Python-Project-Rahul-12310157-35

April 12, 2025

[1]:

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

# Set visual style
sns.set(style="whitegrid")
plt.rcParams['figure.figsize ]   (10   6)

# Load dataset
df   pd.read_csv( phone_usage_india_reduced.csv )

# Basic info
print(df.head())
print(df.info())
print(df.describe())
```

```
     User ID  Age  Gender   Location Phone Brand       OS  Screen Time (hrs/day)  \
   0 U12001 58 Female Hyderabad OnePlus Android      3.3
   1 U12002 47 Female Mumbai Motorola iOS 2.9 2 U12003 58 Other Lucknow
     Realme iOS 1.7
   3 U12004 38 Male Mumbai Motorola Android    5.0
   4 U12005 37 Male       Pune  Apple Android    3.4
Data Usage (GB/month) Calls Duration (mins/day) Number of Apps Installed \
0    44.1 35.7 39

1                 22.4 249.7 128

2                 18.8 288.1 150

3                 40.8 207.3 171

4                 30.8 23.2 165

Social Media Time (hrs/day) E-commerce Spend (INR/month) \

0                        3.6 9234

1                        4.0 6593

2                        4.3 3981

3                        5.5 154

4                        2.2 4924
```

```
       Streaming Time (hrs/day) Gaming Time (hrs/day) \
0                   1.3 3.6
1                   1.1 3.2

2                   6.4 1.4

3                   6.4 4.2

4                   2.5 4.9

     Monthly Recharge Cost (INR) Primary Use

0                      1983    Gaming

1                      233 Work

2                      646 Gaming

3                      567 Work

4                      1778 Entertainment

    <class
    'pandas.core.frame.DataFrame'>
    RangeIndex: 5686 entries, 0 to 5685
    Data columns (total 16 columns):
     # Column                      Non-Null Count Dtype
    --- ------                     -------------- -----
    0   User ID     5686 non-null object
    1   Age    5686 non-null int64
    2   Gender      5686 non-null object
    3   Location    5686 non-null object 4 Phone Brand    5686   non-null
        object
5                      OS 5686 non-null object
6                      Screen Time (hrs/day)    5686 non-null float64
7                      Data Usage (GB/month)    5686  non-null  float64  8
                       Calls Duration (mins/day) 5686 non-null float64
    9  Number of Apps Installed 5686 non-null int64
    10 Social Media Time  5686 non-null float64
     (hrs/day)
    11 E-commerce Spend (INR/month) 5686 non- int64 null
    12 Streaming Time (hrs/day) 5686 non-null float64
    13 Gaming Time (hrs/day)   5686 non-null float64 14 Monthly Recharge
       Cost (INR)5686 non-null int64
    15 Primary Use               5686 non-null object
    dtypes: float64(6), int64(4), object(6) memory
    usage: 710.9+ KB
    None
```

```
         Age Screen Time (hrs/day) Data Usage (GB/month) \
count 5686.000000 5686.000000 5686.000000 mean 37.537988
6.505153 25.433961 std 13.406711 3.177343 14.119625
min    15.000000          1.000000          1.000000
25%    26.000000          3.700000         13.025000
50%    38.000000          6.500000         25.600000
75%    49.000000          9.200000         37.500000
max    60.000000         12.000000         50.000000
   Calls Duration (mins/day) Number of Apps Installed \

count            5686.000000           5686.000000
mean              150.445445            104.251319
std                84.890449             54.929894
min                 5.000000             10.000000
25%                77.300000             58.000000
50%               148.900000            103.000000
75%               222.375000            151.000000
max               300.000000            200.000000
             Social Media Time (hrs/day) E-commerce Spend
      (INR/month) \
count              5686.000000              5686.000000
mean                  3.270612              5117.840661
std                   1.583853              2853.038252
min                   0.500000               103.000000
25%                   1.900000              2662.250000
50%                   3.300000              5142.000000
75%                   4.600000              7610.000000
max                   6.000000              9995.000000
      Streaming Time (hrs/day) Gaming Time (hrs/day) \
count            5686.000000         5686.000000
mean                4.263120            2.503693
std                 2.154641            1.442080
min                 0.500000            0.000000
25%                 2.400000            1.200000
50%                 4.200000            2.500000
75%                 6.100000            3.800000
max                 8.000000            5.000000
      Monthly Recharge Cost (INR)
count      5686.000000     mean
1036.512663 std  550.611059  min
100.000000 25%   559.000000
50%                1019.500000
75%                1517.750000
```

```
max                     2000.000000
```

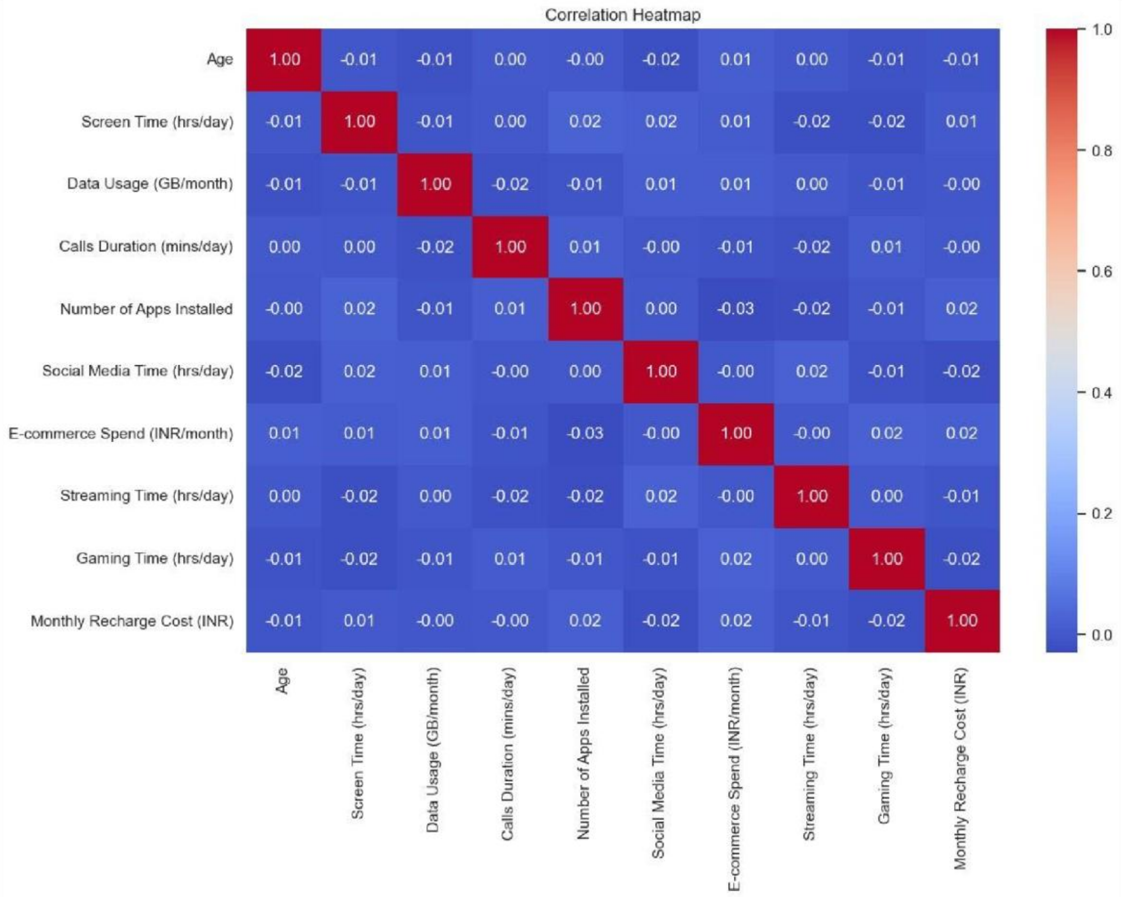
[2]:

```
# Checking for null values
print(df.isnull() sum())

# Data types
print(df.dtypes)

# Unique values in each column
for col in df.columns:
print(f"{col}: {df[col].nunique()} unique values")
```

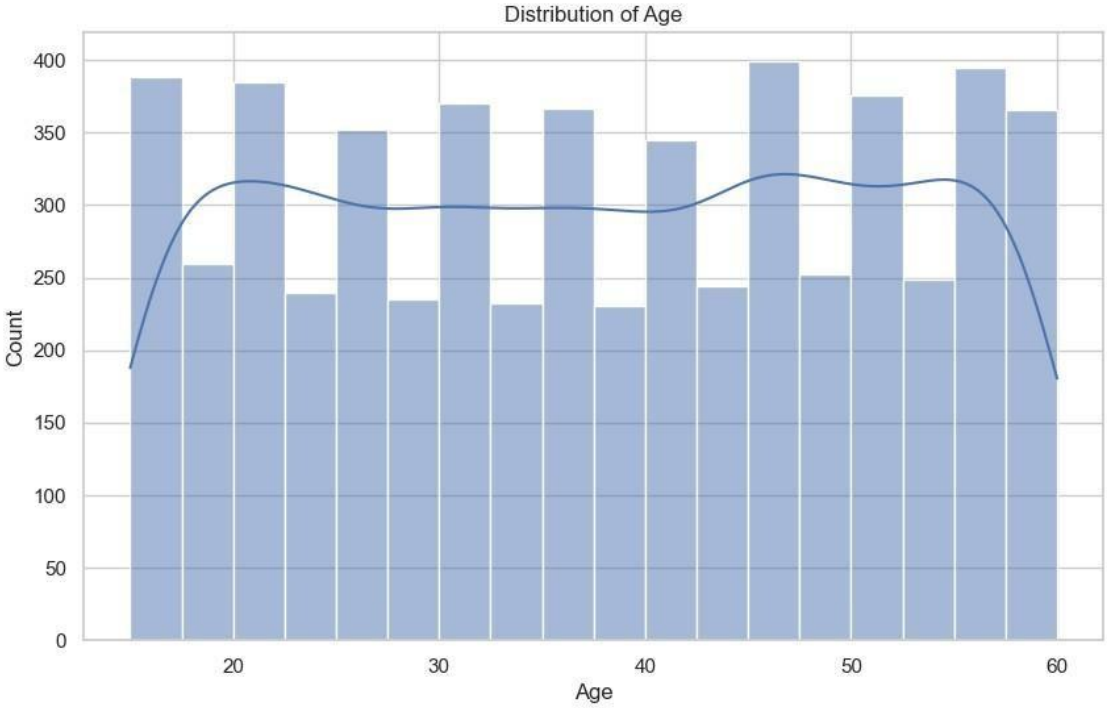
```
User ID                       0
Age                           0
Gender     0 Location         0
Phone Brand                   0
OS                            0
Screen Time (hrs/day)         0
Data Usage (GB/month)         0
Calls Duration (mins/day)  0
Number of Apps Installed      0
Social Media Time             0
(hrs/day)
E-commerce Spend              0
(INR/month)
Streaming Time (hrs/day)      0
Gaming Time (hrs/day)         0
Monthly Recharge Cost         0
(INR)
Primary Use dtype:            0
int64
User ID                        object
Age                             int64
Gender                         object
Location                       object
Phone Brand                    object
OS                             object
Screen Time (hrs/day)         float64
Data Usage (GB/month)         float64
Calls Duration (mins/day)  float64
Number of Apps Installed         int64
Social Media Time               float64
(hrs/day)
E-commerce Spend                 int64
(INR/month)
Streaming Time (hrs/day)  float64
Gaming Time (hrs/day)           float64
```

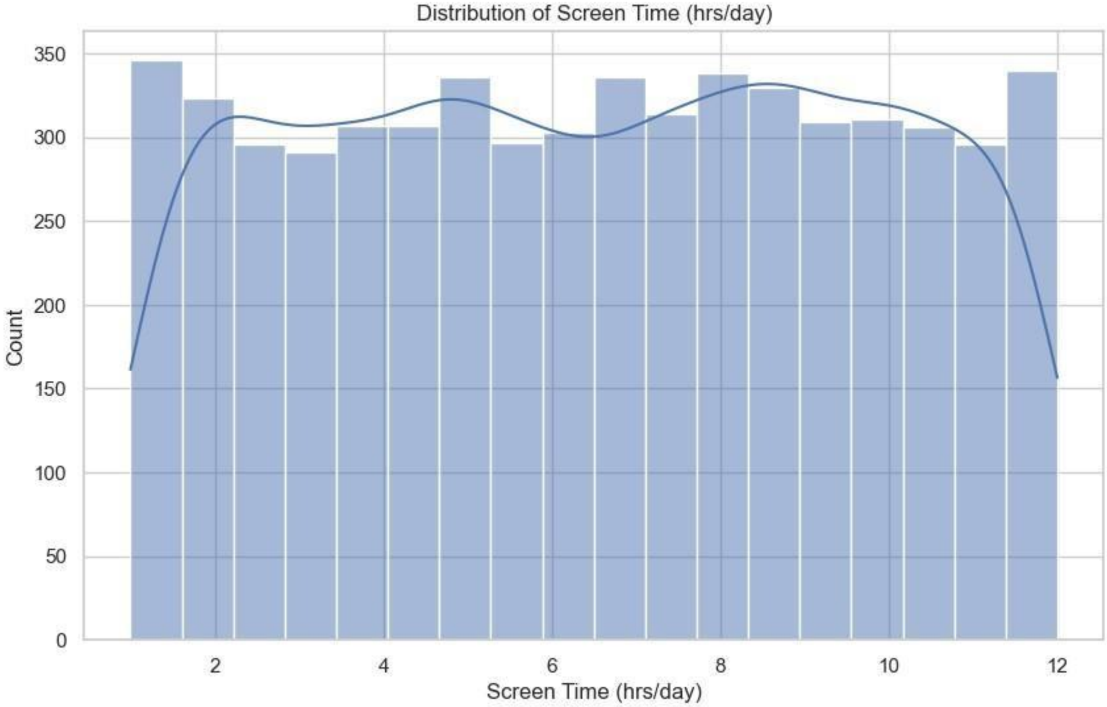
```
Monthly Recharge Cost        int64
(INR)
Primary Use                 object
dtype: object User ID: 5686
unique values
Age: 46 unique values
Gender: 3 unique values
Location: 10 unique values
Phone Brand: 10 unique values
OS: 2 unique values
Screen Time (hrs/day): 111 unique values
Data Usage (GB/month): 491 unique values
Calls Duration (mins/day): 2518 unique values
Number of Apps Installed: 191 unique values
Social  Media  Time  (hrs/day):  56  unique  values  E-commerce  Spend
(INR/month): 4332 unique values
Streaming Time (hrs/day): 76 unique values
Gaming Time (hrs/day): 51 unique values
Monthly Recharge Cost (INR): 1800 unique values
Primary Use: 5 unique values
```

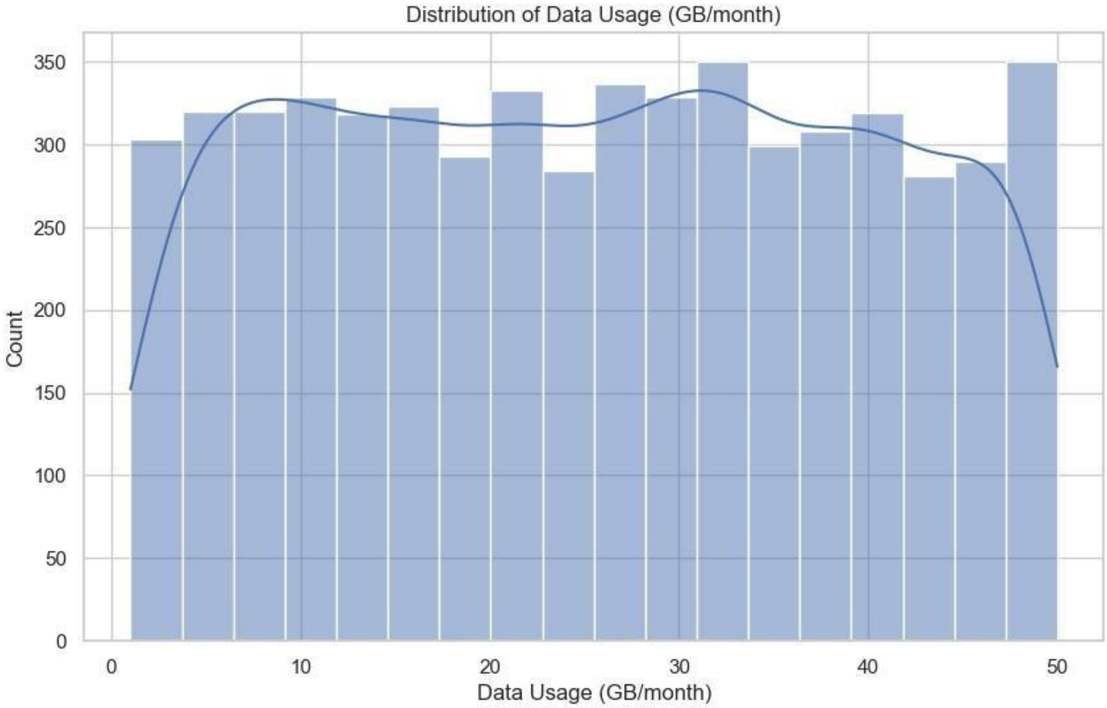
[3]:
```
plt.figure(figsize=(12  8))
sns.heatmap(df.corr(numeric_only=True)  annot=True  cmap='coolwarm'  fmt=".2f")
plt.title("Correlation Heatmap")
plt.show()
```

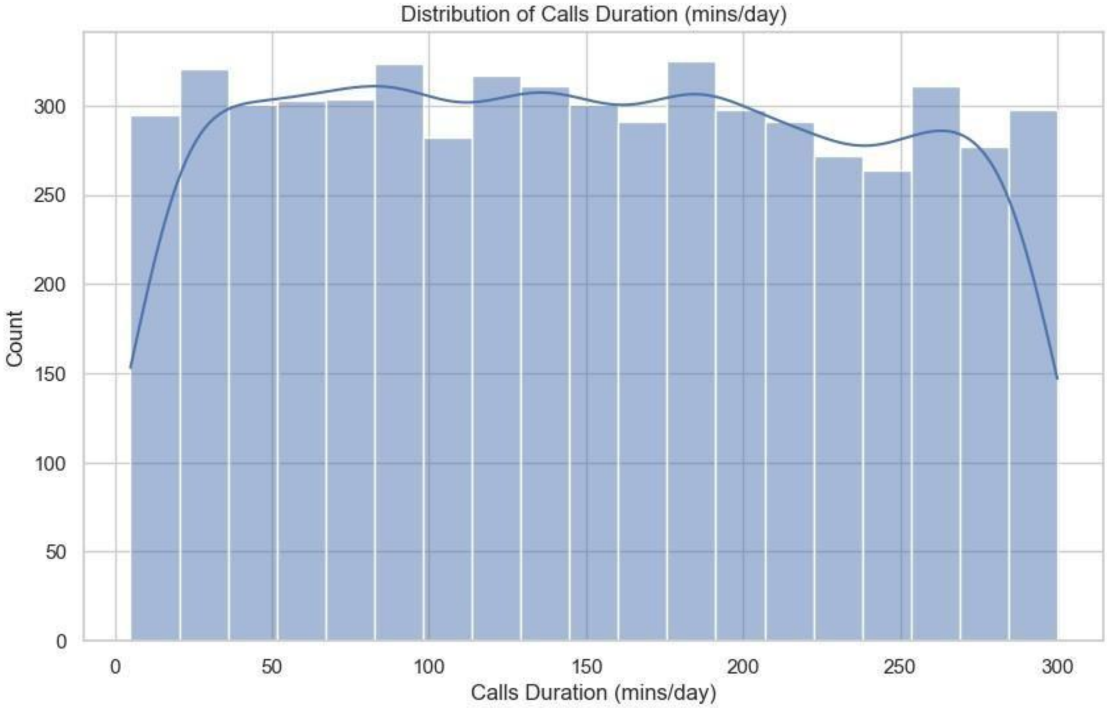


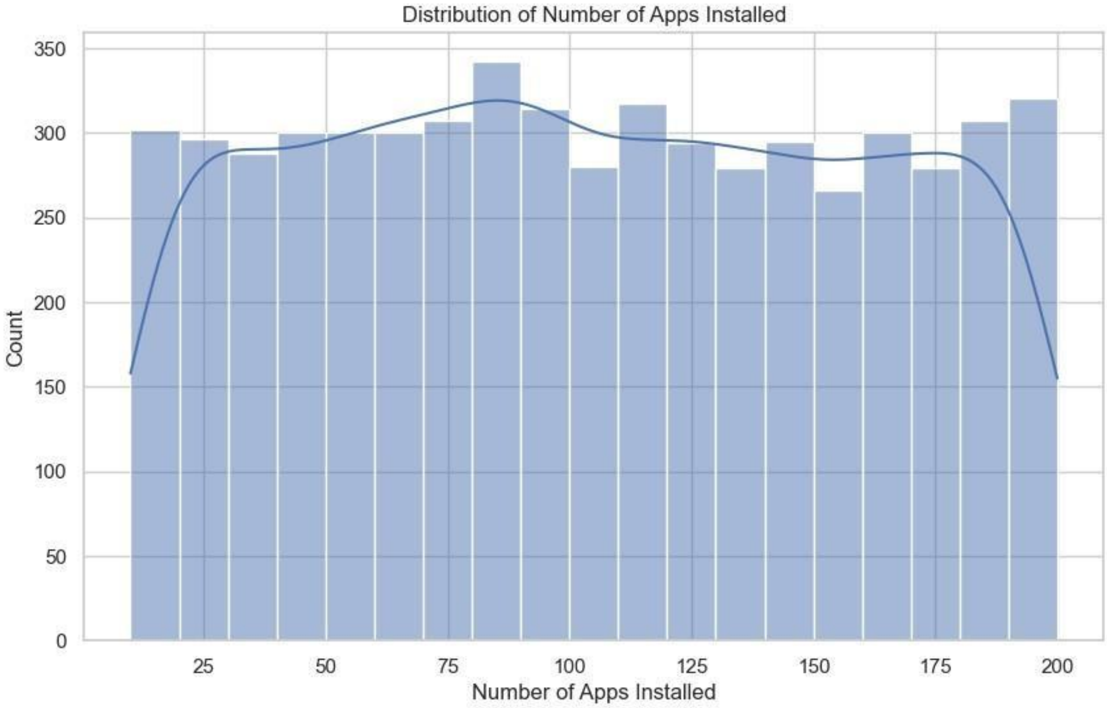
[4]:
```
for col in df.select_dtypes(include=np.number).columns:
    plt.figure()
    sns.histplot(df[col], kde=True)
    plt.title(f"Distribution of {col}")
    plt.show()
```

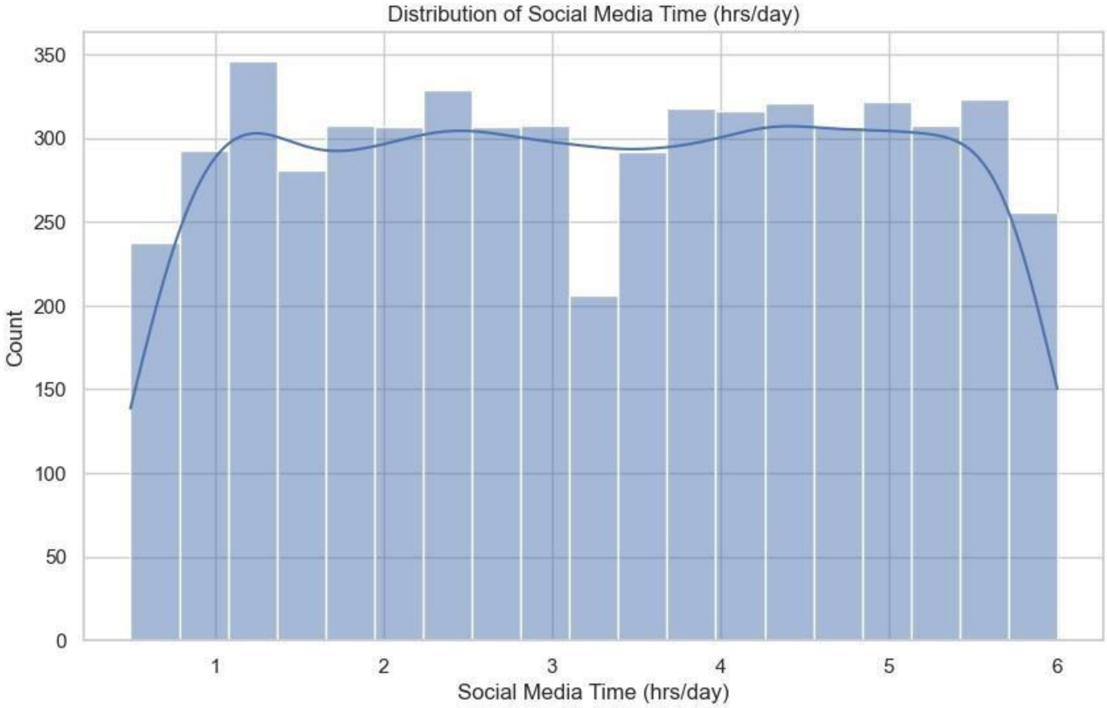

Distribution of Age
Count
0
50
100
150
200
250
300
350
400
20
30
40
50
60
Age

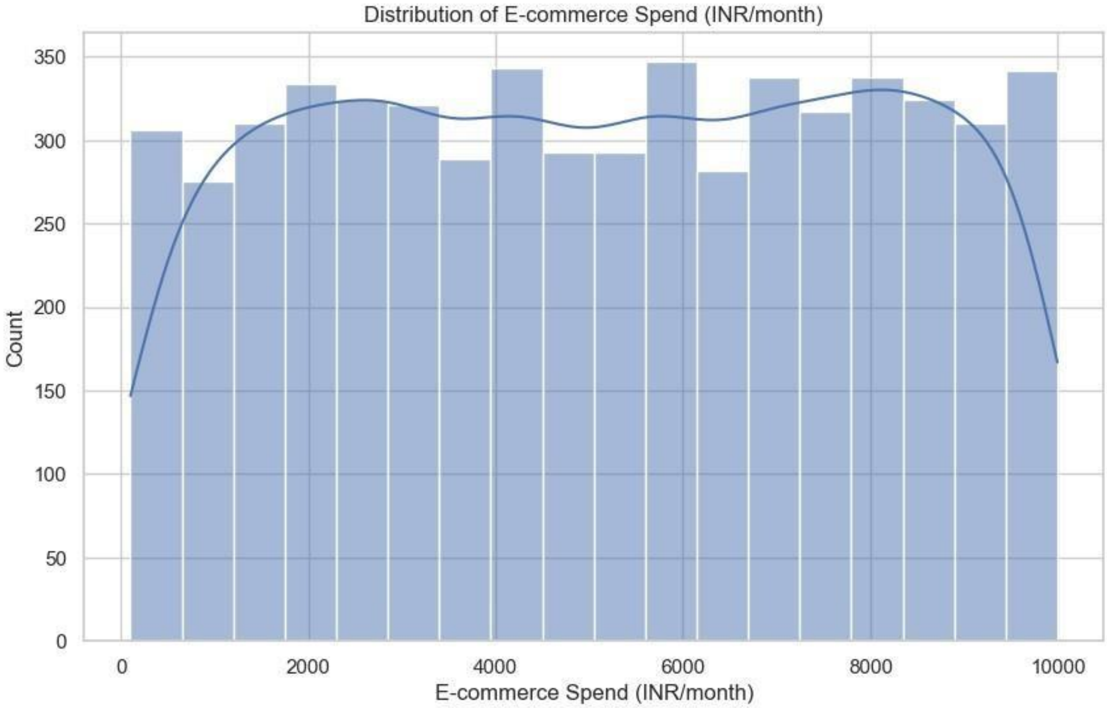

Distribution of Screen Time (hrs/day)
Count
0
50
100
150
200
250
300
350
2
4
6
8
10
12
Screen Time (hrs/day)

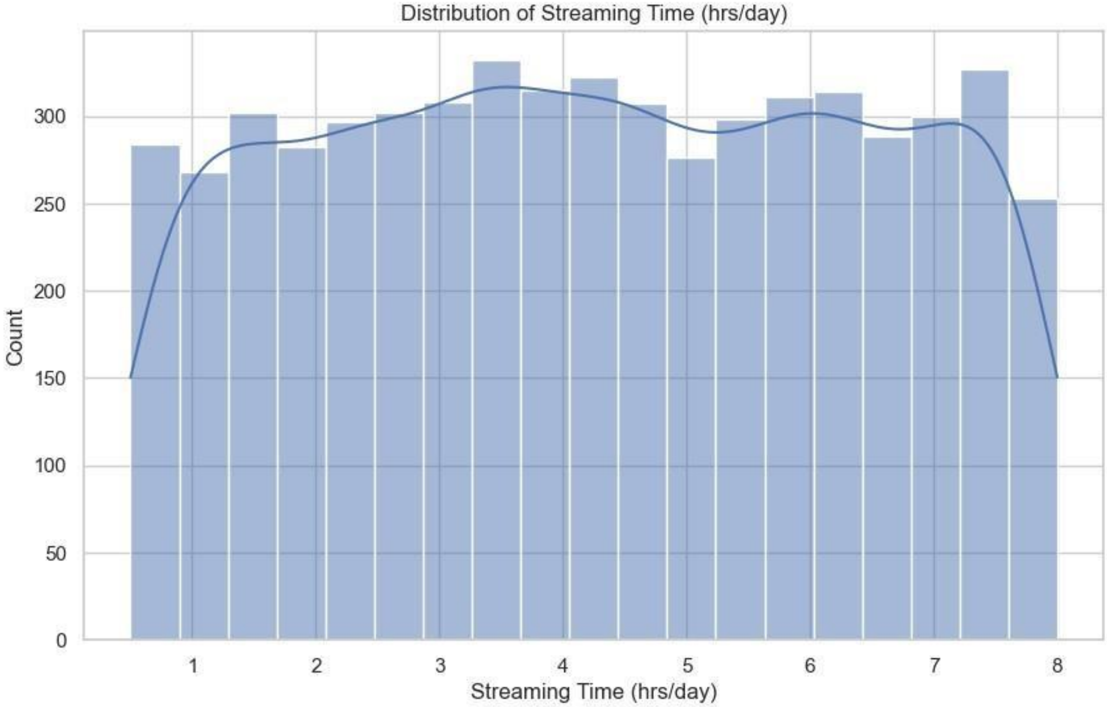

Distribution of Data Usage (GB/month)
Count
0
50
100
150
200
250
300
350
0
10
20
30
40
50
Data Usage (GB/month)

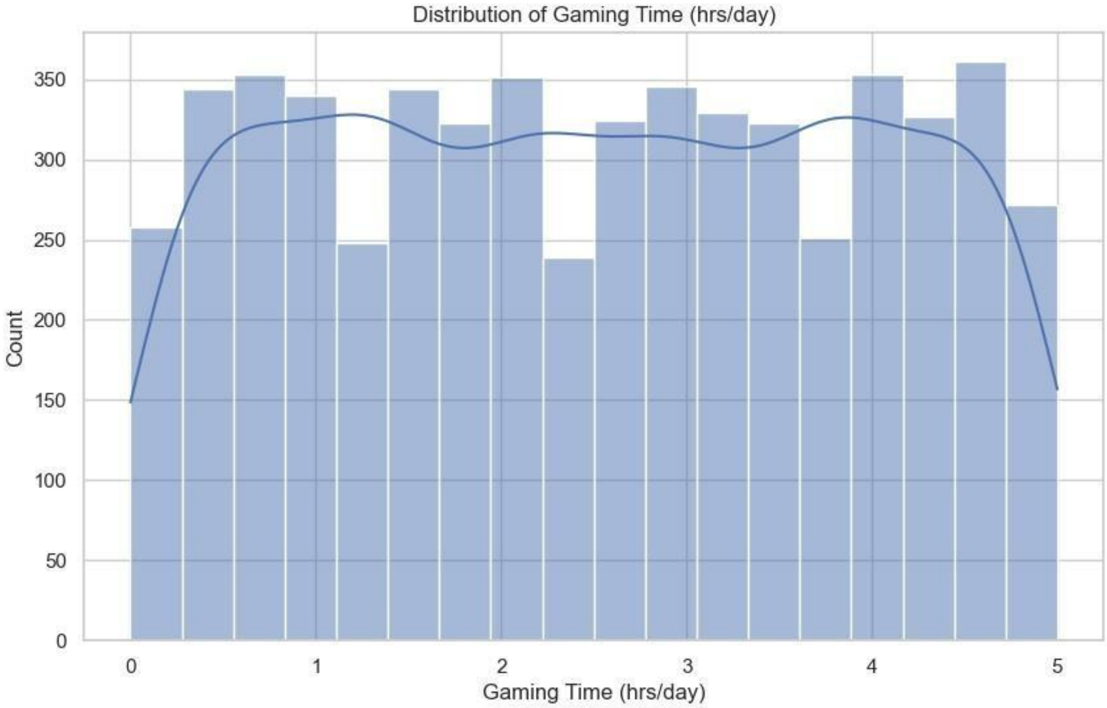

Distribution of Calls Duration (mins/day)
Count
0
50
100
150
200
250
300
0
50
100
150
200
250
300
Calls Duration (mins/day)

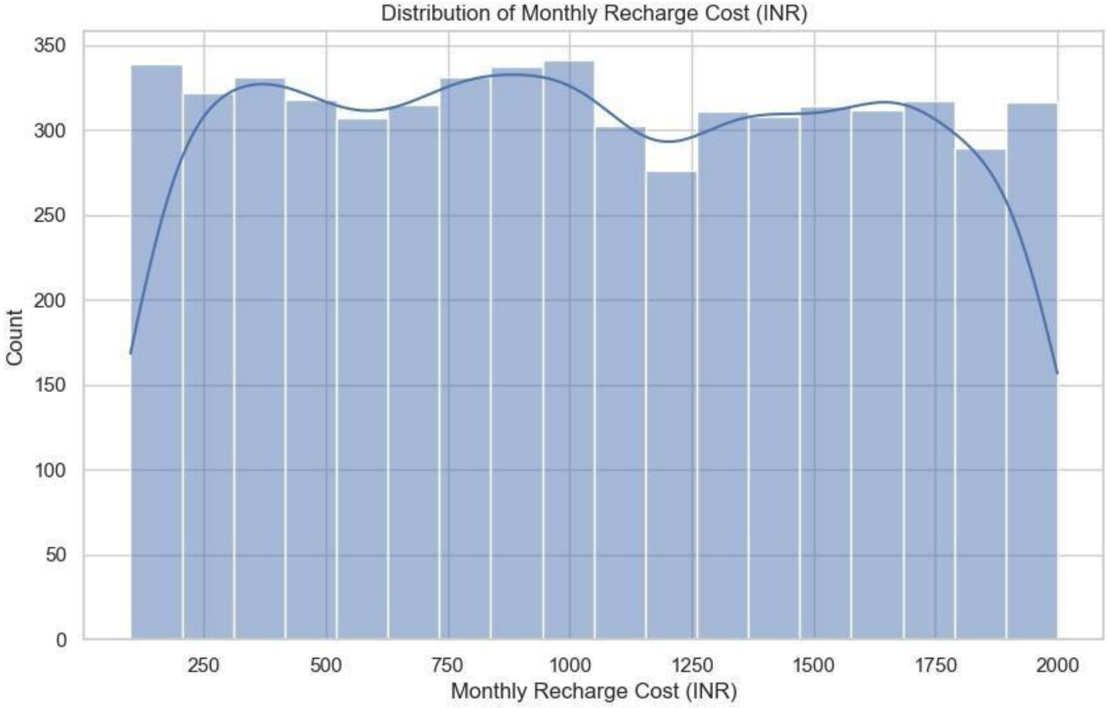

Distribution of Number of Apps Installed
Count
0
50
100
150
200
250
300
350
25
50
75
100
125
150
175
200
Number of Apps Installed


Distribution of Social Media Time (hrs/day)
Count
0
50
100
150
200
250
300
350
1
2
3
4
5
6
Social Media Time (hrs/day)


Distribution of E-commerce Spend (INR/month)
Count
0
50
100
150
200
250
300
350
0
2000
4000
6000
8000
10000
E-commerce Spend (INR/month)

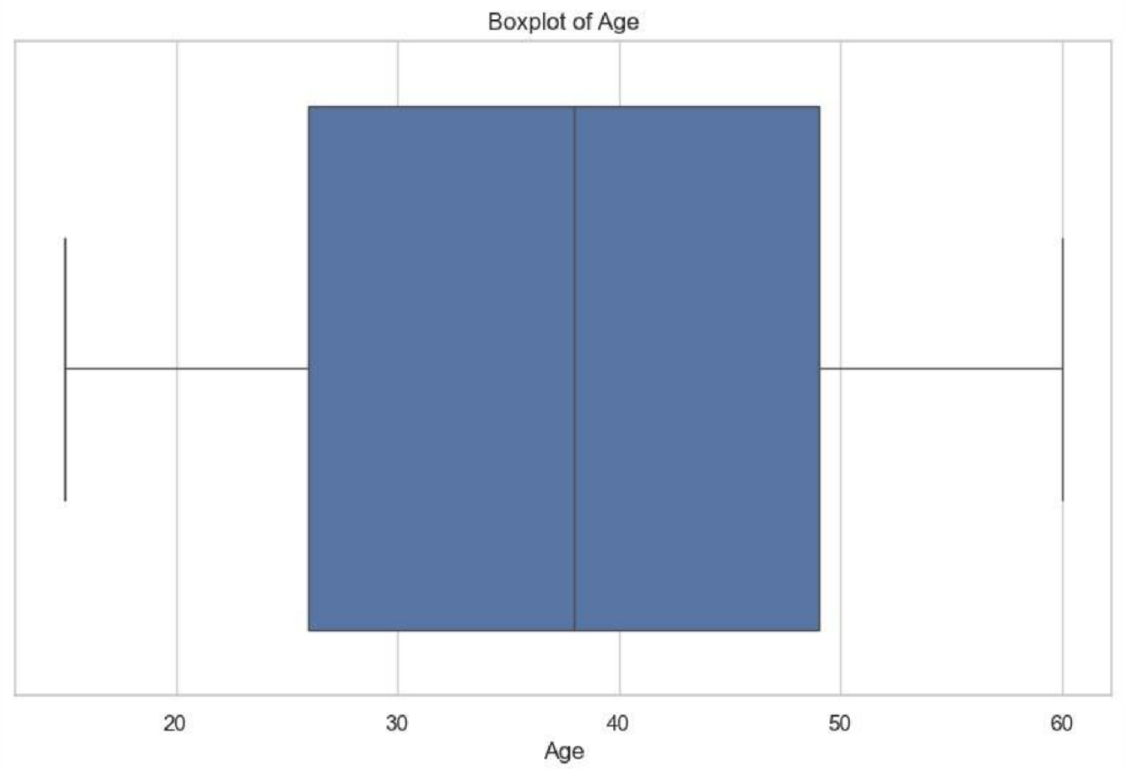

Distribution of Streaming Time (hrs/day)
Count
0
50
100
150
200
250
300
1
2
3
4
5
6
7
8
Streaming Time (hrs/day)

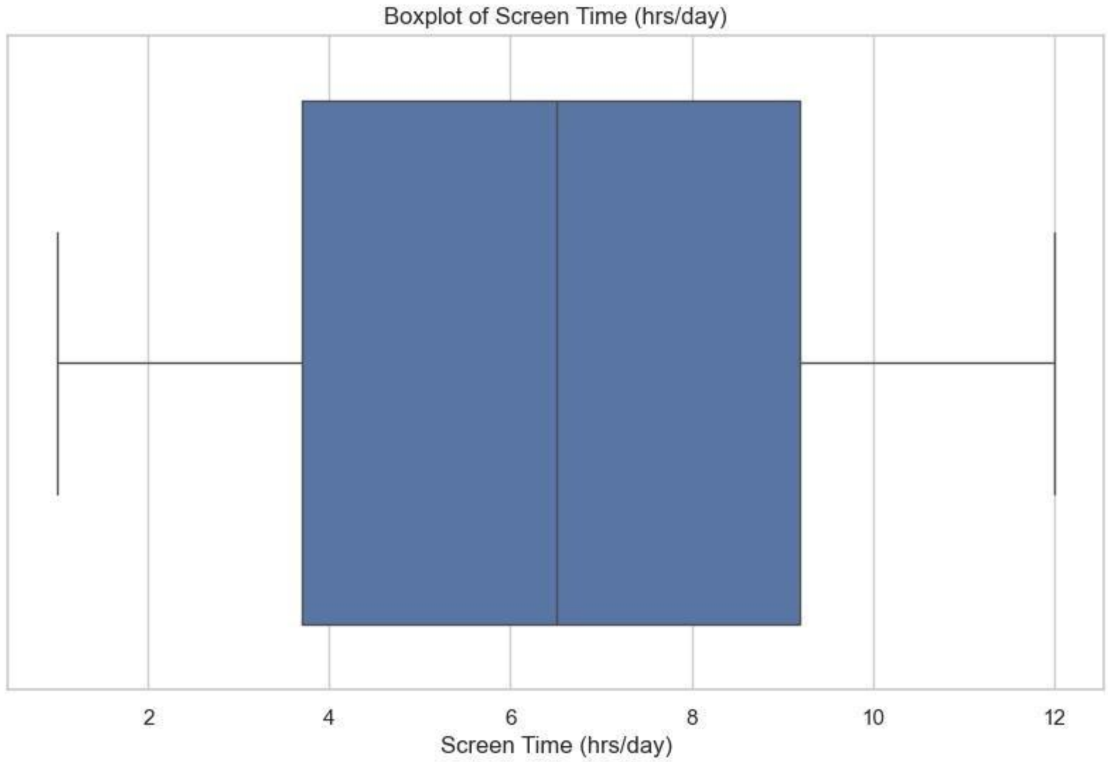

Distribution of Gaming Time (hrs/day)
Count
0
50
100
150
200
250
300
350
0
1
2
3
4
5
Gaming Time (hrs/day)

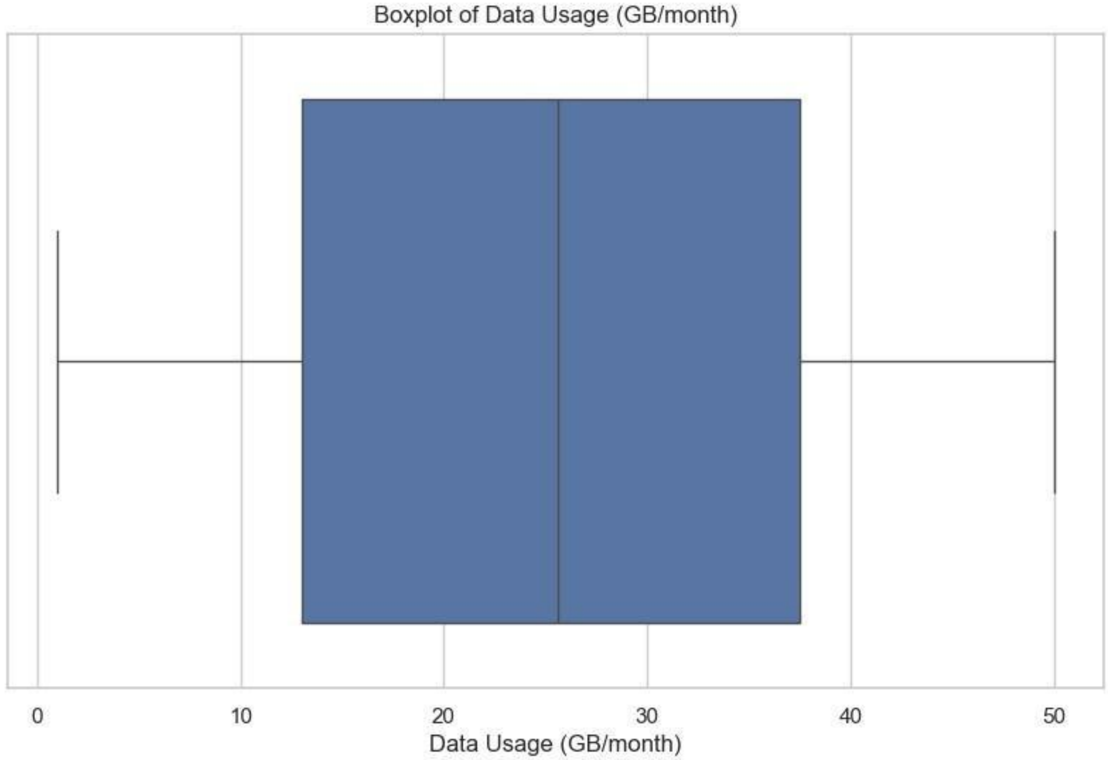

Distribution of Monthly Recharge Cost (INR)
Count
0
50
100
150
200
250
300
350
250
500
750
1000
1250
1500
1750
2000
Monthly Recharge Cost (INR)

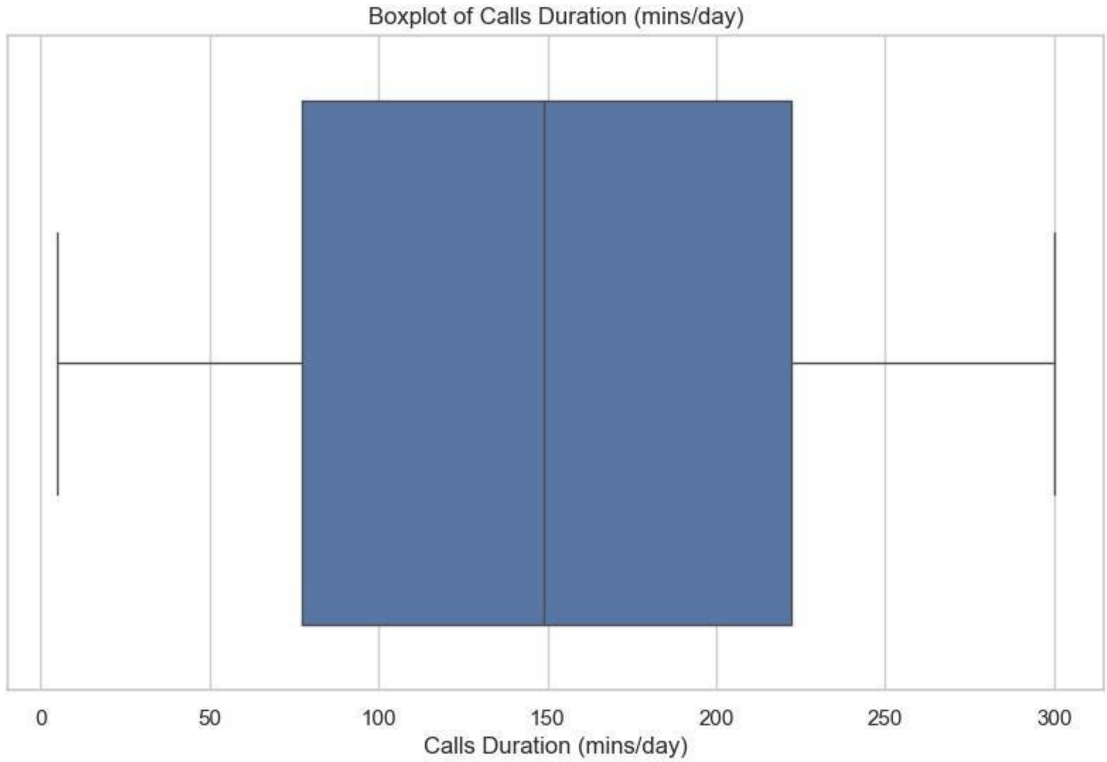
[5]:

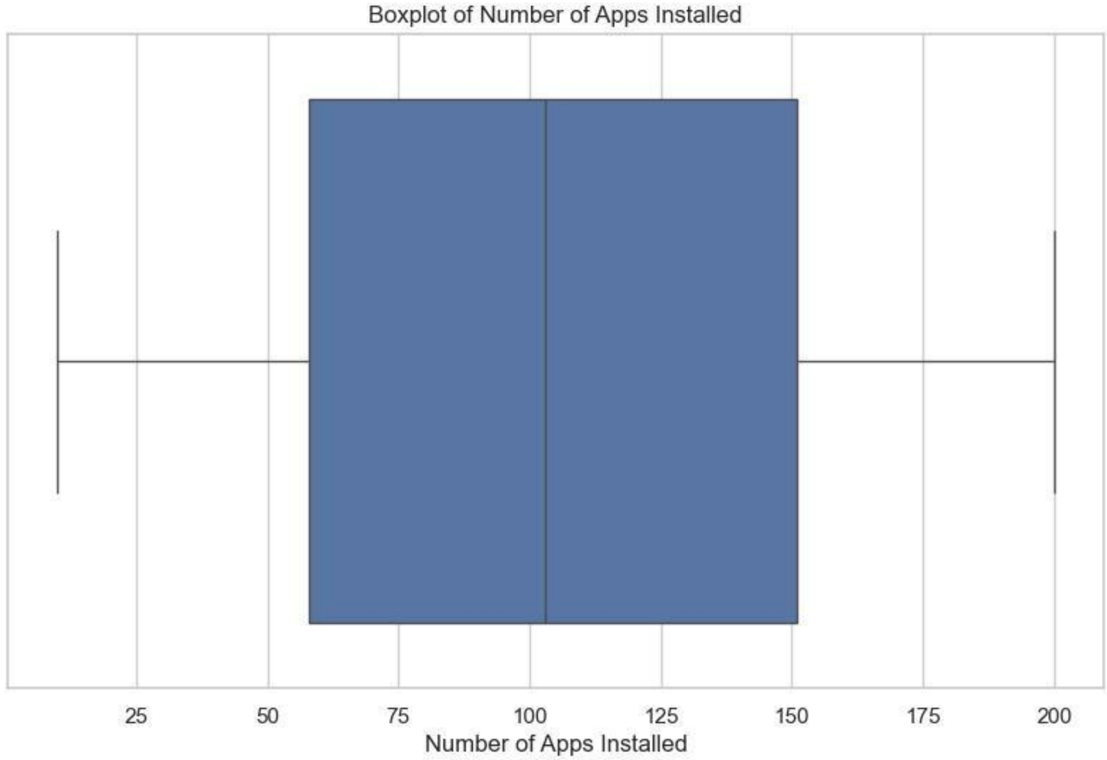
```
for col in df.select_dtypes(include=np.number).columns:
    plt.figure()
    sns.boxplot(data=df, x=col)
    plt.title(f"Boxplot of {col}")
    plt.show()
```

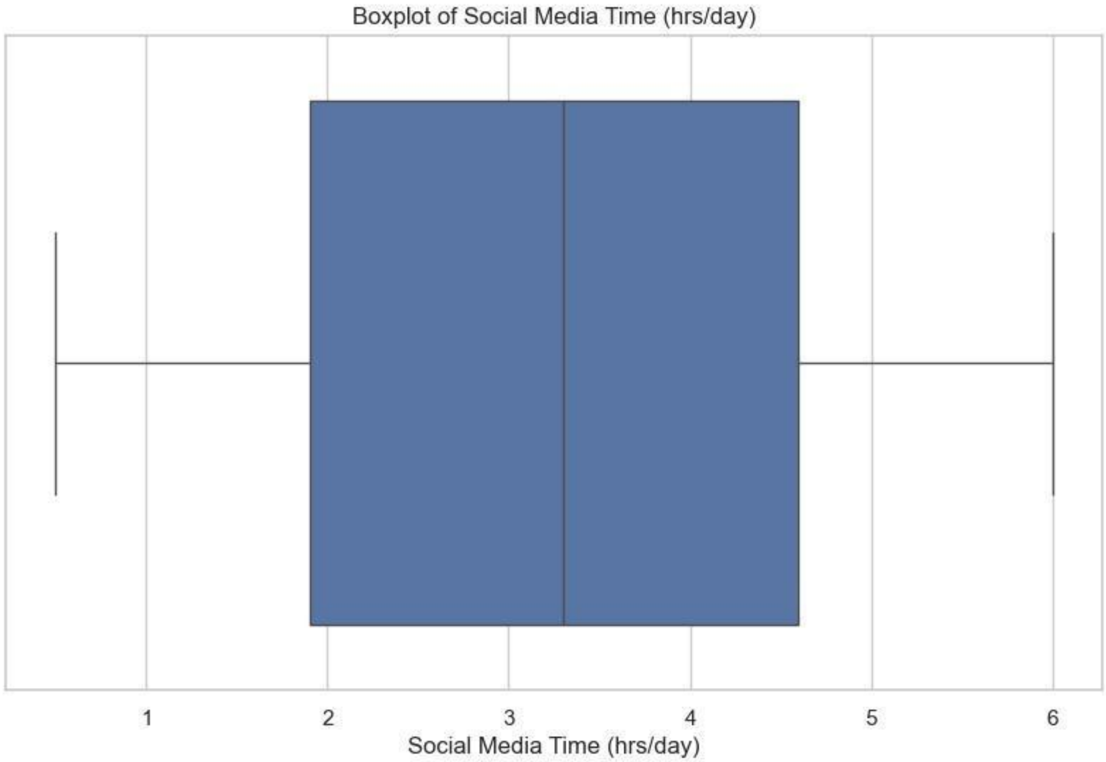


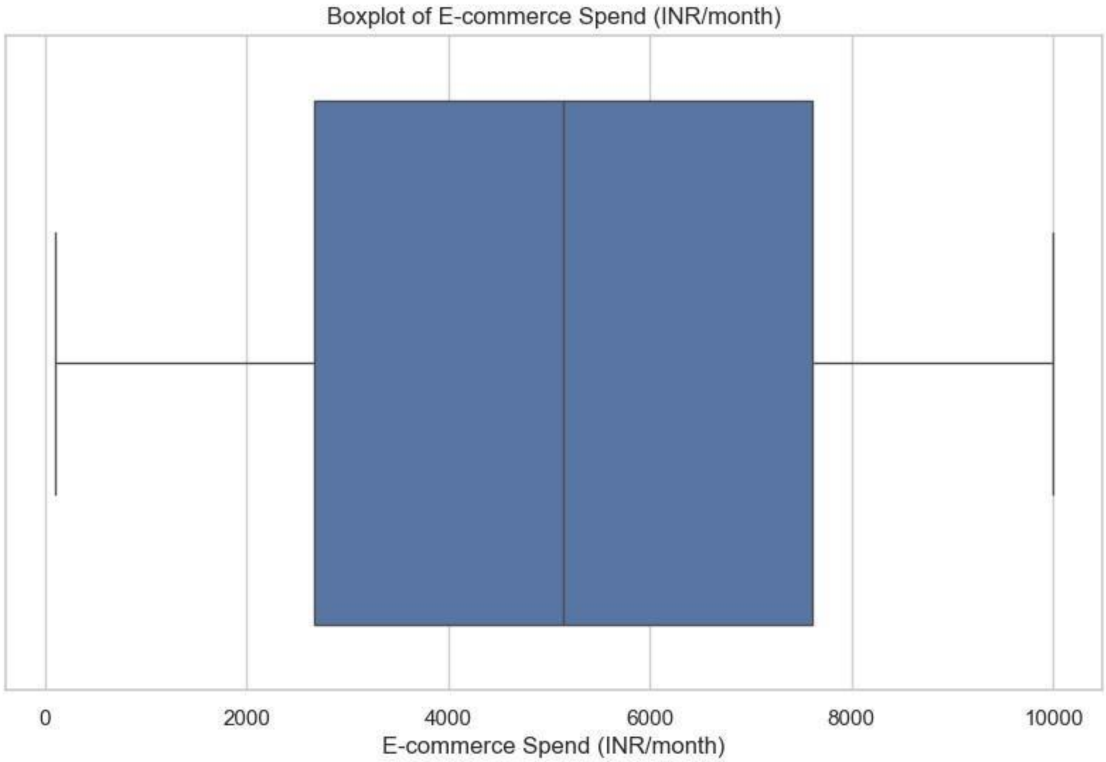

Boxplot of Screen Time (hrs/day)
2
4
6
8
10
12
Screen Time (hrs/day)

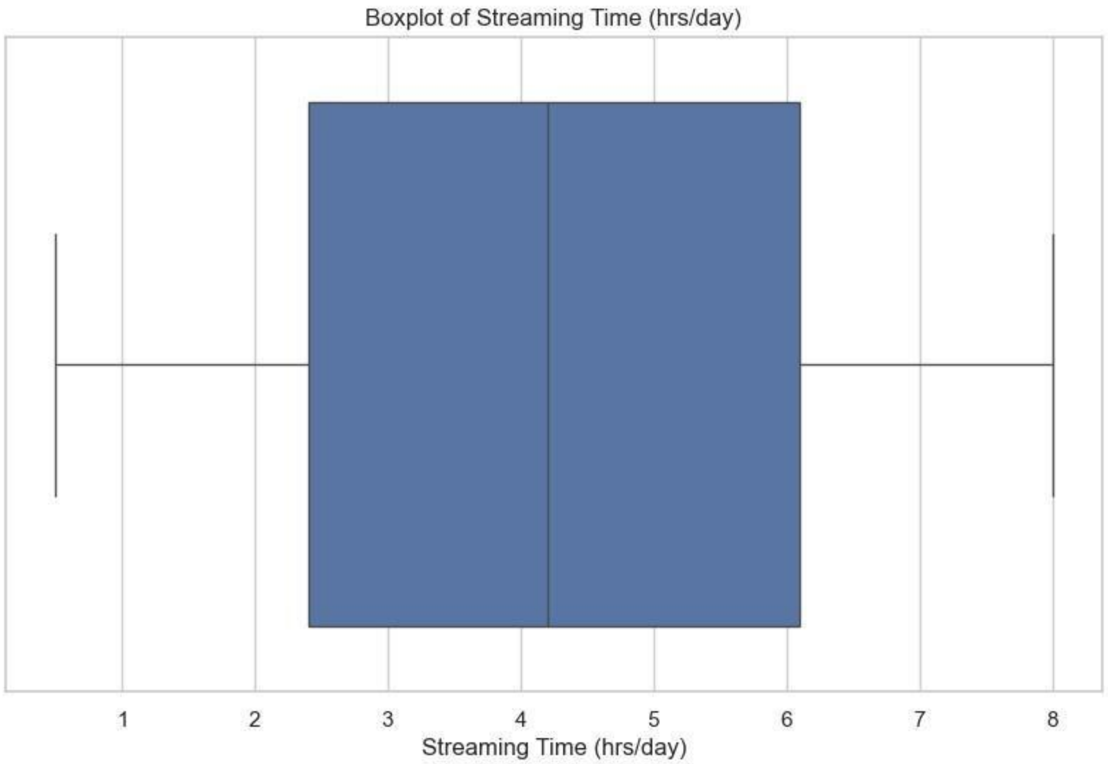

Boxplot of Data Usage (GB/month)
0
10
20
30
40
50
Data Usage (GB/month)

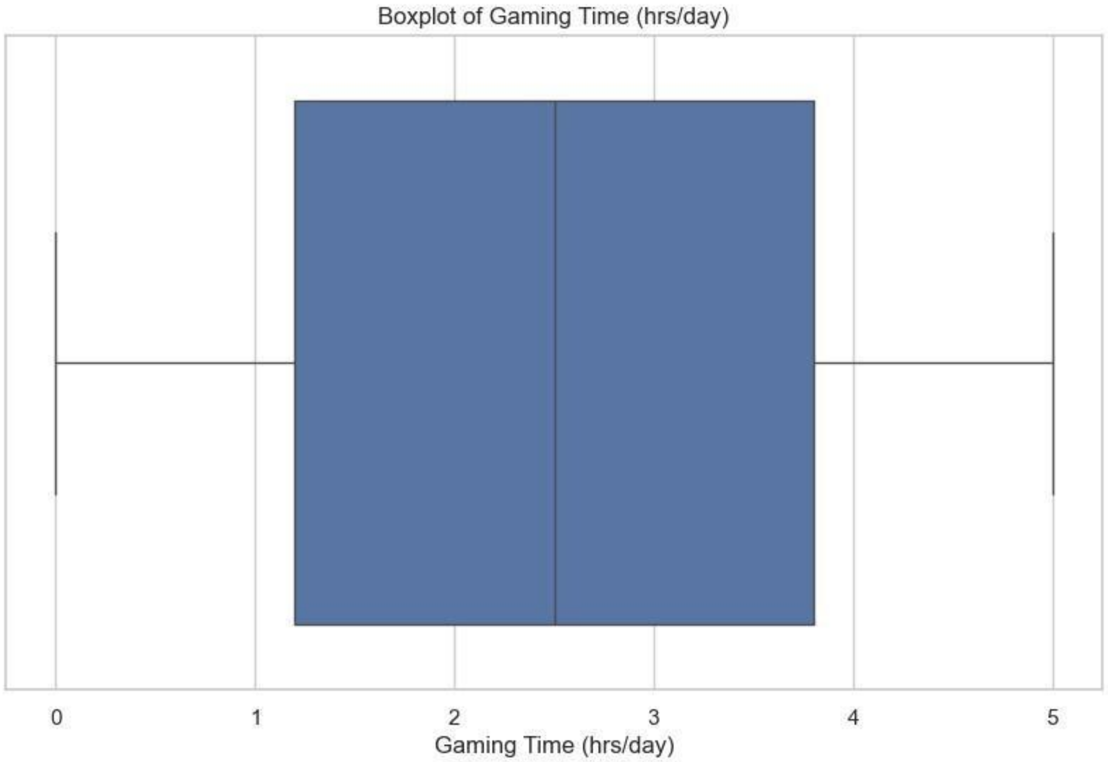

Boxplot of Calls Duration (mins/day)
0
50
100
150
200
250
300
Calls Duration (mins/day)

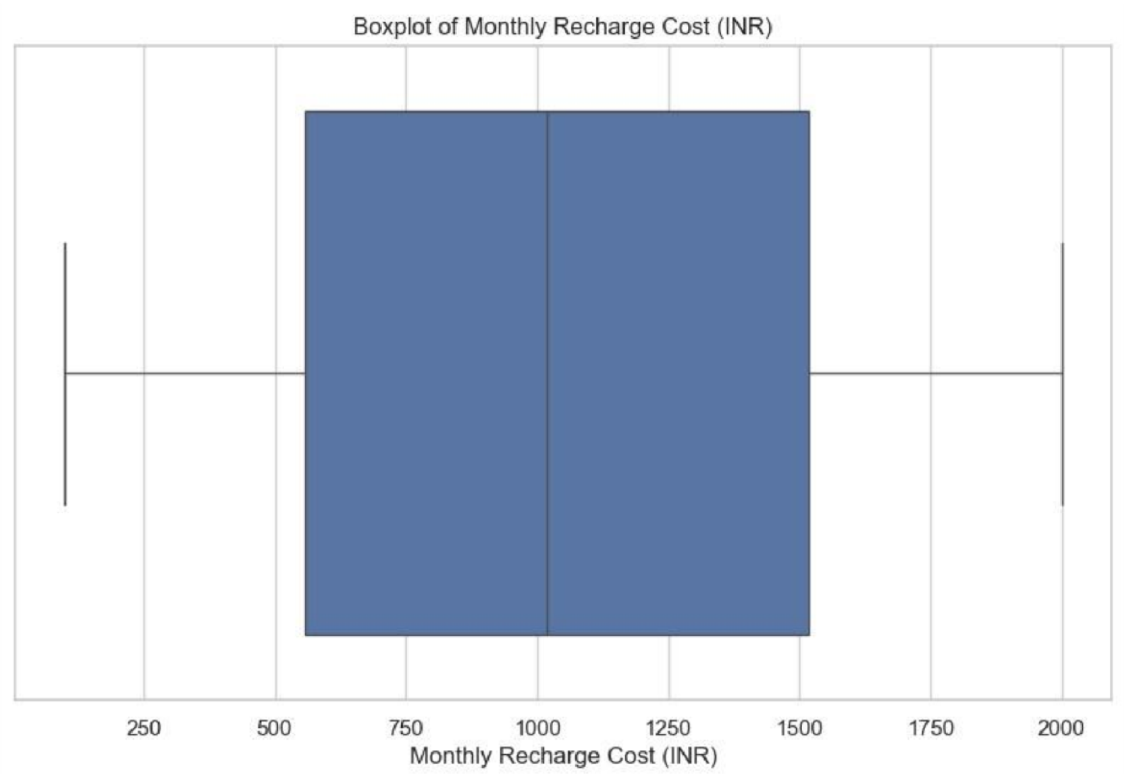

Boxplot of Number of Apps Installed
25
50
75
100
125
150
175
200
Number of Apps Installed


Boxplot of Social Media Time (hrs/day)
1
2
3
4
5
6
Social Media Time (hrs/day)


Boxplot of E-commerce Spend (INR/month)
0
2000
4000
6000
8000
10000
E-commerce Spend (INR/month)


Boxplot of Streaming Time (hrs/day)
1
2
3
4
5
6
7
8
Streaming Time (hrs/day)


Boxplot of Gaming Time (hrs/day)
0
1
2
3
4
5
Gaming Time (hrs/day)



```
[9]: if 'CategoryCol' in df.columns:
         for col in df select_dtypes(include=np.number).columns:
             plt.figure()
             sns.boxplot(x='CategoryCol     =col, data=df)
             plt.title(f"{col} across CategoryCol")
             plt.show()
```

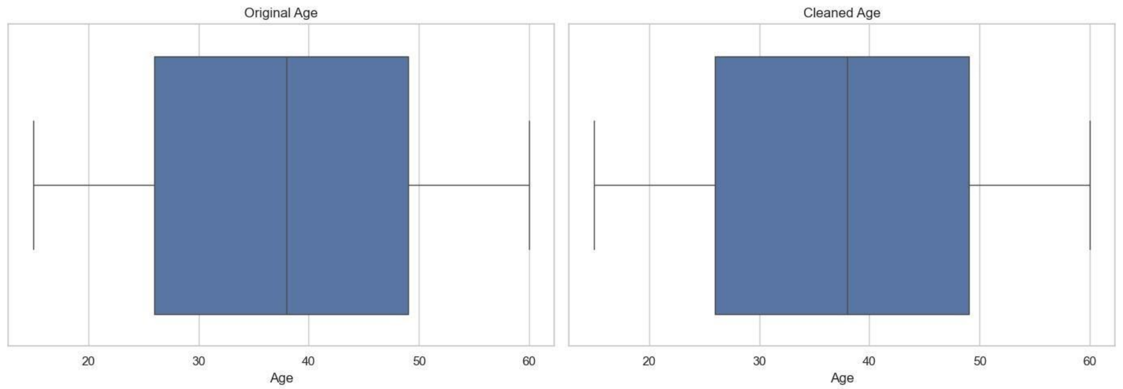
```
[10]: def remove_outliers_iqr(data, col):
          Q1   data[col].quantile(0.25)
          Q3   data[col].quantile(0.75)
          IQR   Q3   Q1
          lower   Q1   1.5 * IQR
          upper   Q3 + 1.5 * IQR
          outliers   data[(data[col] < lower) | (data[col] > upper)]
          print(f"{col}  {len(outliers)} outliers")
          return data[(data[col] >= lower) & (data[col] <= upper)]

      # Apply to all numerical columns
      df_cleaned   df.copy()
      for col in df.select_dtypes(include=np.number).columns:
          df_cleaned   remove_outliers_iqr(df_cleaned, col)
```

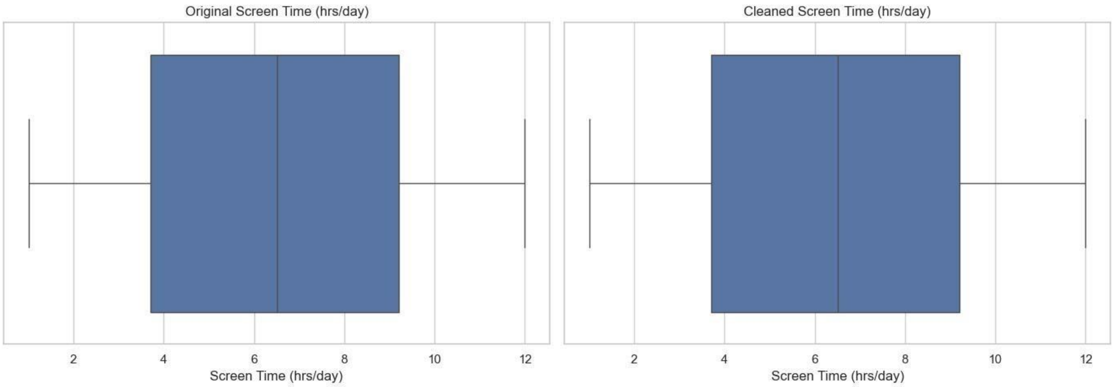
```
Age: 0 outliers
Screen Time (hrs/day): 0 outliers
Data Usage (GB/month): 0 outliers Calls Duration (mins/day): 0 outliers
```

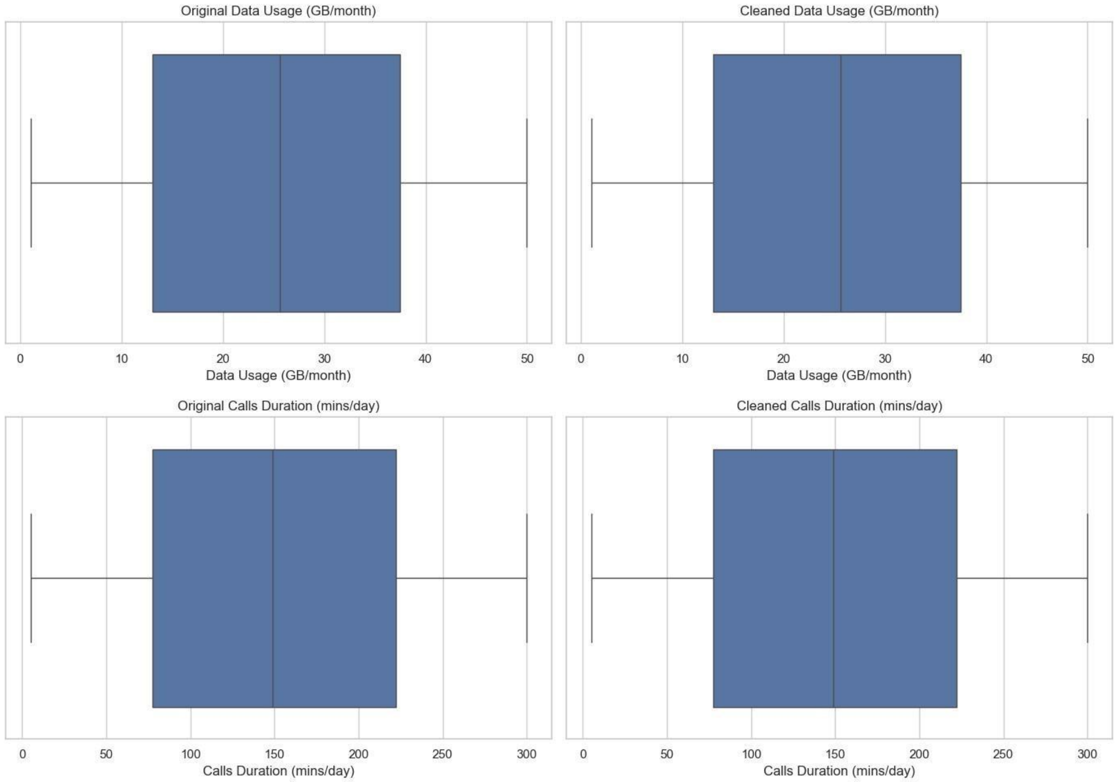
```
Number of Apps Installed: 0 outliers
Social Media Time (hrs/day): 0 outliers
E-commerce Spend (INR/month): 0 outliers
Streaming Time (hrs/day): 0 outliers
Gaming Time (hrs/day): 0 outliers
Monthly Recharge Cost (INR): 0 outliers
```

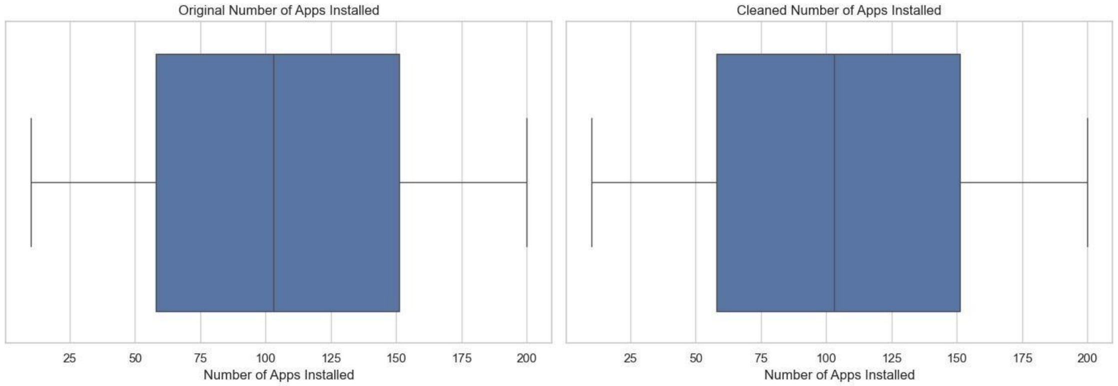
[11]:

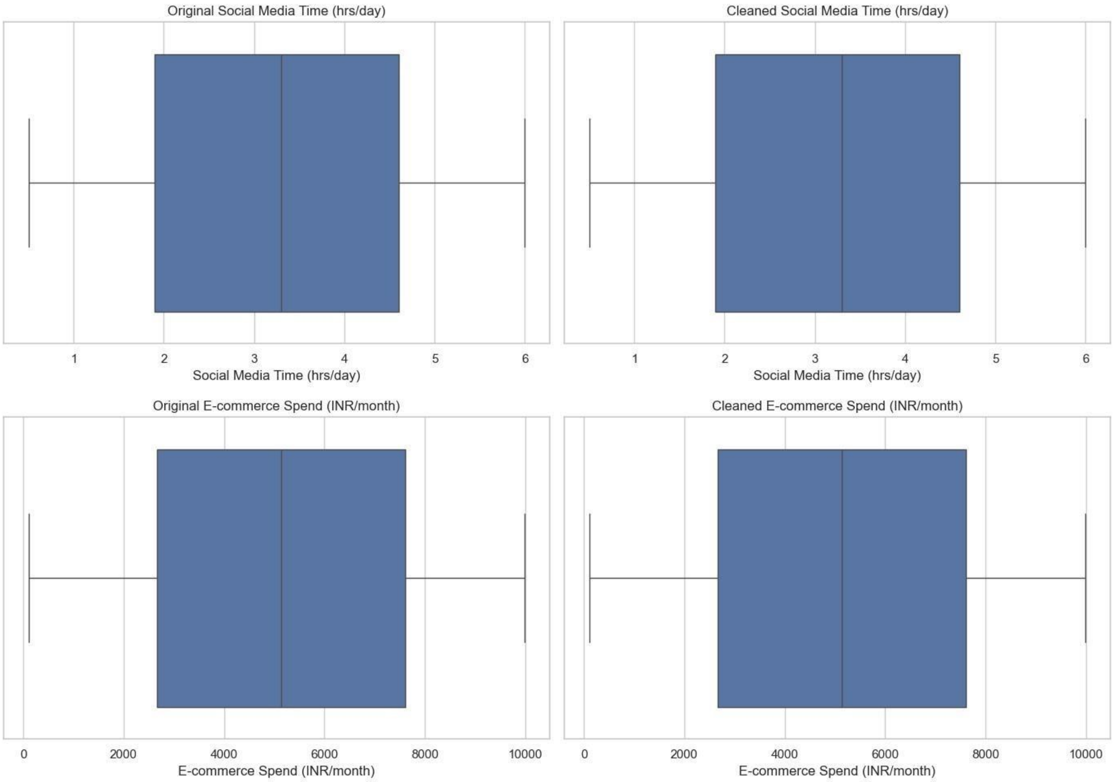
```
for col in df.select_dtypes(include=np.number).columns:
    fig, axes = plt.subplots(1, 2,
    figsize=(14, 5)) sns.boxplot(x=df[col],
    ax=axes[0]) axes[0].set_title(f'Original
    {col}') sns.boxplot(x=df_cleaned[col],
    ax=axes[1]) axes[1].set_title(f'Cleaned
    {col}') plt.tight layout() plt.show()
```

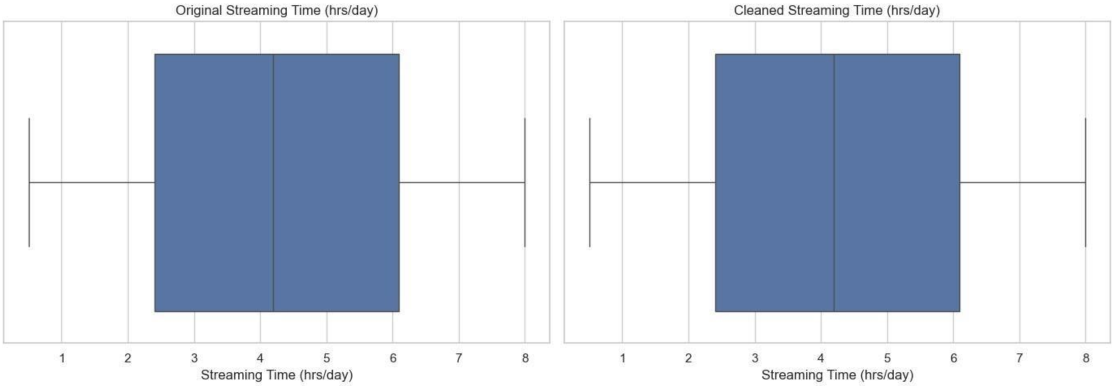


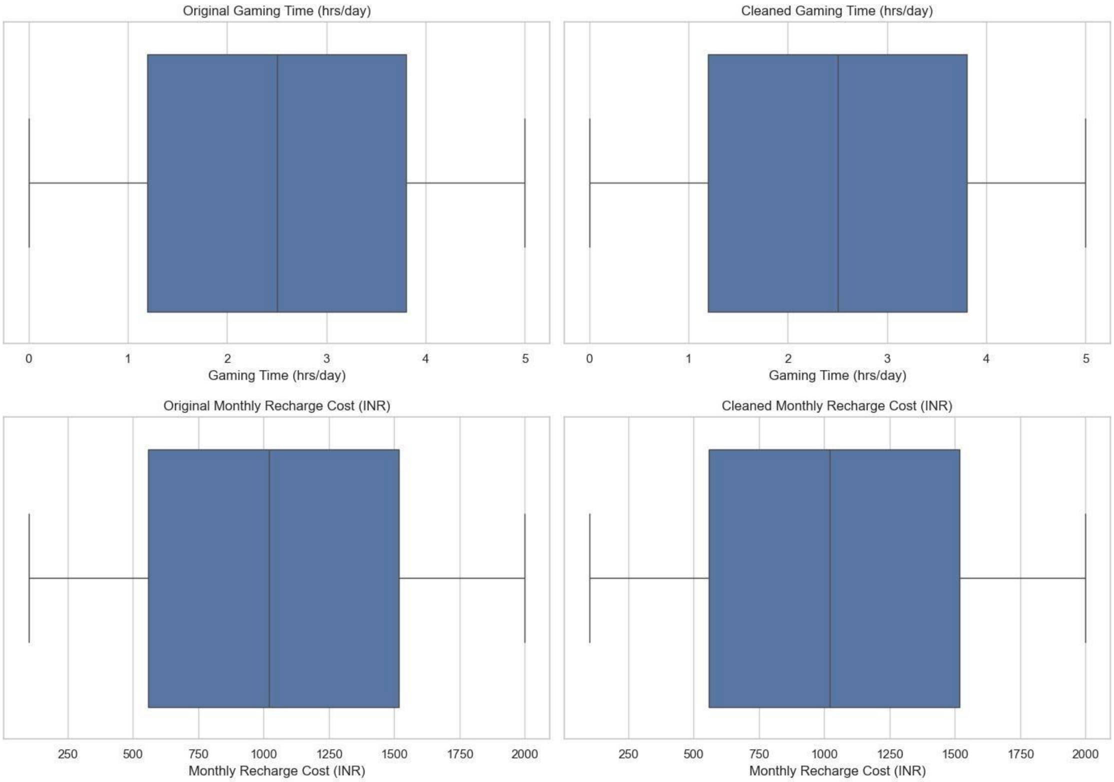



Original Data Usage (GB/month)
0
10
20
30
40
50
Data Usage (GB/month)
Cleaned Data Usage (GB/month)
0
10
20
30
40
50
Data Usage (GB/month)
Original Calls Duration (mins/day)
0
50
100
150
200
250
300
Calls Duration (mins/day)
Cleaned Calls Duration (mins/day)
0
50
100
150
200
250
300
Calls Duration (mins/day)


Original Number of Apps Installed
25
50
75
100
125
150
175
200
Number of Apps Installed
Cleaned Number of Apps Installed
25
50
75
100
125
150
175
200
Number of Apps Installed


Original Social Media Time (hrs/day)
Cleaned Social Media Time (hrs/day)
1
2
3
4
5
6
Social Media Time (hrs/day)
Original E-commerce Spend (INR/month)
Cleaned E-commerce Spend (INR/month)
0
2000
4000
6000
8000
10000
E-commerce Spend (INR/month)

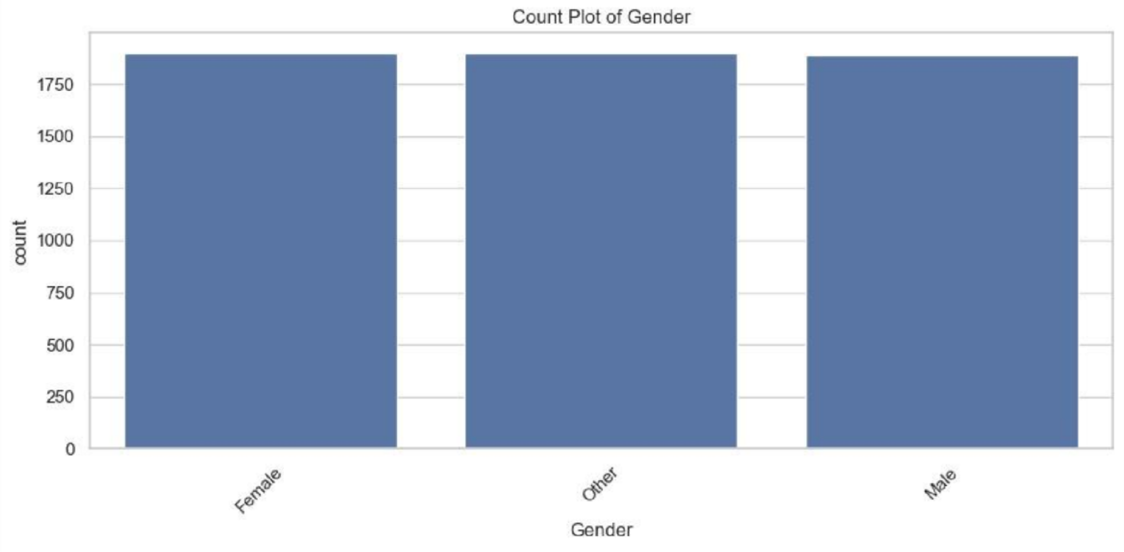

Original Streaming Time (hrs/day)
Cleaned Streaming Time (hrs/day)
1
2
3
4
5
6
7
8
Streaming Time (hrs/day)

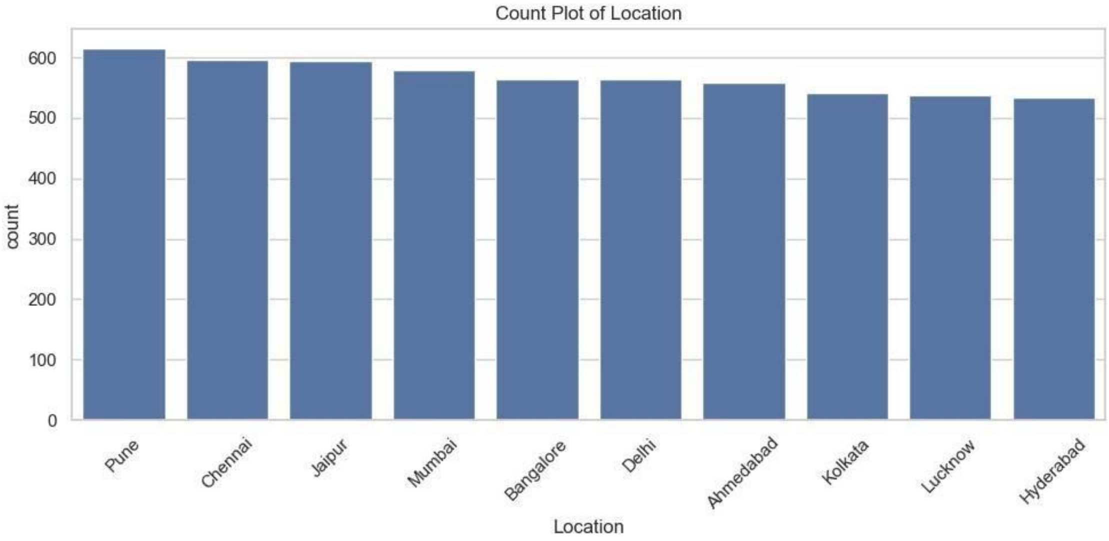

Original Gaming Time (hrs/day)
0
1
2
3
4
5
Gaming Time (hrs/day)
Cleaned Gaming Time (hrs/day)
0
1
2
3
4
5
Gaming Time (hrs/day)
Original Monthly Recharge Cost (INR)
250
500
750
1000
1250
1500
1750
2000
Monthly Recharge Cost (INR)
Cleaned Monthly Recharge Cost (INR)
250
500
750
1000
1250
1500
1750
2000
Monthly Recharge Cost (INR)

[13]:

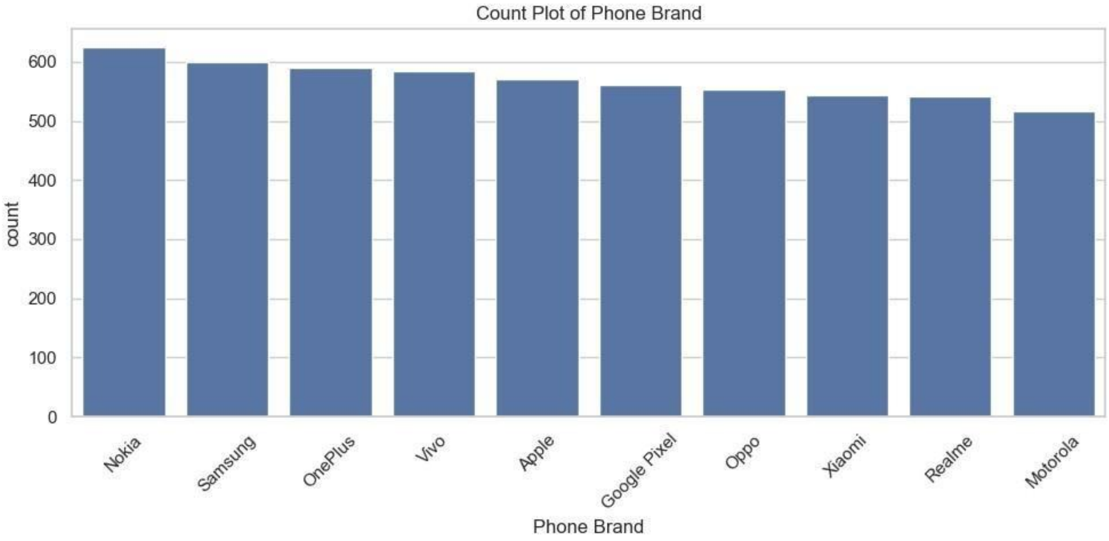
```
cat_cols   df.select_dtypes(include='object ) columns

for col in cat_cols:
    plt.figure(figsize=(10  5))
    sns.countplot(data=df, x=col, order=df[col].value_counts() index)
    plt.title(f"Count Plot of {col}")
    plt.xticks(rotation=45)
    plt.tight_layout()
    plt.show()
```

Count Plot of User ID
1.0
0.8
0.6
0.4
0.2
0.0
count
User ID

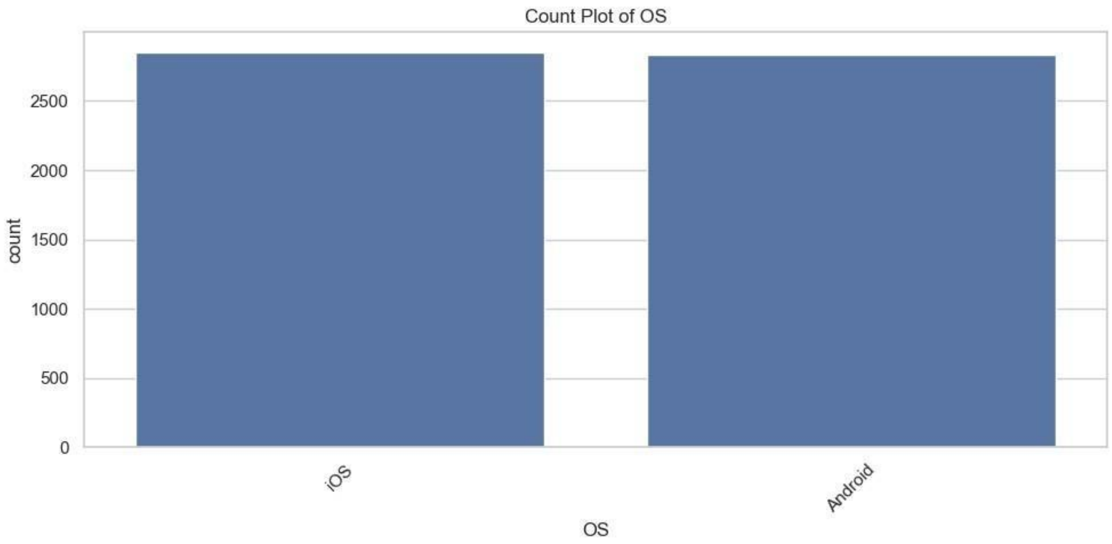


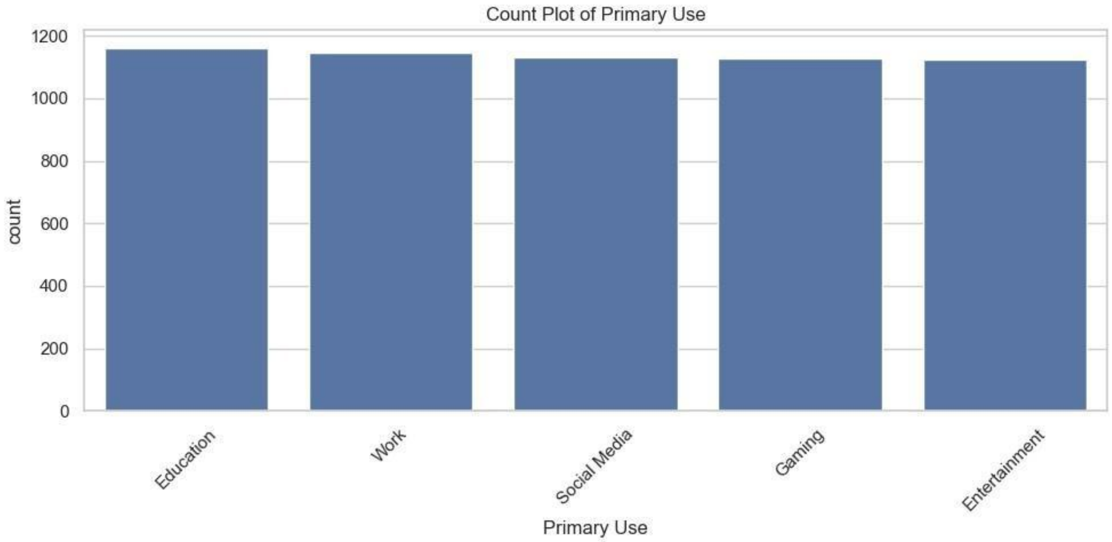


Count Plot of Location

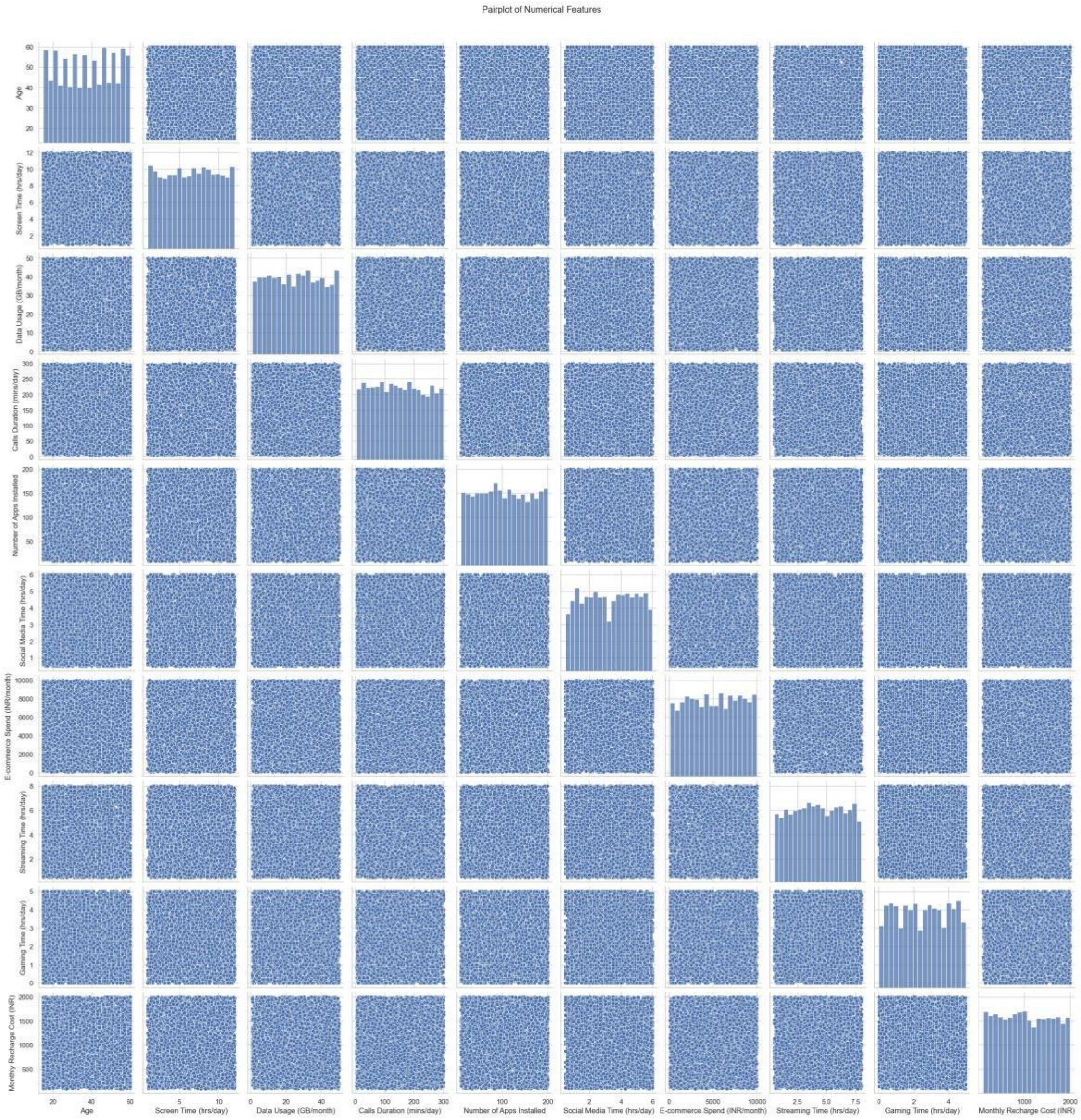


Count Plot of Phone Brand

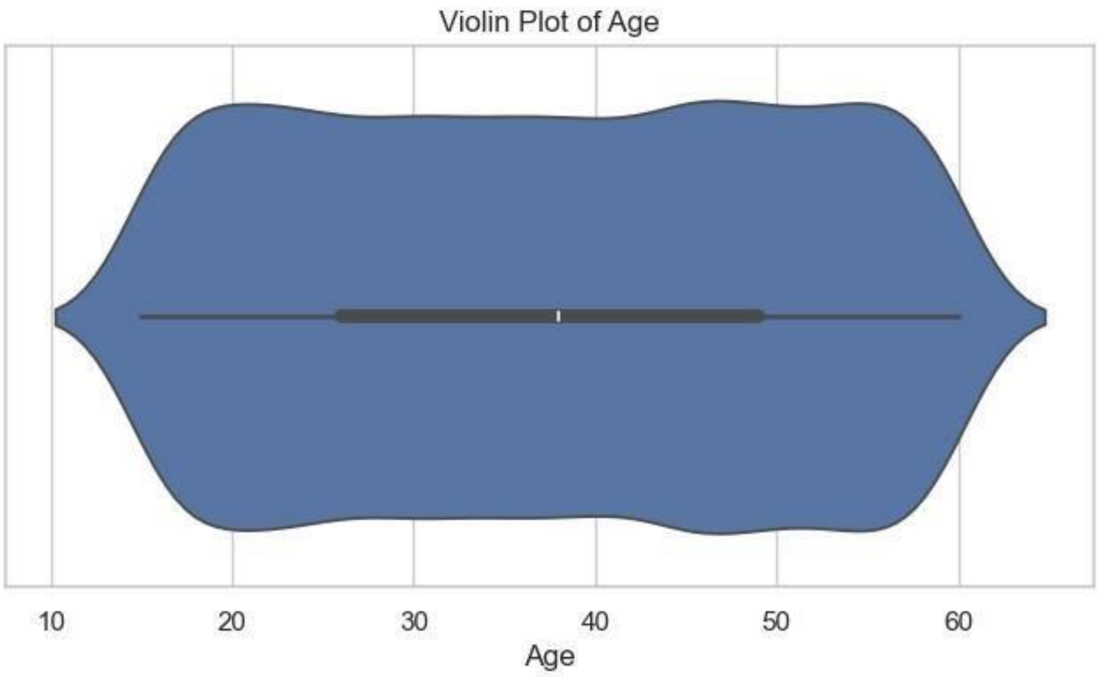


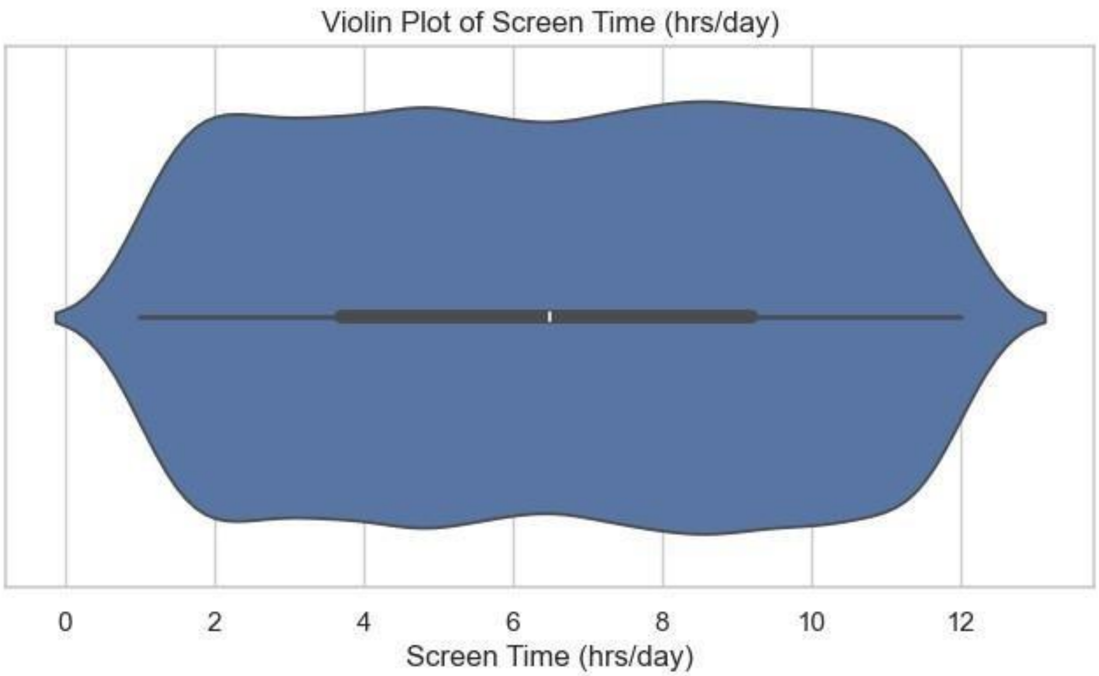


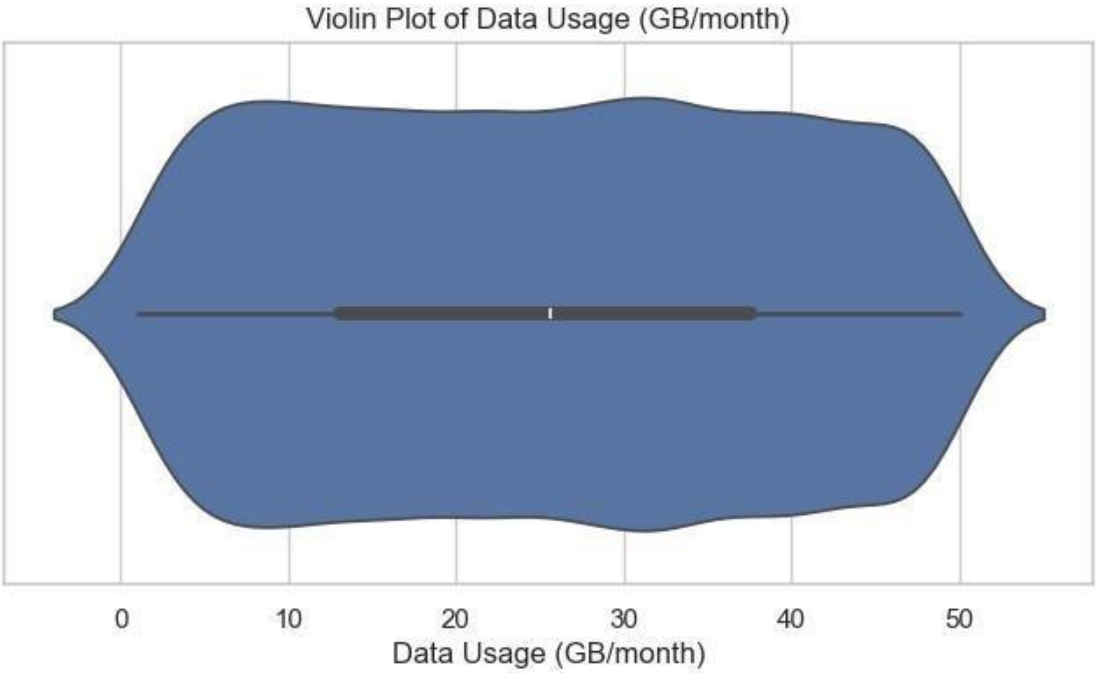
```
[14]:
sns.pairplot(df.select_dtypes(include=np.numbe
r)) plt   .suptitle("Pairplot of Numerical
Features", y=1.02) plt.show()
```

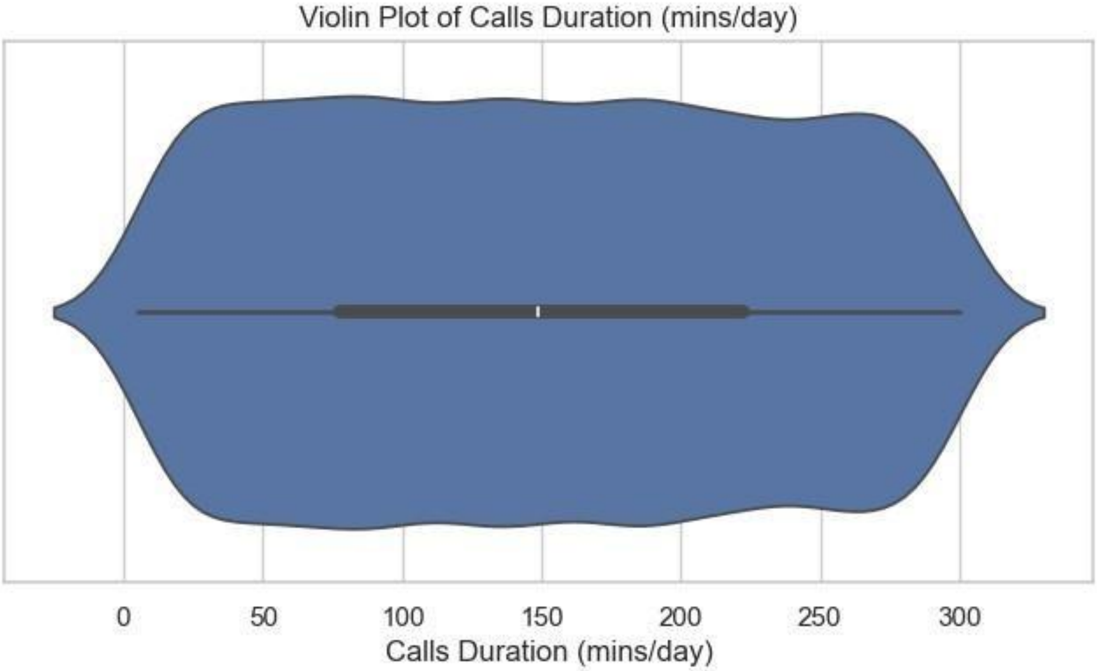


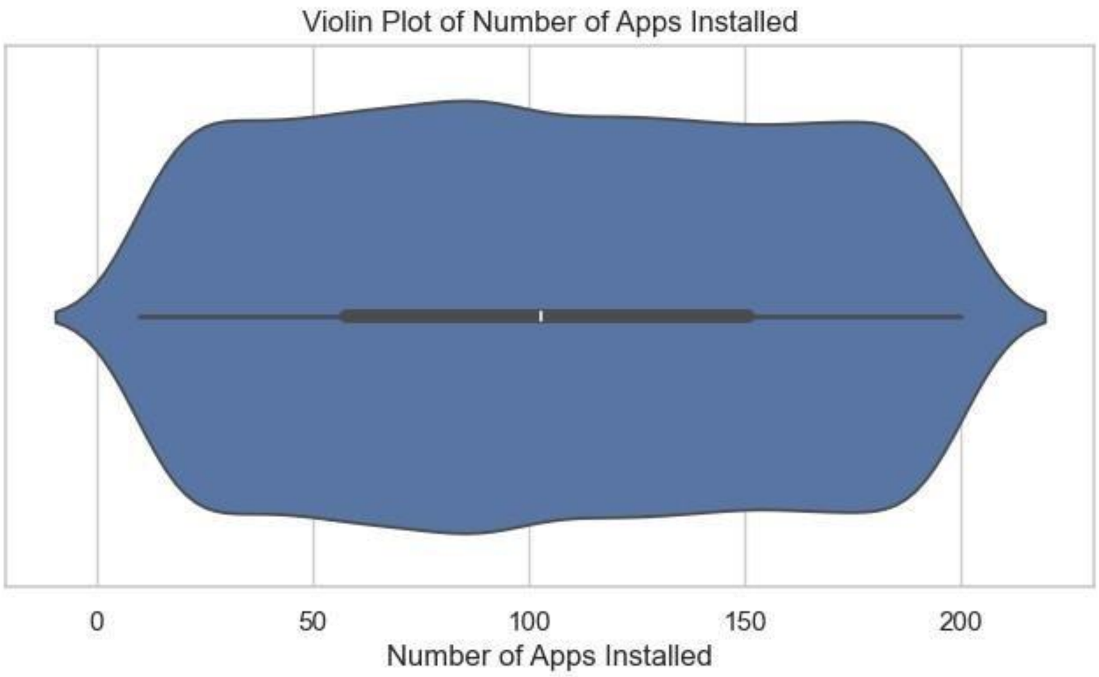
[15]:
```
for col in df.select_dtypes(include=np.number).columns:
    plt.figure(figsize=(8  4))
    sns.violinplot(x=df[col])
    plt.title(f"Violin Plot of {col}")
    plt.show()
```

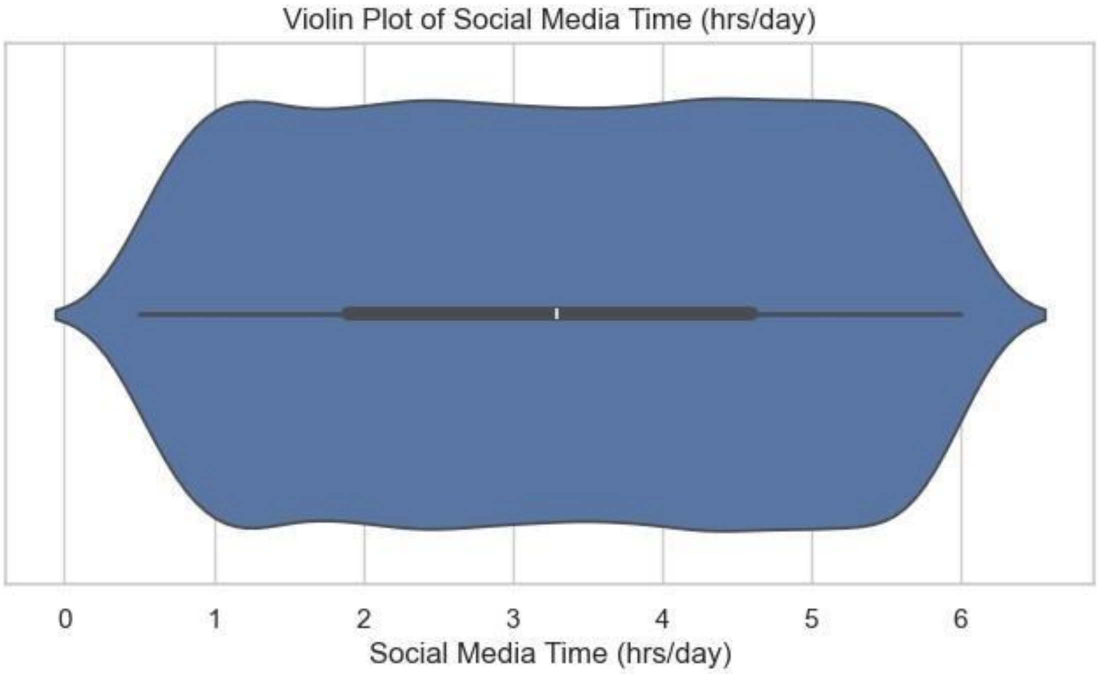

Violin Plot of Age
10
20
30
40
50
60
Age

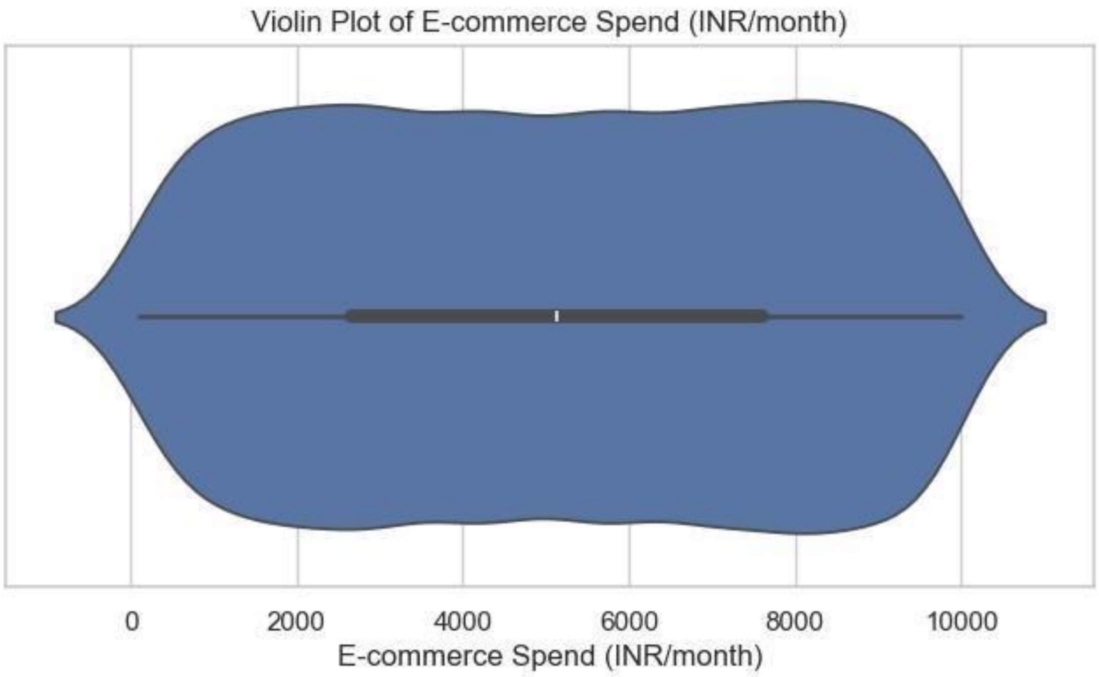

Violin Plot of Screen Time (hrs/day)
0
2
4
6
8
10
12
Screen Time (hrs/day)

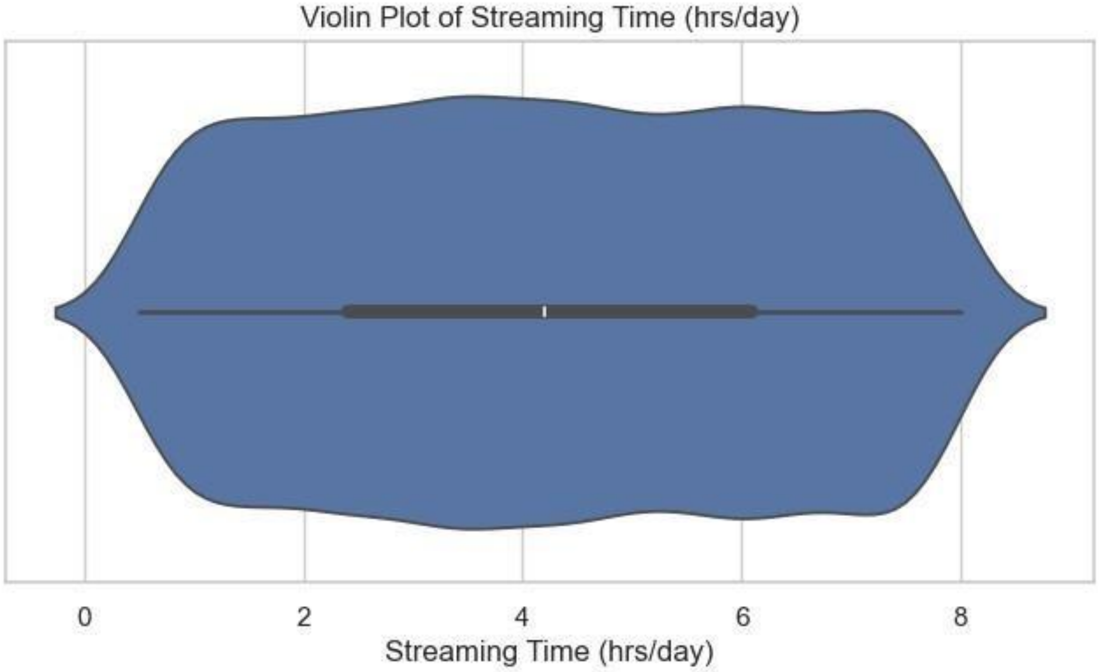

Violin Plot of Data Usage (GB/month)
0
10
20
30
40
50
Data Usage (GB/month)

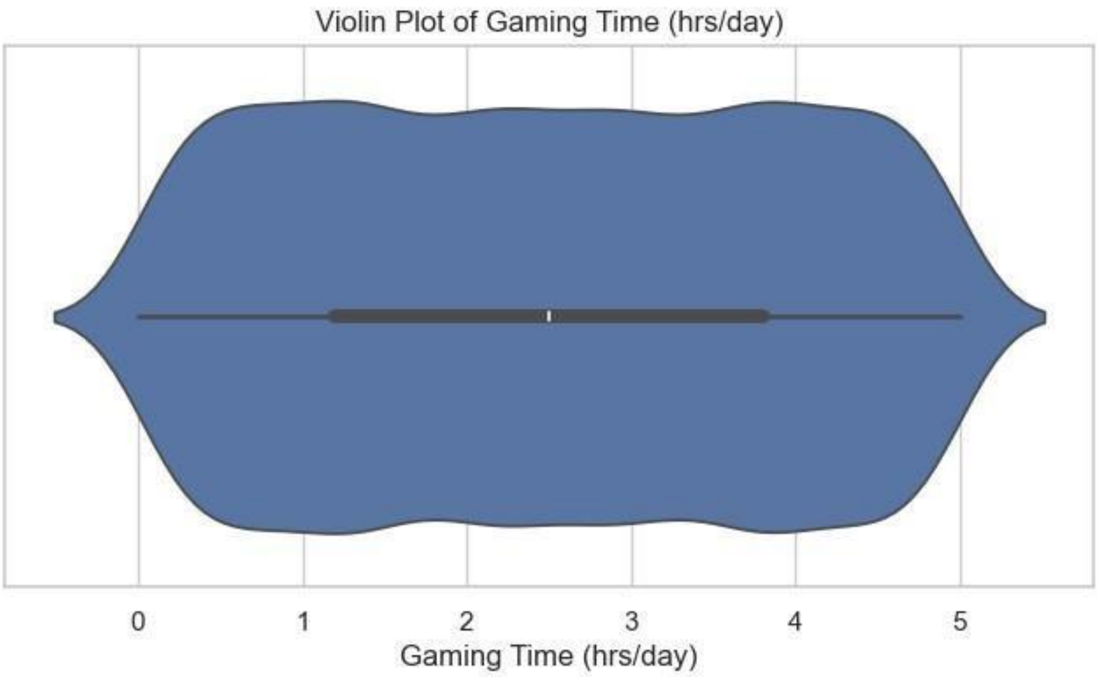

Violin Plot of Calls Duration (mins/day)
0
50
100
150
200
250
300
Calls Duration (mins/day)

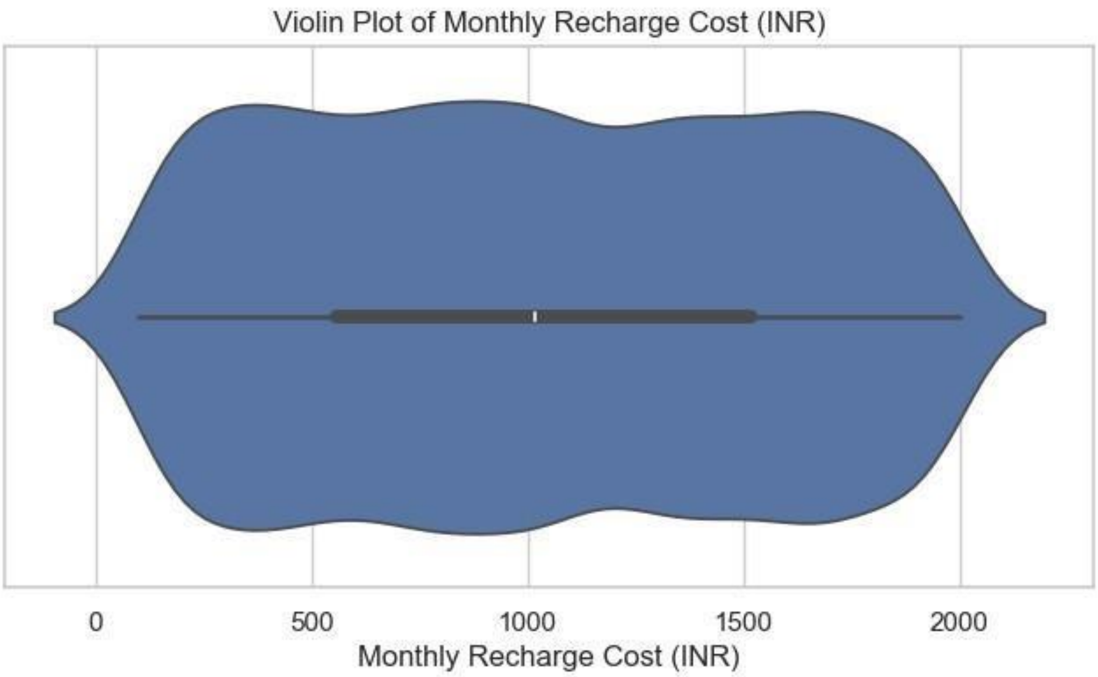

Violin Plot of Number of Apps Installed
0
50
100
150
200
Number of Apps Installed


Violin Plot of Social Media Time (hrs/day)
0
1
2
3
4
5
6
Social Media Time (hrs/day)


Violin Plot of E-commerce Spend (INR/month)
0
2000
4000
6000
8000
10000
E-commerce Spend (INR/month)


Violin Plot of Streaming Time (hrs/day)
0
2
4
6
8
Streaming Time (hrs/day)





```
[18]: # Replace 'CategoryCol' with actual categorical column
      if 'CategoryCol' in df.columns:
```

```
    for col in df select_dtypes(include=np.number).columns:
        plt.figure(figsize=(10  5))
        sns.swarmplot(x='CategoryCol'    =col, data=df)
        plt.title(f"{col} across CategoryCol")
        plt.xticks(rotation=45)
        plt.tight_layout()
        plt.show()
```

[ ]: