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

step 1: Load and explore the dataset

```
dt=pd.read_csv("googleplaystore.csv")
print(df)
```

```
                                                 App
Category  \
0         Photo Editor & Candy Camera & Grid & ScrapBook
ART_AND_DESIGN
1                                    Coloring book moana
ART_AND_DESIGN
2      U Launcher Lite – FREE Live Cool Themes, Hide ...
ART_AND_DESIGN
3                                  Sketch - Draw & Paint
ART_AND_DESIGN
4                Pixel Draw - Number Art Coloring Book
ART_AND_DESIGN
...                                                 ...
...
10836                                  Sya9a Maroc - FR
FAMILY
10837                  Fr. Mike Schmitz Audio Teachings
FAMILY
10838                           Parkinson Exercices FR
MEDICAL
10839                     The SCP Foundation DB fr nn5n
BOOKS_AND_REFERENCE
10840     iHoroscope - 2018 Daily Horoscope & Astrology
LIFESTYLE

       Rating Reviews                Size     Installs  Type Price  \
0         4.1     159                19M      10,000+  Free     0
1         3.9     967                14M     500,000+  Free     0
2         4.7   87510                8.7M   5,000,000+  Free     0
3         4.5  215644                25M  50,000,000+  Free     0
4         4.3     967                2.8M     100,000+  Free     0
...       ...     ...                 ...          ...   ...   ...
10836     4.5      38                53M       5,000+  Free     0
10837     5.0       4                3.6M        100+  Free     0
10838     NaN       3                9.5M       1,000+  Free     0
10839     4.5     114  Varies with device       1,000+  Free     0
10840     4.5  398307                19M  10,000,000+  Free     0

      Content Rating                     Genres      Last Updated  \
```

```
0           Everyone                Art & Design   January 7, 2018
1           Everyone  Art & Design;Pretend Play  January 15, 2018
2           Everyone                Art & Design    August 1, 2018
3               Teen                Art & Design      June 8, 2018
4           Everyone    Art & Design;Creativity     June 20, 2018
...              ...                         ...               ...
10836       Everyone                   Education     July 25, 2017
10837       Everyone                   Education      July 6, 2018
10838       Everyone                     Medical  January 20, 2017
10839     Mature 17+           Books & Reference  January 19, 2015
10840       Everyone                   Lifestyle     July 25, 2018

               Current Ver         Android Ver
0                    1.0.0        4.0.3 and up
1                    2.0.0        4.0.3 and up
2                    1.2.4        4.0.3 and up
3      Varies with device          4.2 and up
4                      1.1          4.4 and up
...                    ...                 ...
10836                1.48          4.1 and up
10837                   1          4.1 and up
10838                   1          2.2 and up
10839  Varies with device  Varies with device
10840  Varies with device  Varies with device

[10841 rows x 13 columns]
```

```
dt.head()
```

```
                                                 App        Category
Rating  \
0     Photo Editor & Candy Camera & Grid & ScrapBook  ART_AND_DESIGN
4.1
1                                 Coloring book moana  ART_AND_DESIGN
3.9
2  U Launcher Lite – FREE Live Cool Themes, Hide ...  ART_AND_DESIGN
4.7
3                               Sketch - Draw & Paint  ART_AND_DESIGN
4.5
4                Pixel Draw - Number Art Coloring Book  ART_AND_DESIGN
4.3

  Reviews  Size     Installs  Type Price Content Rating  \
0     159   19M      10,000+  Free     0       Everyone
1     967   14M     500,000+  Free     0       Everyone
2   87510  8.7M   5,000,000+  Free     0       Everyone
3  215644   25M  50,000,000+  Free     0           Teen
4     967  2.8M     100,000+  Free     0       Everyone

                      Genres      Last Updated         Current Ver  \
```

```
0               Art & Design   January 7, 2018               1.0.0
1  Art & Design;Pretend Play  January 15, 2018               2.0.0
2               Art & Design    August 1, 2018               1.2.4
3               Art & Design      June 8, 2018  Varies with device
4    Art & Design;Creativity     June 20, 2018                 1.1

    Android Ver
0  4.0.3 and up
1  4.0.3 and up
2  4.0.3 and up
3    4.2 and up
4    4.4 and up
```

```
dt.sample(10)  #random select in dataset
```

```
                                App       Category  Rating  Reviews  \
1563                    metroZONE      LIFESTYLE     4.1    47497
8820                DS Creator 2.0          TOOLS     1.0        2
3910              My Talking Angela         FAMILY     4.5  9876369
6892   Evolution: Battle for Utopia         FAMILY     4.2   246705
7656       Soo Co-op Mobile Banking        FINANCE     4.5      159
7875          CT MyChiroTown Mobile        MEDICAL     3.9       40
4536         Offroad Pickup Truck R          FAMILY     4.4     6367
934                          STARZ  ENTERTAINMENT     4.3    88185
2340  Pill Identifier and Drug list        MEDICAL     4.0      488
8235         DB for Fallout Shelter          FAMILY     4.0     3323

                    Size      Installs  Type Price Content Rating  \
1563                 34M   10,000,000+  Free     0       Everyone
8820                4.4M          500+  Free     0       Everyone
3910                 99M  100,000,000+  Free     0       Everyone
6892                 27M    1,000,000+  Free     0           Teen
7656                 14M        1,000+  Free     0       Everyone
7875                4.0M        5,000+  Free     0       Everyone
4536                 96M    1,000,000+  Free     0       Everyone
934   Varies with device   10,000,000+  Free     0     Mature 17+
2340                 17M      100,000+  Free     0       Everyone
8235                 47M      100,000+  Free     0       Everyone

             Genres        Last Updated         Current Ver  \
1563     Lifestyle        June 8, 2018         5.3.0.54.7
8820         Tools      March 23, 2018       2.0.180226.1
3910        Casual        July 3, 2018           3.7.2.51
6892      Strategy         May 4, 2018              3.5.2
7656       Finance  September 12, 2017             4.2.87
7875       Medical        July 7, 2015              4.1.0
4536    Simulation       July 14, 2017                1.4
934   Entertainment       June 20, 2018  Varies with device
2340       Medical      August 1, 2018                3.8
8235    Simulation      March 29, 2018                1.9
```

```
             Android Ver
1563          5.0 and up
8820          4.0 and up
3910          4.1 and up
6892        4.0.3 and up
7656        4.0.3 and up
7875        2.3.3 and up
4536          2.3 and up
934   Varies with device
2340          4.1 and up
8235          4.0 and up
```

```
dt.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10841 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             10841 non-null  object 
 1   Category        10841 non-null  object 
 2   Rating          9367 non-null   float64
 3   Reviews         10841 non-null  object 
 4   Size            10841 non-null  object 
 5   Installs        10841 non-null  object 
 6   Type            10840 non-null  object 
 7   Price           10841 non-null  object 
 8   Content Rating  10840 non-null  object 
 9   Genres          10841 non-null  object 
 10  Last Updated    10841 non-null  object 
 11  Current Ver     10833 non-null  object 
 12  Android Ver     10838 non-null  object 
dtypes: float64(1), object(12)
memory usage: 1.1+ MB
```

step 2 Data cleaning

1.covert data types for better analysis 2.Handle missing values 3.Remove duplicates 4.Detect Outliers and Remove them

1.covert data types for better analysis

```
#price
dt["Price"]= dt["Price"] . astype(str).str.replace("Everyone","0")
dt["Price"]= dt["Price"].astype(str).str.replace(r"[^\d.]",
"",regex=True)
dt["Price"] =pd.to_numeric(dt["Price"],errors='coerce')
```

```
#install
dt["Installs"] = dataset["Installs"].str.replace("free", "0")
dt["Installs"]= dt["Installs"].str.replace(r"[+,]","",regex=True)
dt["Installs"]=pd.to_numeric(dt["Installs"],errors='coerce')

dt["Last Updated"]=pd.to_datetime(dt["Last Updated"],errors="coerce")



print(dt.dtypes)
```

```
App                        object
Category                   object
Rating                    float64
Reviews                    object
Size                       object
Installs                  float64
Type                       object
Price                     float64
Content Rating             object
Genres                     object
Last Updated      datetime64[ns]
Current Ver                object
Android Ver                object
dtype: object
```

```
dt.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10357 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   App             10357 non-null  object
 1   Category        10357 non-null  object
 2   Rating          10357 non-null  float64
 3   Reviews         10357 non-null  object
 4   Size            10357 non-null  object
 5   Installs        10357 non-null  float64
 6   Type            10357 non-null  object
 7   Price           10357 non-null  float64
 8   Content Rating  10357 non-null  object
 9   Genres          10357 non-null  object
 10  Last Updated    10357 non-null  datetime64[ns]
 11  Current Ver     10357 non-null  object
 12  Android Ver     10357 non-null  object
dtypes: datetime64[ns](1), float64(3), object(9)
memory usage: 1.1+ MB
```

2.Handle missing values

```
dt.isna().sum()
```

```
App                  0
Category             0
Rating            1474
Reviews              0
Size                 0
Installs             1
Type                 1
Price                0
Content Rating       1
Genres               0
Last Updated         1
Current Ver          8
Android Ver          3
dtype: int64
```

```
dt["Rating"].fillna(dt["Rating"].median(),inplace=True)

dt["Type"].fillna(dt["Type"].mode()[0], inplace=True)

dt["Content Rating"].fillna(dt["Content Rating"].mode()
[0],inplace=True)

dt["Current Ver"].fillna(dt["Current Ver"].mode()[0],inplace=True)

dt["Android Ver"].fillna(dt["Android Ver"].mode()[0],inplace=True)

dt["Last Updated"].fillna(dt["Last Updated"].mode()[0],inplace=True)

dt.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10841 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   App             10841 non-null  object
 1   Category        10841 non-null  object
 2   Rating          10841 non-null  float64
 3   Reviews         10841 non-null  object
 4   Size            10841 non-null  object
 5   Installs        10840 non-null  float64
 6   Type            10841 non-null  object
 7   Price           10841 non-null  float64
 8   Content Rating  10841 non-null  object
 9   Genres          10841 non-null  object
 10  Last Updated    10841 non-null  datetime64[ns]
 11  Current Ver     10841 non-null  object
 12  Android Ver     10841 non-null  object
```

```
dtypes: datetime64[ns](1), float64(3), object(9)
memory usage: 1.1+ MB
```

```
dt.isna().sum()
```

```
App                0
Category           0
Rating             0
Reviews            0
Size               0
Installs           1
Type               0
Price              0
Content Rating     0
Genres             0
Last Updated       0
Current Ver        0
Android Ver        0
dtype: int64
```

3.Remove duplicates

```
dt.duplicated().sum()
```

```
0
```

```
dt=dt.drop_duplicates(keep='first')
```

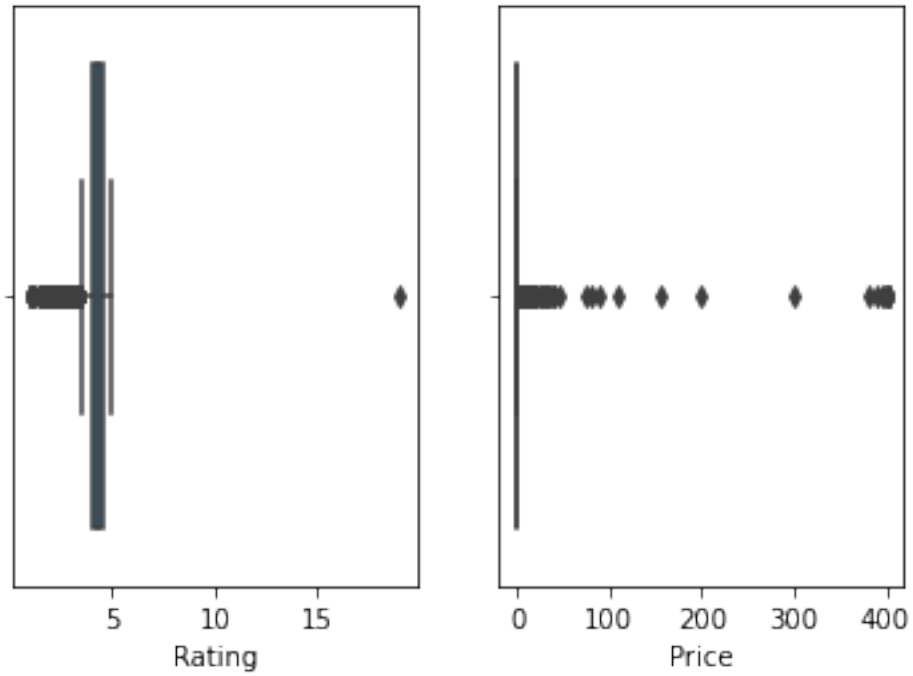
4.Detect Outliers and Remove them

```
dt.describe()
```

```
              Rating      Installs          Price
count  10358.000000  1.035700e+04  10358.000000
mean       4.205165  1.415776e+07      1.030701
std        0.506868  8.023955e+07     16.277843
min        1.000000  0.000000e+00      0.000000
25%        4.100000  1.000000e+03      0.000000
50%        4.300000  1.000000e+05      0.000000
75%        4.500000  1.000000e+06      0.000000
max       19.000000  1.000000e+09    400.000000
```

```
plt.subplot(1,2,1)
sns.boxplot(dt['Rating'])
plt.subplot(1,2,2)
sns.boxplot(dt["Price"])
plt.show()
```

```
C:\Users\user\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From
version 0.12, the only valid positional argument will be `data`, and
passing other arguments without an explicit keyword will result in an
error or misinterpretation.
  warnings.warn(
C:\Users\user\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From
version 0.12, the only valid positional argument will be `data`, and
passing other arguments without an explicit keyword will result in an
error or misinterpretation.
  warnings.warn(
```



Lets understand and handle RATING column first for Outlier detection

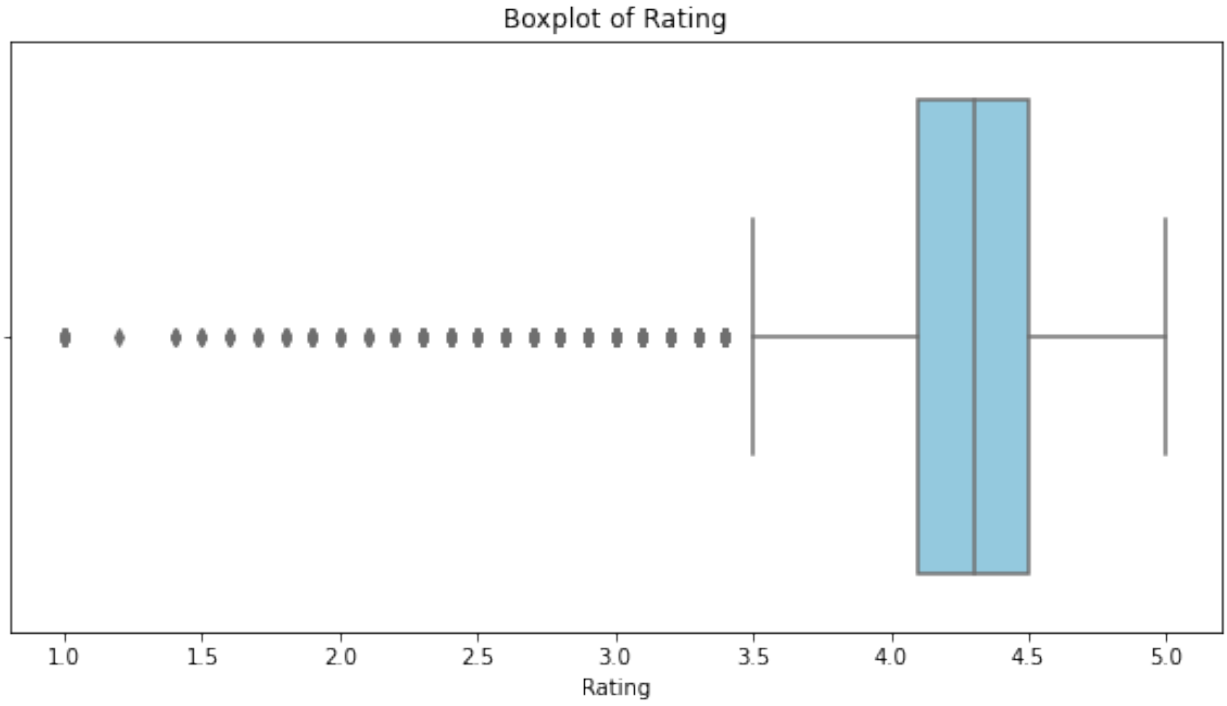
```
(dt["Rating"]>5).sum() # only one value is greater than 5 and its
outlier ,we will remove it
```

```
1
```

```
dt=dt[dt["Rating"]<=5]
```

```
plt.figure(figsize=(10,5))
sns.boxplot(x=dt["Rating"],color="skyblue")
```

```
plt.title("Boxplot of Rating")
plt.show()
```



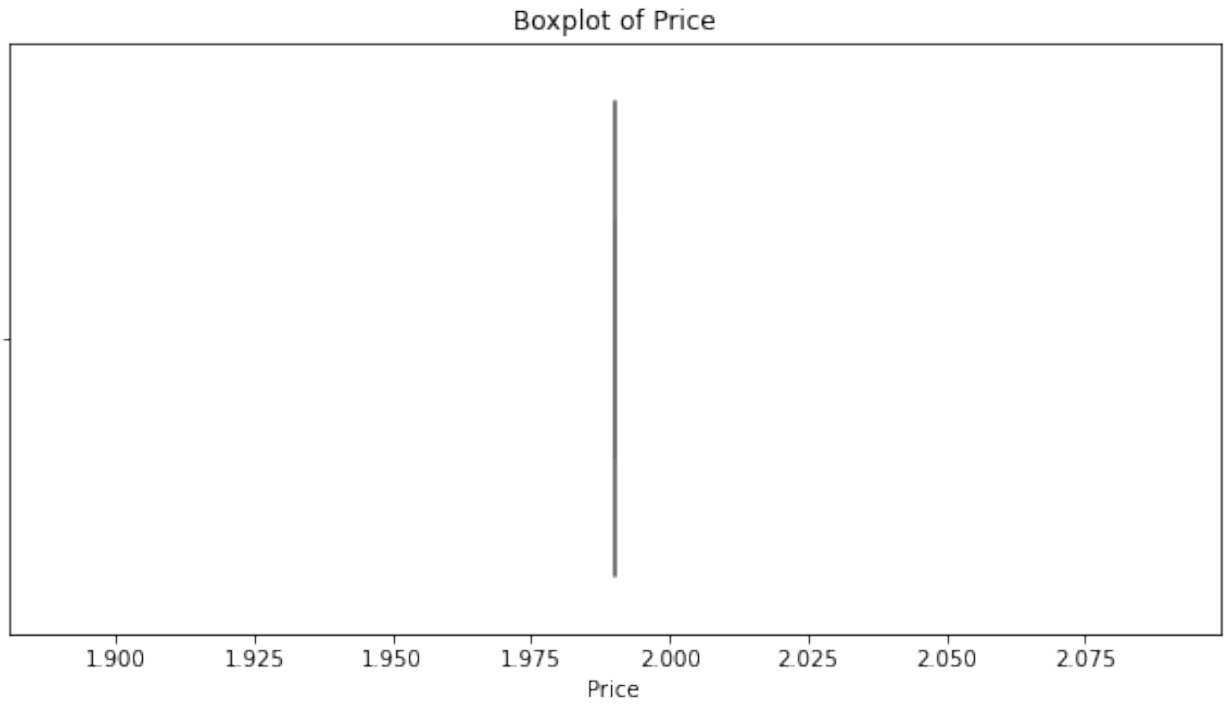

```
##Capping if price column outliers using  percentile method

upper_limit=dt["Price"].quantile(0.95) #set upper limit at 95th
percentile
upper_limit
```

```
1.99
```

```
dt["Price"]=dt["Price"].clip(upper=upper_limit)#cap value above 95th
percentile
```

```
C:\Users\user\AppData\Local\Temp\ipykernel_23456\1325210236.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
  dt["Price"]=dt["Price"].clip(upper=upper_limit)#caping
```

```
plt.figure(figsize=(10,5))
sns.boxplot(x=dt["Price"],color="skyblue")
plt.title("Boxplot of Price")
plt.show()
```



3.Buisness Questions for Analysis

Q.1 what is the averge rating of apps on the play store(non-graphical)

```
avg_rating=dt["Rating"].mean()
print(f"average rating of apps on the Play Store :{avg_rating:.2f}")
```

```
average rating of apps on the Play Store :4.20
```

Q.2 What percentage of apps are free vs paid.

```
total_apps= dt.shape[0]
free_apps=dt[dt["Type"] == "Free"].shape[0]
paid_apps=dt[dt["Type"] == "Paid"].shape[0]
free_apps_percentage=(free_apps/total_apps)*100
paid_apps_percentage=(paid_apps/total_apps)*100

print(f"Free Apps Percentage:{free_apps_percentage:.2f}%")
print(f"Paid Apps percentage:{paid_apps_percentage:.2f}%")
```

```
Free Apps Percentage:92.61%
Paid Apps percentage:7.39%
```

```
3.What is the most common app category.
```

```
most_common_app_cat= dt["Category"].value_counts()
most_common_app_cat
```

```
FAMILY                 1943
GAME                   1121
TOOLS                   843
BUSINESS                427
MEDICAL                 408
PRODUCTIVITY            407
PERSONALIZATION         388
LIFESTYLE               373
COMMUNICATION           366
FINANCE                 360
SPORTS                  351
PHOTOGRAPHY             322
HEALTH_AND_FITNESS      306
SOCIAL                  280
NEWS_AND_MAGAZINES      264
TRAVEL_AND_LOCAL        237
BOOKS_AND_REFERENCE     230
SHOPPING                224
DATING                  196
VIDEO_PLAYERS           175
MAPS_AND_NAVIGATION     137
EDUCATION               130
FOOD_AND_DRINK          124
ENTERTAINMENT           111
AUTO_AND_VEHICLES        85
LIBRARIES_AND_DEMO       85
WEATHER                  82
HOUSE_AND_HOME           80
ART_AND_DESIGN           65
EVENTS                   64
PARENTING                60
COMICS                   60
BEAUTY                   53
Name: Category, dtype: int64
```

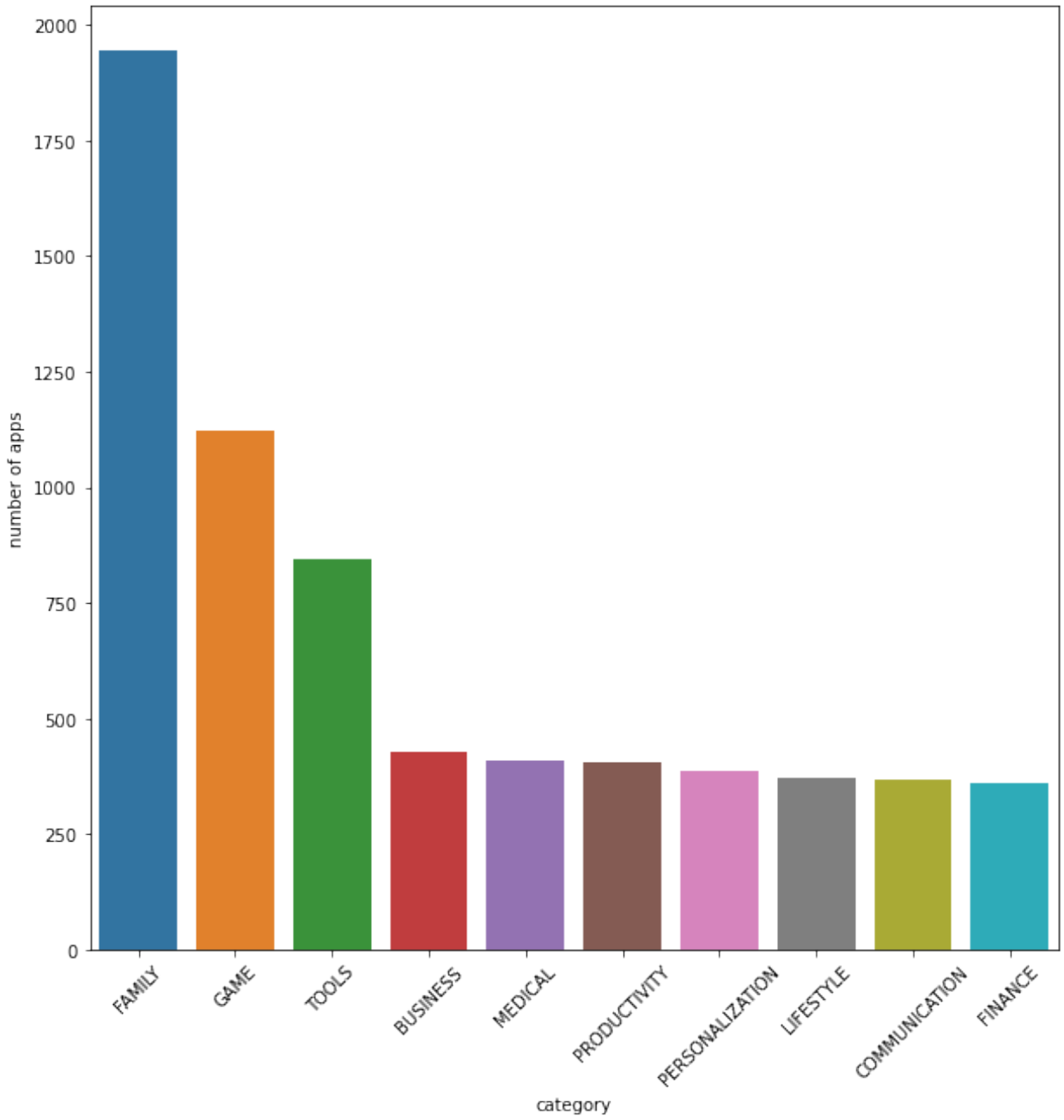
```
most_common_app_cat_name= dt["Category"].value_counts().idxmax()
print(f"most_common_app_cat:{most_common_app_cat_name}")
```

```
most_common_app_cat:FAMILY
```

Q.4 Which app category has the highest number of apps?(categorical variables)

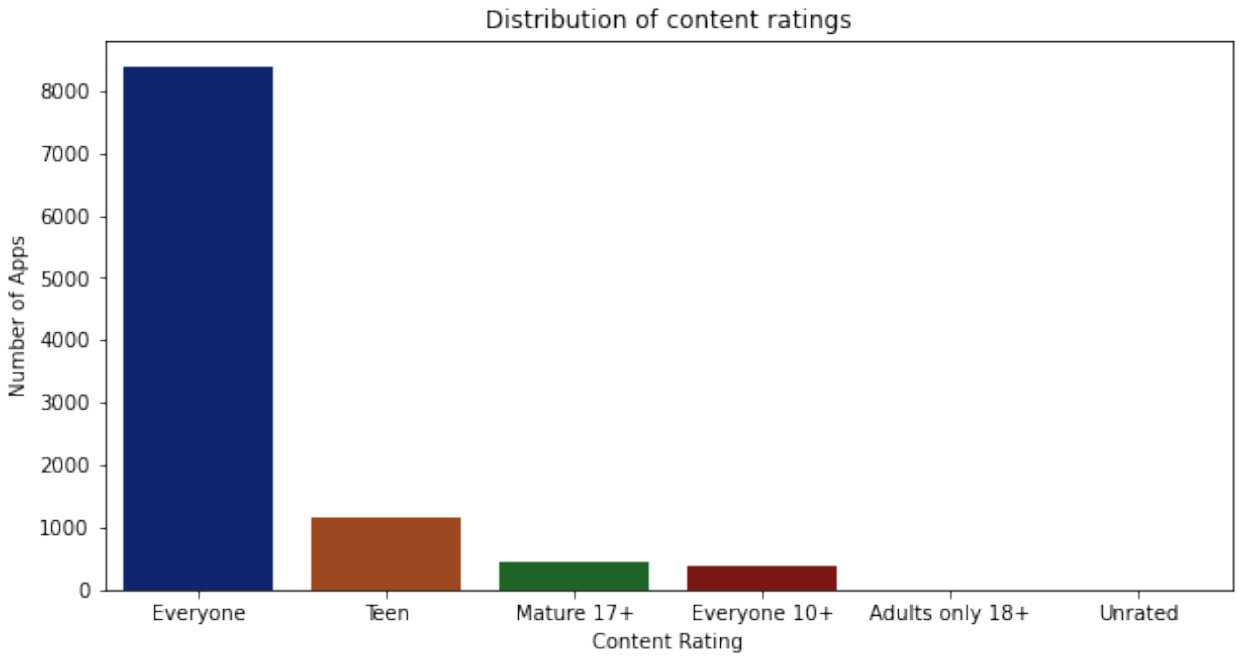
```
most_common_app_cat = dt["Category"].value_counts().head(10)#top ten
name
plt.figure(figsize=(10,10))
```

```
sns.barplot(x=most_common_app_cat.index,y=most_common_app_cat.values)
plt.xticks(rotation=45)
plt.xlabel("category")
plt.ylabel("number of apps")

Text(0, 0.5, 'number of apps')
```



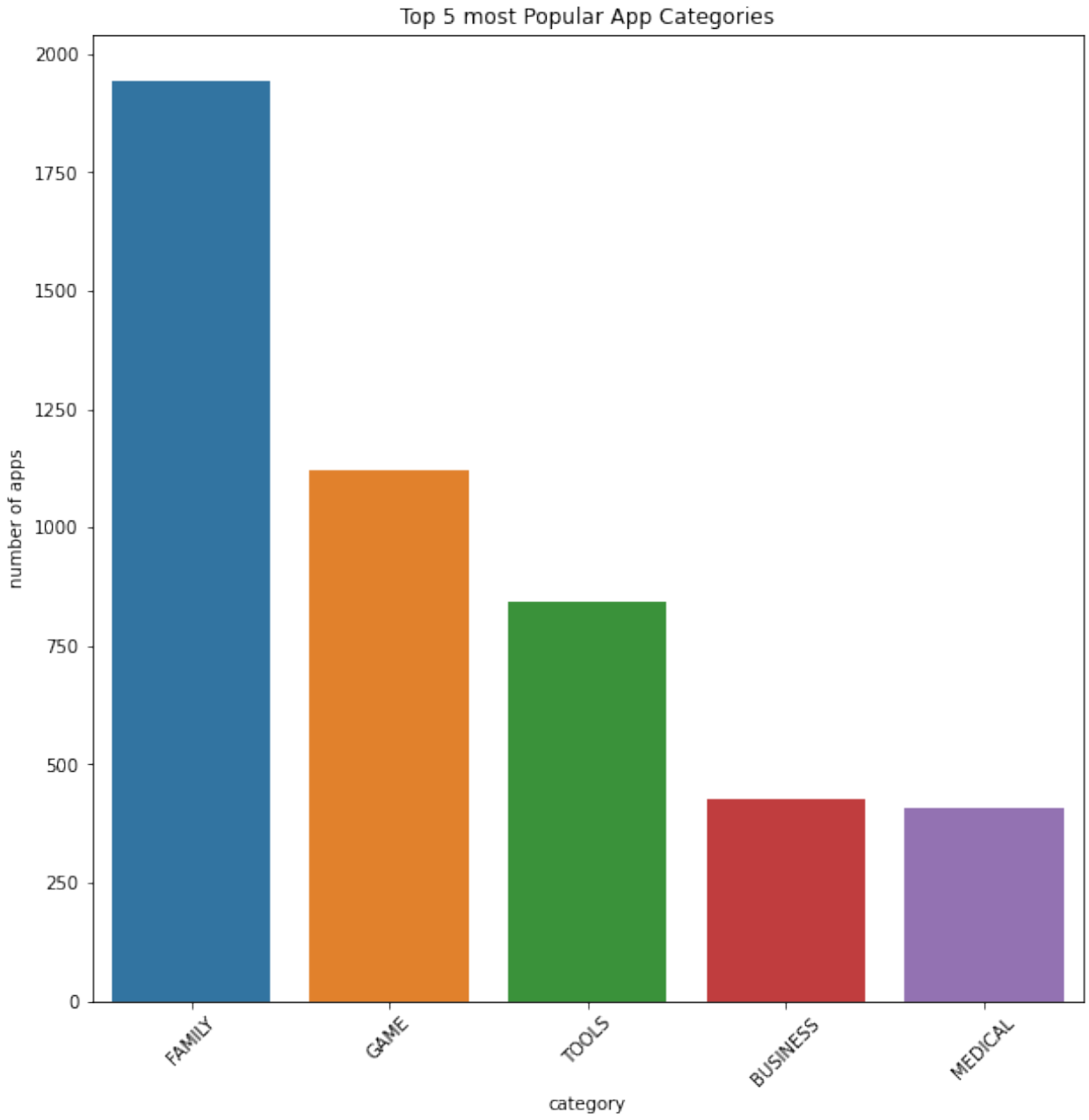
Q.5 WHAT IS THE distribution of content ratings?

```
content_Rating =dt["Content Rating"].value_counts()# for counts
plt.figure(figsize=(10,5))
sns.barplot(x=content_Rating.index ,y=content_Rating.values ,palette='
dark')
plt.xlabel("Content Rating")
plt.title("Distribution of content ratings")
plt.ylabel("Number of Apps")
plt.show()#rating is the most common
```



1. How many apps belong to the 5 most popular categories?

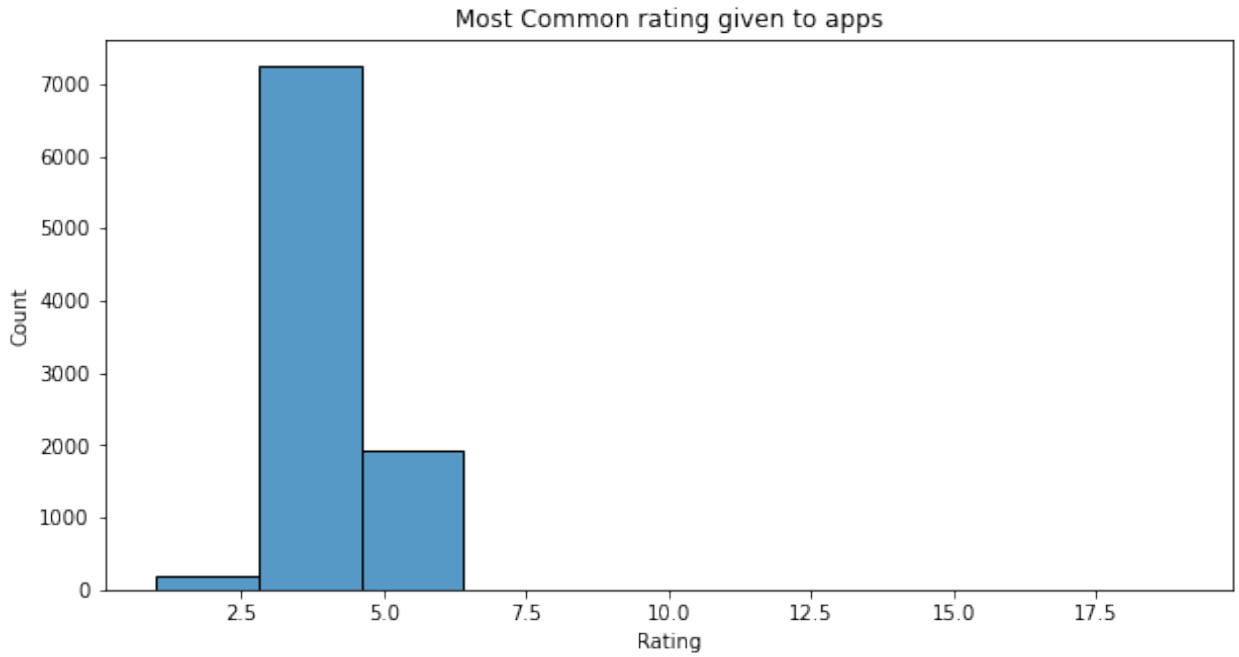
```
most_common_app_cat = dt["Category"].value_counts().head(5)#top ten
name
plt.figure(figsize=(10,10))
sns.barplot(x=most_common_app_cat.index,y=most_common_app_cat.values)
plt.xticks(rotation=45)
plt.title("Top 5 most Popular App Categories")
plt.xlabel("category")
plt.ylabel("number of apps")

Text(0, 0.5, 'number of apps')
```



Q.7 What is the most common rating given to apps?(Numerical variables)

```
plt.figure(figsize=(10,5))
sns.histplot(dataset['Rating'],bins=10)
plt.title("Most Common rating given to apps")
```

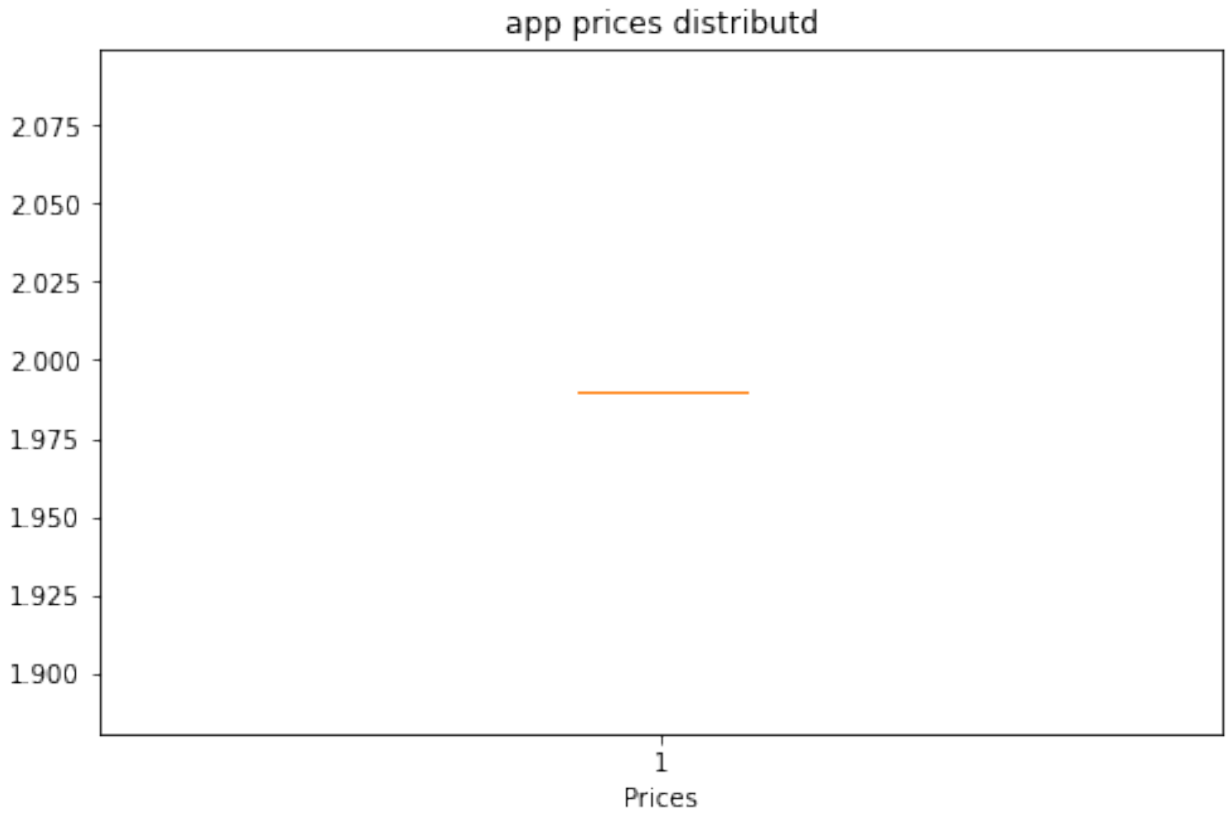
```
Text(0.5, 1.0, 'Most Common rating given to apps')
```



Q.8 How are app prices distributed?

```
plt.figure(figsize=(8,5))
plt.boxplot(dt["Price"])
plt.title("app prices distributd")
plt.xlabel("Prices")
plt.show
```

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



Q.9 Do free apps have better ratings than paid apps?(Numerical vs CAtegorical)

```
free_apps_avg_rating=dt[dt["Type"]=="Free"]["Rating"].mean()
paid_apps_avg_rating=dt[dt["Type"]=="Paid"]["Rating"].mean()
print(f"Averge Rating for free Apps:{free_apps_avg_rating:.2f}")
print(f"Averge Rating For Paid Apps:{free_apps_avg_rating:.2f}")
```

```
Averge Rating for free Apps:4.20
Averge Rating For Paid Apps:4.20
```

Q.10 which app categories have the highest averge ratings?

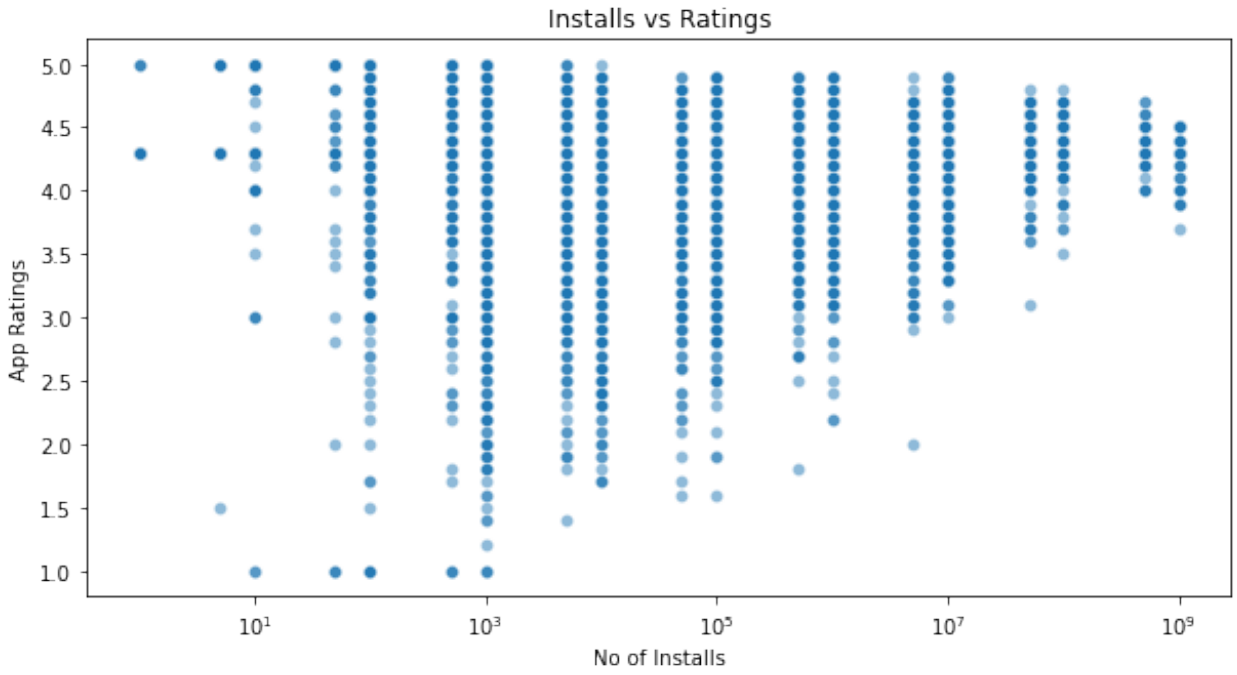
```
category_avg_rating =dt.groupby("Category")
["Rating"].mean().sort_values(ascending=False)
category_avg_rating.head(10)
```

```
Category
EVENTS                 4.395313
EDUCATION              4.375385
ART_AND_DESIGN         4.355385
BOOKS_AND_REFERENCE    4.336522
PERSONALIZATION        4.327062
PARENTING              4.300000
```

```
BEAUTY                 4.283019
GAME                   4.282070
HEALTH_AND_FITNESS     4.266993
SOCIAL                 4.260714
Name: Rating, dtype: float64
```

Q.11 does a higher number of innstalls correlate with higher ratings?

```
plt.figure(figsize=(10,5))
sns.scatterplot(x=dt["Installs"],y=dt["Rating"],alpha=0.5)
plt.title("Installs vs Ratings")
plt.xscale("log")

plt.xlabel("No of Installs")
plt.ylabel("App Ratings")
plt.show() # strong correlation between installs and ratings.
```



Q.12 Do paid apps generate more installs than free apps?

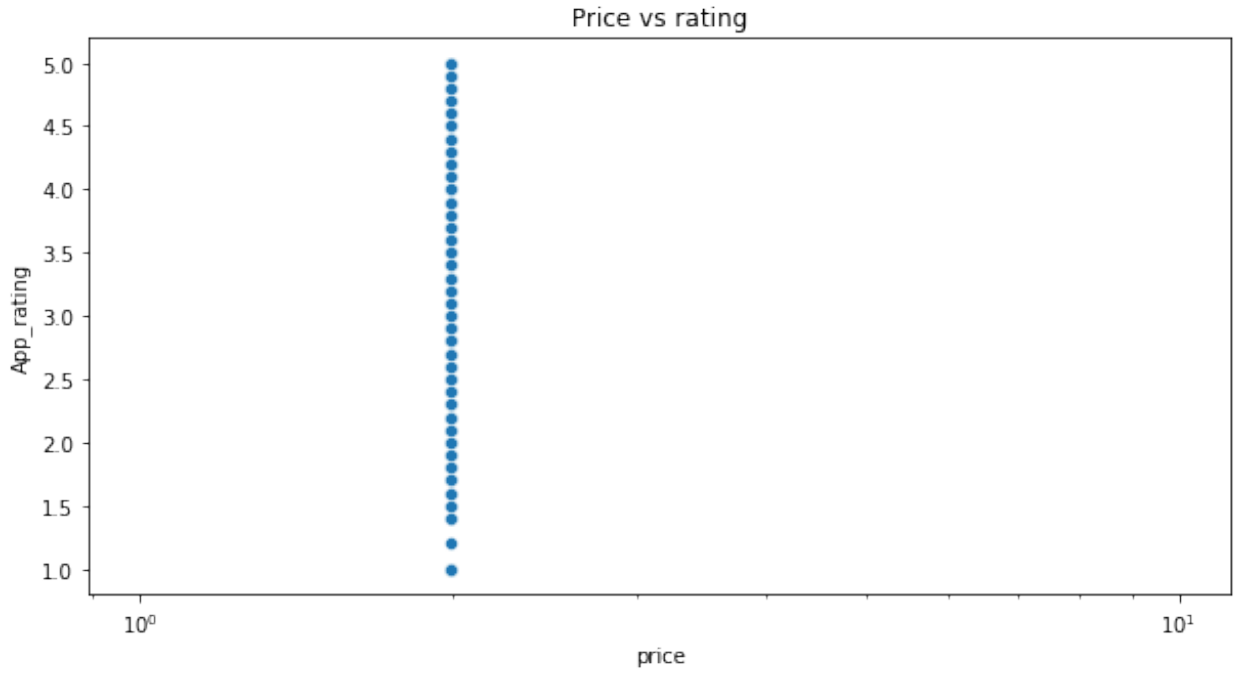
```
free_installs=dt[dt["Type"]=="Free"]["Installs"].mean()
paid_installs=dt[dt["Type"]=="Paid"]["Installs"].mean()
print(f"Average Installs of free Apps:{free_installs:.2f}")
print(f"Average Installs of Paid Apps:{paid_installs:.2f}")
```

```
Average Installs of free Apps:15279679.80
Average Installs of Paid Apps:90491.35
```

Q.13 Are expensive apps rated higher than free apps?

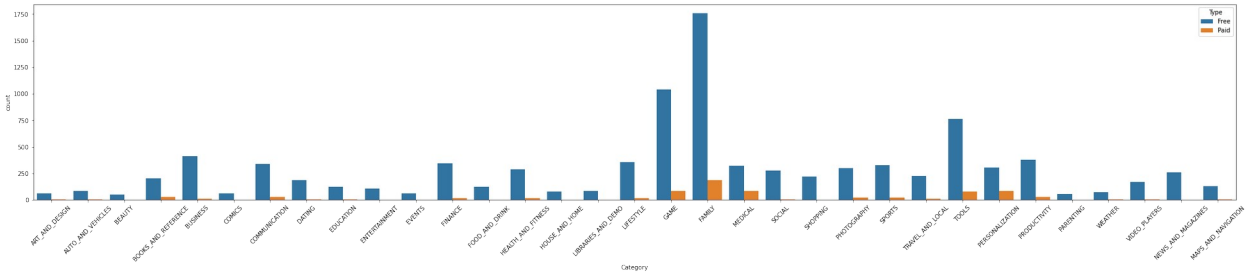
```
plt.figure(figsize=(10,5))
sns.scatterplot(x=dt["Price"],y=dt["Rating"])
plt.title("Price vs rating")
plt.xscale("log")
plt.xlabel("price")
plt.ylabel("App_rating")

plt.show
```

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



Q.14 which categories have the most paid apps?(Categorical vs categorical)

```
plt.figure(figsize=(36,6))
sns.countplot(x="Category",hue="Type",data=dt)
plt.xticks(rotation=45)
plt.show()
```



Thank you