_csv(r'E:/Internship
Studio/Project/Retail_data_Response.csv', header=0, encoding='utf-8')

response

     customer_id  response
0         CS1112         0
1         CS1113         0
2         CS1114         1
3         CS1115         1
4         CS1116         1
...          ...       ...
6879      CS8996         0
6880      CS8997         0
6881      CS8998         0
6882      CS8999         0
6883      CS9000         0

[6884 rows x 2 columns]

df = trxn.merge(response,on='customer_id',how='left')
df

       customer_id trans_date  tran_amount  response
0           CS5295  11-Feb-13           35       1.0
```

```
1           CS4768  15-Mar-15           39        1.0
2           CS2122  26-Feb-13           52        0.0
3           CS1217  16-Nov-11           99        0.0
4           CS1850  20-Nov-13           78        0.0
...            ...        ...          ...        ...
124995      CS8433  26-Jun-11           64        0.0
124996      CS7232  19-Aug-14           38        0.0
124997      CS8731  28-Nov-14           42        0.0
124998      CS8133  14-Dec-13           13        0.0
124999      CS7996  13-Dec-14           36        0.0

[125000 rows x 4 columns]

# features
df.dtypes

customer_id     object
trans_date      object
tran_amount      int64
response       float64
dtype: object

df.shape

(125000, 4)

df.tail()

       customer_id trans_date  tran_amount  response
124995      CS8433  26-Jun-11           64       0.0
124996      CS7232  19-Aug-14           38       0.0
124997      CS8731  28-Nov-14           42       0.0
124998      CS8133  14-Dec-13           13       0.0
124999      CS7996  13-Dec-14           36       0.0

df.describe()

         tran_amount       response
count  125000.000000  124969.000000
mean       64.991912       0.110763
std        22.860006       0.313840
min        10.000000       0.000000
25%        47.000000       0.000000
50%        65.000000       0.000000
75%        83.000000       0.000000
max       105.000000       1.000000

# Missing Values

df.isnull().sum()
```

```
customer_id     0
trans_date      0
tran_amount     0
response       31
dtype: int64
```

```
df = df.dropna()
```

```
df
```

```
       customer_id trans_date  tran_amount  response
0           CS5295  11-Feb-13           35       1.0
1           CS4768  15-Mar-15           39       1.0
2           CS2122  26-Feb-13           52       0.0
3           CS1217  16-Nov-11           99       0.0
4           CS1850  20-Nov-13           78       0.0
...            ...        ...          ...       ...
124995      CS8433  26-Jun-11           64       0.0
124996      CS7232  19-Aug-14           38       0.0
124997      CS8731  28-Nov-14           42       0.0
124998      CS8133  14-Dec-13           13       0.0
124999      CS7996  13-Dec-14           36       0.0

[124969 rows x 4 columns]
```

```
# change dtypes

df['trans_date']= pd.to_datetime(df['trans_date'])
df['response']= df['response'].astype('int64')
```

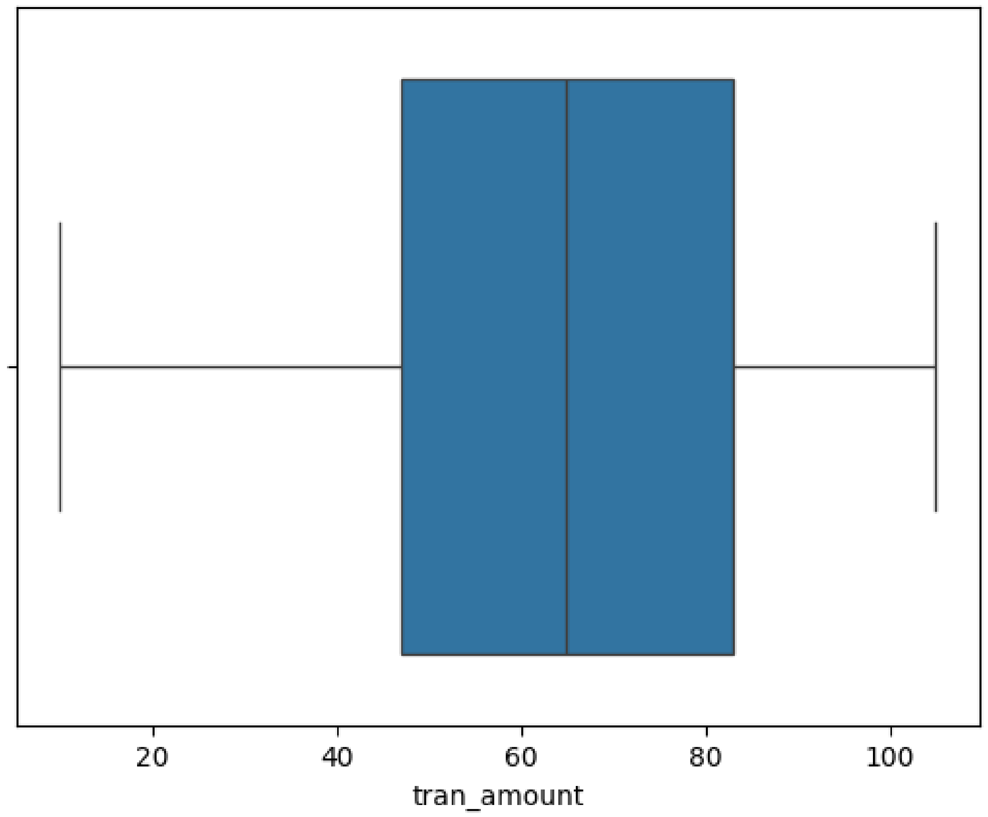
```
C:\Users\Anish\AppData\Local\Temp\ipykernel_12564\2474506332.py:3:
UserWarning: Could not infer format, so each element will be parsed
individually, falling back to `dateutil`. To ensure parsing is
consistent and as-expected, please specify a format.
  df['trans_date']= pd.to_datetime(df['trans_date'])
C:\Users\Anish\AppData\Local\Temp\ipykernel_12564\2474506332.py:3:
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['trans_date']= pd.to_datetime(df['trans_date'])
C:\Users\Anish\AppData\Local\Temp\ipykernel_12564\2474506332.py:4:
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['response']= df['response'].astype('int64')

set(df['response'])

{0, 1}

df.info()

<class 'pandas.core.frame.DataFrame'>
Index: 124969 entries, 0 to 124999
Data columns (total 4 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   customer_id  124969 non-null  object
 1   trans_date   124969 non-null  datetime64[ns]
 2   tran_amount  124969 non-null  int64
 3   response     124969 non-null  int64
dtypes: datetime64[ns](1), int64(2), object(1)
memory usage: 4.8+ MB

# check outliers
# z-score

from scipy import stats
import numpy as np

#calc z score
z_scores = np.abs(stats.zscore(df['tran_amount']))

#set a threshold

threshold= 3

outliers= z_scores>threshold


print(df[outliers])

Empty DataFrame
Columns: [customer_id, trans_date, tran_amount, response]
Index: []

# check outliers
# z-score

from scipy import stats
import numpy as np

#calc z score
z_scores = np.abs(stats.zscore(df['response']))
```

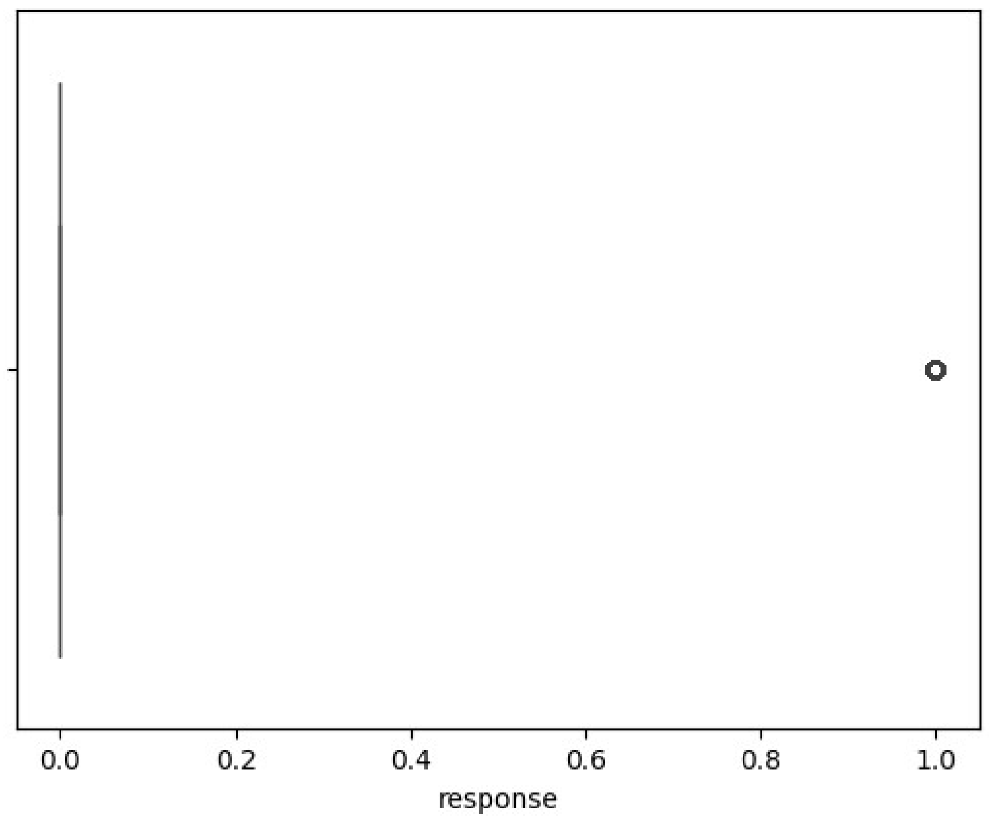
```
#set a threshold

threshold= 3

outliers= z_scores>threshold


print(df[outliers])
```

```
Empty DataFrame
Columns: [customer_id, trans_date, tran_amount, response]
Index: []
```

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

sns.boxplot(x=df['tran_amount'])
plt.show()
```



```
sns.boxplot(x=df['response'])
plt.show()
```



```
# creating new columns

df['month']= df['trans_date'].dt.month

C:\Users\Anish\AppData\Local\Temp\ipykernel_12564\197175934.py:3: 
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['month']= df['trans_date'].dt.month

df

       customer_id trans_date  tran_amount  response  month
0           CS5295 2013-02-11           35         1      2
1           CS4768 2015-03-15           39         1      3
2           CS2122 2013-02-26           52         0      2
3           CS1217 2011-11-16           99         0     11
4           CS1850 2013-11-20           78         0     11
...            ...        ...          ...       ...    ...
124995      CS8433 2011-06-26           64         0      6
124996      CS7232 2014-08-19           38         0      8
```

```
124997      CS8731 2014-11-28          42          0     11
124998      CS8133 2013-12-14          13          0     12
124999      CS7996 2014-12-13          36          0     12

[124969 rows x 5 columns]
```

```
# Which 3 months have had the highest transaction amounts?

monthly_sales = df.groupby('month')['tran_amount'].sum()
monthly_sales =
monthly_sales.sort_values(ascending=False).reset_index().head(3)
monthly_sales
```

```
   month  tran_amount
0      8       726775
1     10       725058
2      1       724089
```

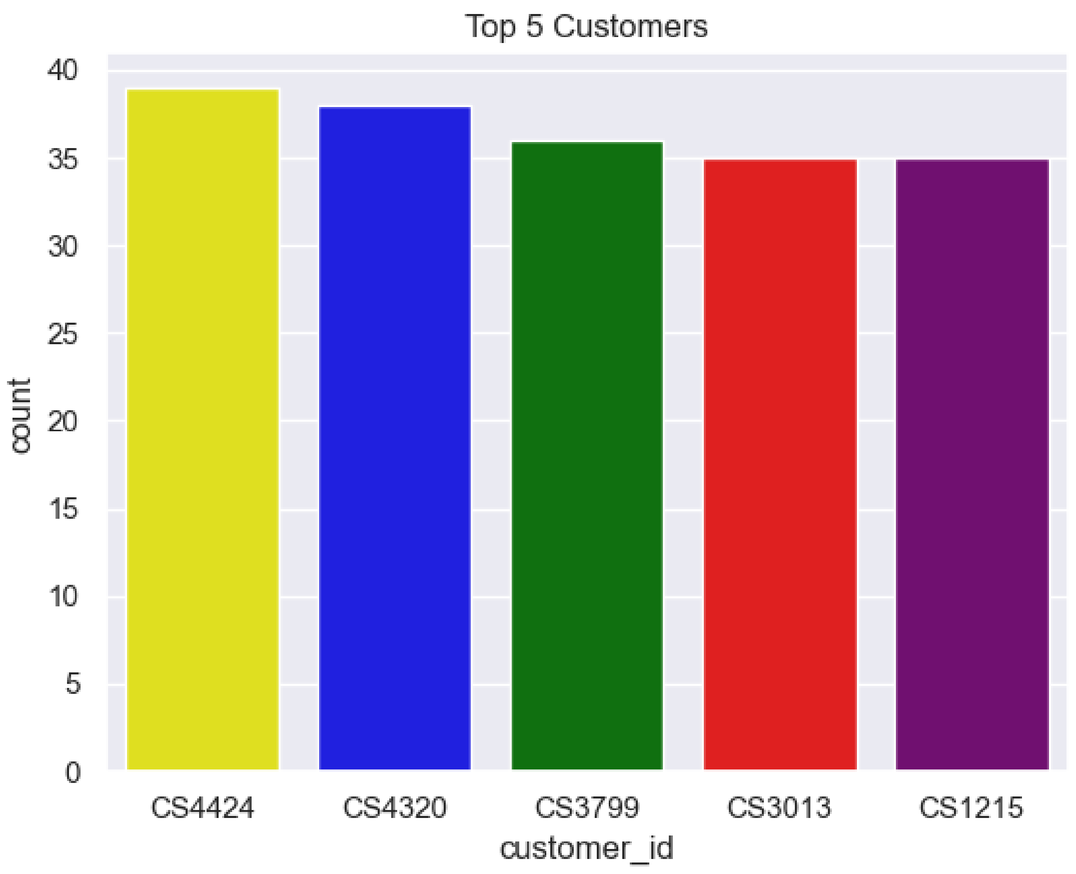
```
# Customers having highest num of orders

customer_counts= df['customer_id'].value_counts().reset_index()
customer_counts.columns=['customer_id','count']

# sort

top_5_cus= customer_counts.sort_values(by='count',
ascending=False).head(5)
top_5_cus
```

```
  customer_id  count
0      CS4424     39
1      CS4320     38
2      CS3799     36
3      CS3013     35
4      CS1215     35
```

```
sns.set(style='darkgrid')

colors = ['yellow', 'blue', 'green', 'red', 'purple']

sns.barplot(x='customer_id',y='count',data=top_5_cus, palette=colors )
plt.title('Top 5 Customers')
plt.savefig('count_plot.png')
```

```
C:\Users\Anish\AppData\Local\Temp\ipykernel_12564\1920850022.py:3:
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.
```

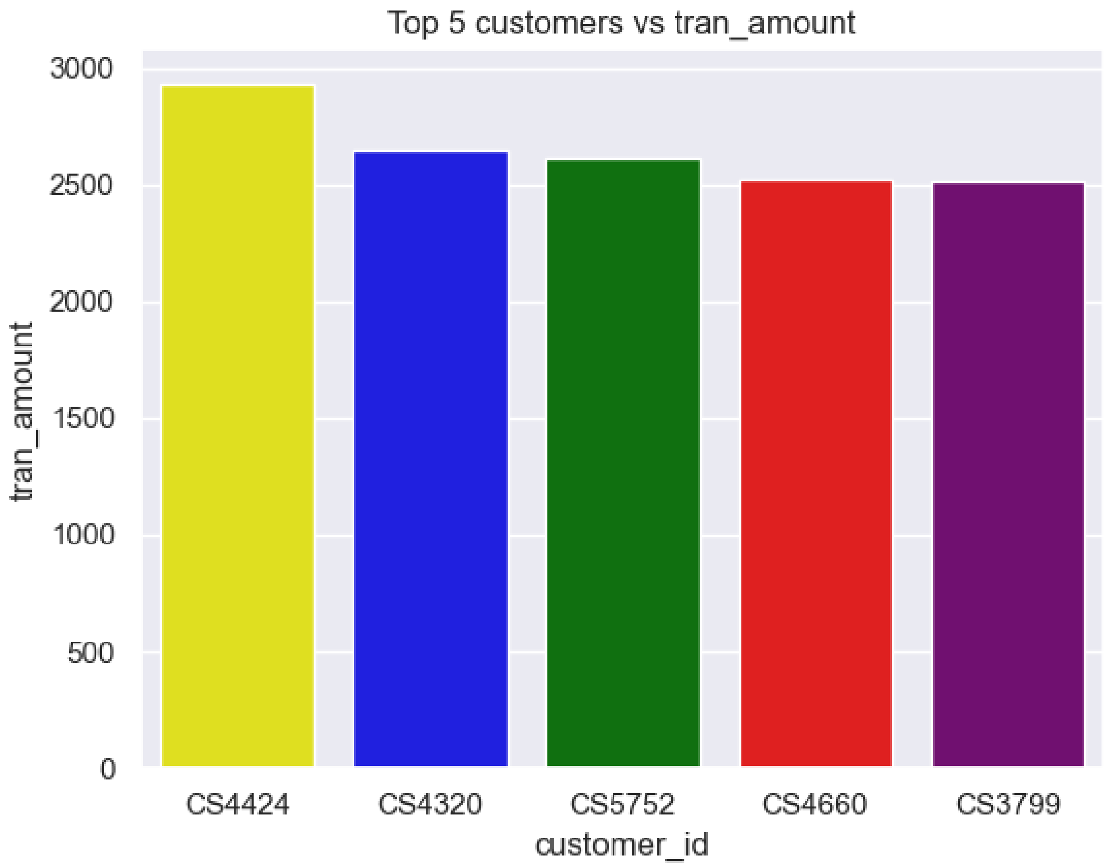
```
  sns.barplot(x='customer_id',y='count',data=top_5_cus, palette=colors
)
```



```
# Customers having highest value of orders

customer_sales = df.groupby('customer_id')
['tran_amount'].sum().reset_index()

# sort

top_5_sal= customer_sales.sort_values(by='tran_amount',
ascending=False).head(5)
top_5_sal

     customer_id  tran_amount
3312      CS4424         2933
3208      CS4320         2647
4640      CS5752         2612
3548      CS4660         2527
2687      CS3799         2513

colors = ['yellow', 'blue', 'green', 'red', 'purple']
```

```
sns.barplot(x='customer_id',y='tran_amount',data=top_5_sal,
palette=colors)
plt.title('Top 5 customers vs tran_amount')
plt.savefig('bar_plot.png')
```

```
C:\Users\Anish\AppData\Local\Temp\ipykernel_12564\2125539671.py:3:
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='customer_id',y='tran_amount',data=top_5_sal,
palette=colors)
```



Advanced Analytics

Time Serires Analysis

```
df
```

```
      customer_id trans_date  tran_amount  response  month
0          CS5295 2013-02-11           35         1      2
```

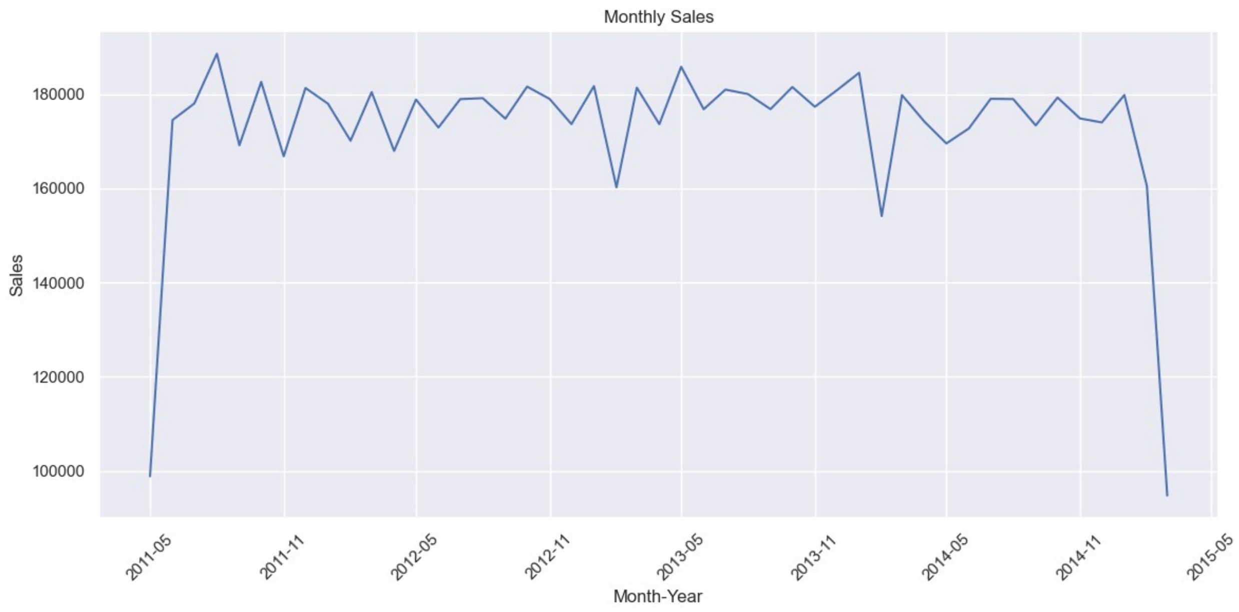
```
1           CS4768 2015-03-15          39          1      3
2           CS2122 2013-02-26          52          0      2
3           CS1217 2011-11-16          99          0     11
4           CS1850 2013-11-20          78          0     11
...            ...        ...         ...        ...    ...
124995      CS8433 2011-06-26          64          0      6
124996      CS7232 2014-08-19          38          0      8
124997      CS8731 2014-11-28          42          0     11
124998      CS8133 2013-12-14          13          0     12
124999      CS7996 2014-12-13          36          0     12

[124969 rows x 5 columns]
```

```
import matplotlib.dates as mdates

df['month_year'] = df['trans_date'].dt.to_period('M')
df
```

```
C:\Users\Anish\AppData\Local\Temp\ipykernel_12564\2558405081.py:3: 
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['month_year'] = df['trans_date'].dt.to_period('M')
```

```
       customer_id trans_date  tran_amount  response  month month_year
0           CS5295 2013-02-11          35          1      2    2013-02
1           CS4768 2015-03-15          39          1      3    2015-03
2           CS2122 2013-02-26          52          0      2    2013-02
3           CS1217 2011-11-16          99          0     11    2011-11
4           CS1850 2013-11-20          78          0     11    2013-11
...            ...        ...         ...        ...    ...        ...
124995      CS8433 2011-06-26          64          0      6    2011-06
124996      CS7232 2014-08-19          38          0      8    2014-08
124997      CS8731 2014-11-28          42          0     11    2014-11
124998      CS8133 2013-12-14          13          0     12    2013-12
124999      CS7996 2014-12-13          36          0     12    2014-12

[124969 rows x 6 columns]
```

```
# Convert the PeriodIndex to DateTimeIndex
monthly_sales = df.groupby('month_year')['tran_amount'].sum()

# Convert PeriodIndex to DateTimeIndex
monthly_sales.index = monthly_sales.index.to_timestamp()

plt.figure(figsize=(12,6))  # Increase the size of the figure
plt.plot(monthly_sales.index, monthly_sales.values)  # Plot the data
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter('%Y-%m'))  #
Format the x-axis labels
plt.gca().xaxis.set_major_locator(mdates.MonthLocator(interval=6))  #
Set the x-axis interval
plt.xlabel('Month-Year')
plt.ylabel('Sales')
plt.title('Monthly Sales')
plt.xticks(rotation=45)  # Rotate the x-axis labels
plt.tight_layout()  # Adjust the layout for better visibility
plt.savefig('line_plot.png')
plt.show()
```



Cohort Segmentation

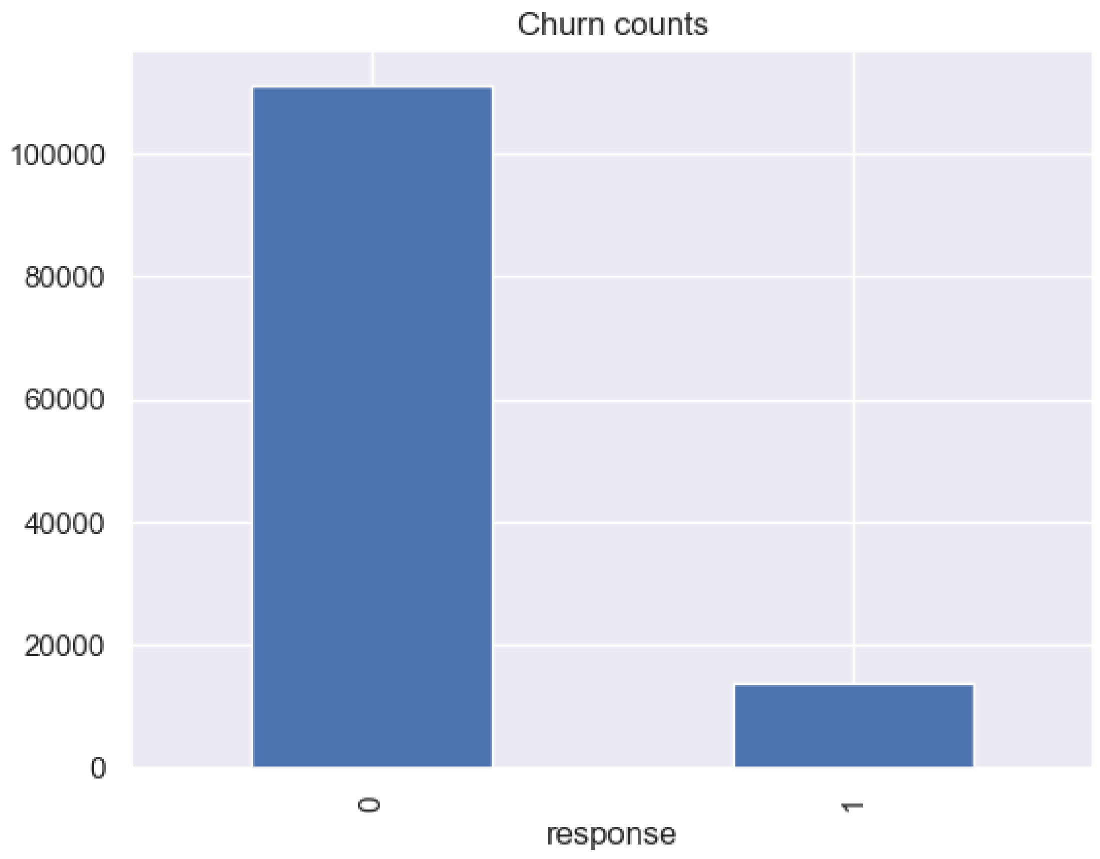
```
# Recency will be the maximum of trans_date
recency = df.groupby('customer_id')['trans_date'].max()

# Frequency will be the count of transactions
frequency = df.groupby('customer_id')['trans_date'].count()

# Monetary will be the sum of tran_amount
monetary = df.groupby('customer_id')['tran_amount'].sum()

# Combine all three into a DataFrame
rfm = pd.DataFrame({'recency': recency, 'frequency': frequency,
'monetary': monetary})

rfm

               recency  frequency  monetary
customer_id
```

```
CS1112      2015-01-14         15      1012
CS1113      2015-02-09         20      1490
CS1114      2015-02-12         19      1432
CS1115      2015-03-05         22      1659
CS1116      2014-08-25         13       857
...                ...        ...       ...
CS8996      2014-12-09         13       582
CS8997      2014-06-28         14       543
CS8998      2014-12-22         13       624
CS8999      2014-07-02         12       383
CS9000      2015-02-28         13       533

[6884 rows x 3 columns]

# Customer segmentation

def segment_customer(row):
    if row['recency'].year >= 2012 and row['frequency'] >= 15 and
row['monetary'] > 1000:
        return 'P0'
    elif (2011 <= row['recency'].year < 2012) and (10 <
row['frequency'] <= 15) and (500 < row['monetary'] <= 1000):
        return 'P1'
    else:
        return 'P2'

rfm['Segment'] = rfm.apply(segment_customer, axis=1)

rfm

               recency  frequency  monetary Segment
customer_id
CS1112      2015-01-14         15      1012      P0
CS1113      2015-02-09         20      1490      P0
CS1114      2015-02-12         19      1432      P0
CS1115      2015-03-05         22      1659      P0
CS1116      2014-08-25         13       857      P2
...                ...        ...       ...     ...
CS8996      2014-12-09         13       582      P2
CS8997      2014-06-28         14       543      P2
CS8998      2014-12-22         13       624      P2
CS8999      2014-07-02         12       383      P2
CS9000      2015-02-28         13       533      P2

[6884 rows x 4 columns]
```

Churn Analysis

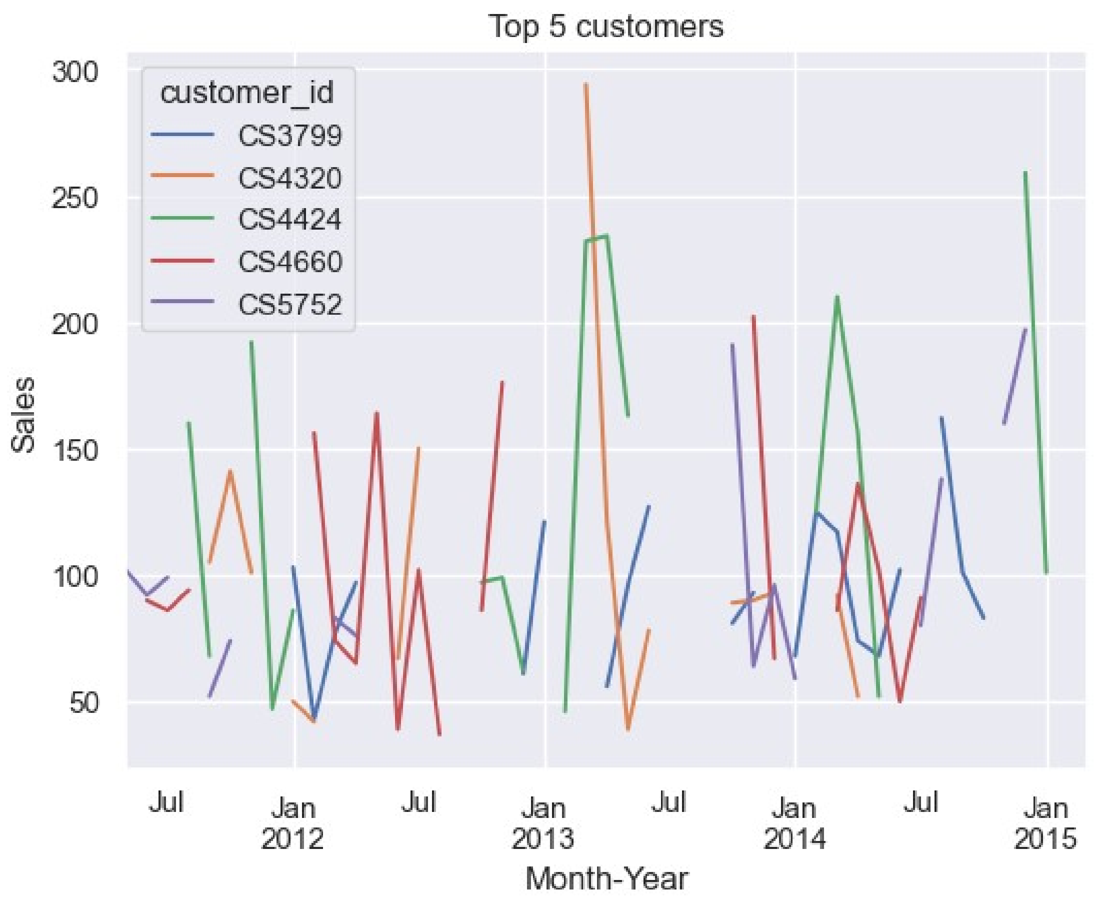
```
# Count the number of churned and active customers
churn_counts = df['response'].value_counts()
```

```
# Plot
churn_counts.plot(kind='bar')
plt.title('Churn counts')
plt.savefig('churn_plot.png')
```



Analyzing top customers

```
# Top 5 customers
top_5_customers = monetary.sort_values(ascending=False).head(5).index

# Filter transactions of top 5 customers
top_customers_df = df[df['customer_id'].isin(top_5_customers)]

# Plot their monthly sales
top_customers_sales = top_customers_df.groupby(['customer_id',
'month_year'])['tran_amount'].sum().unstack(level=0)
top_customers_sales.plot(kind='line')
plt.xlabel('Month-Year')
plt.ylabel('Sales')
plt.title('Top 5 customers')
plt.savefig('line_plot1.png')
plt.show()
```



```
df.to_csv('Main_data.csv')

rfm.to_csv('Additional_analysis.csv')

# This command will use to insert the graphs into excel workbook

from openpyxl import load_workbook
from openpyxl.drawing.image import Image

# Load Excel file
workbook = load_workbook('Data.xlsx')
sheet = workbook.active

# Insert image
img = Image('line_plot1.png')
sheet.add_image(img, 'A1')

# Save the workbook
workbook.save('your_excel_file_with_plot.xlsx')
```