In [1]:

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

1) Load the data file using pandas.

In [2]:

```
dataapp=pd.read_csv("googleplaystore.csv")
```

In [3]:

```
dataapp.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
```

2) Check for null values in the data. Get the number of null values for each column.

In [4]:

```
dataapp.isnull().sum()
```

Out[4]:

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

3)Drop records with nulls in any of the columns

In [5]:
```
dataapp.dropna(inplace=True)
```

In [6]:
```
dataapp.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 9360 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             9360 non-null   object 
 1   Category        9360 non-null   object 
 2   Rating          9360 non-null   float64
 3   Reviews         9360 non-null   object 
 4   Size            9360 non-null   object 
 5   Installs        9360 non-null   object 
 6   Type            9360 non-null   object 
 7   Price           9360 non-null   object 
 8   Content Rating  9360 non-null   object 
 9   Genres          9360 non-null   object 
 10  Last Updated    9360 non-null   object 
 11  Current Ver     9360 non-null   object 
 12  Android Ver     9360 non-null   object 
dtypes: float64(1), object(12)
memory usage: 1023.8+ KB
```

In [7]:
```
dataapp.isnull().sum()
```

Out[7]:
```
App               0
Category          0
Rating            0
Reviews           0
Size              0
Installs          0
Type              0
Price             0
Content Rating    0
Genres            0
Last Updated      0
Current Ver       0
Android Ver       0
dtype: int64
```

4) Variables seem to have incorrect type and inconsistent formatting. You need to fix them:

Size column has sizes in Kb as well as Mb. To analyze, you'll need to convert these to numeric.

Extract the numeric value from the column

Multiply the value by 1,000, if size is mentioned in Mb

Reviews is a numeric field that is loaded as a string field. Convert it to numeric (int/float).

Installs field is currently stored as string and has values like 1,000,000+.

Treat 1,000,000+ as 1,000,000

remove ‘+’, ‘,’ from the field, convert it to integer

Price field is a string and has $symbol. Remove“$' sign, and convert it to numeric.

In [8]:
```
dataapp.dtypes
```

Out[8]:
```
App                object
Category           object
Rating            float64
Reviews            object
Size               object
Installs           object
Type               object
Price              object
Content Rating     object
Genres             object
Last Updated       object
Current Ver        object
Android Ver        object
dtype: object
```

In [9]:
```
dataapp.head()
```

Out[9]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Ar
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	Desi
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0	Everyone	Ar
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	Ar
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Everyone	Desigı

In [10]:

```
dataapp.Size
```

Out[10]:

```
0                      19M
1                      14M
2                     8.7M
3                      25M
4                     2.8M
                ...
10834                 2.6M
10836                  53M
10837                 3.6M
10839   Varies with device
10840                  19M
Name: Size, Length: 9360, dtype: object
```

In [11]:

```
dataapp["Size"] = [float(i.split('M')[0]) if 'M' in i else float(0) for i in dataa
```

In [12]:

```
dataapp.head()
```

Out[12]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19.0	10,000+	Free	0	Everyone	Art
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500,000+	Free	0	Everyone	Desig
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7	5,000,000+	Free	0	Everyone	Art
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25.0	50,000,000+	Free	0	Teen	Art
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8	100,000+	Free	0	Everyone	Design

In [13]:

```
dataapp.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 9360 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             9360 non-null   object 
 1   Category        9360 non-null   object 
 2   Rating          9360 non-null   float64
 3   Reviews         9360 non-null   object 
 4   Size            9360 non-null   float64
 5   Installs        9360 non-null   object 
 6   Type            9360 non-null   object 
 7   Price           9360 non-null   object 
 8   Content Rating  9360 non-null   object 
 9   Genres          9360 non-null   object 
 10  Last Updated    9360 non-null   object 
 11  Current Ver     9360 non-null   object 
 12  Android Ver     9360 non-null   object 
dtypes: float64(2), object(11)
memory usage: 1023.8+ KB
```

In [14]:
```
dataapp["Size"]=dataapp["Size"]*1000
```

In [15]:
```
dataapp.head()
```

Out[15]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19000.0	10,000+	Free	0	Everyone	
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14000.0	500,000+	Free	0	Everyone	D
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8700.0	5,000,000+	Free	0	Everyone	
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25000.0	50,000,000+	Free	0	Teen	
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2800.0	100,000+	Free	0	Everyone	Des

In [16]:
```
dataapp.Size
```

Out[16]:

```
0        19000.0
1        14000.0
2         8700.0
3        25000.0
4         2800.0
          ...
10834     2600.0
10836    53000.0
10837     3600.0
10839        0.0
10840    19000.0
Name: Size, Length: 9360, dtype: float64
```

In [17]:

```
dataapp["Reviews"]=dataapp["Reviews"].astype(int)
```

In [18]:

```
dataapp.Reviews
```

Out[18]:

```
0           159
1           967
2         87510
3        215644
4           967
          ...
10834         7
10836        38
10837         4
10839       114
10840    398307
Name: Reviews, Length: 9360, dtype: int32
```

In [19]:

```
dataapp["Installs"]=[float(i.replace('+','').replace(',','')) if '+' in i or ',' i
```

In [20]:

```
dataapp.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 9360 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             9360 non-null   object 
 1   Category        9360 non-null   object 
 2   Rating          9360 non-null   float64
 3   Reviews         9360 non-null   int32  
 4   Size            9360 non-null   float64
 5   Installs        9360 non-null   float64
 6   Type            9360 non-null   object 
 7   Price           9360 non-null   object 
 8   Content Rating  9360 non-null   object 
 9   Genres          9360 non-null   object 
 10  Last Updated    9360 non-null   object 
 11  Current Ver     9360 non-null   object 
 12  Android Ver     9360 non-null   object 
dtypes: float64(3), int32(1), object(9)
memory usage: 987.2+ KB
```

In [21]:

```
dataapp["Installs"]=dataapp["Installs"].astype(int)
```

In [22]:

```
dataapp.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 9360 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             9360 non-null   object 
 1   Category        9360 non-null   object 
 2   Rating          9360 non-null   float64
 3   Reviews         9360 non-null   int32  
 4   Size            9360 non-null   float64
 5   Installs        9360 non-null   int32  
 6   Type            9360 non-null   object 
 7   Price           9360 non-null   object 
 8   Content Rating  9360 non-null   object 
 9   Genres          9360 non-null   object 
 10  Last Updated    9360 non-null   object 
 11  Current Ver     9360 non-null   object 
 12  Android Ver     9360 non-null   object 
dtypes: float64(2), int32(2), object(9)
memory usage: 950.6+ KB
```

In [23]:

```
dataapp["Price"]=[float(i.replace("$","")) if "$" in i else float(0) for i in data
```

In [24]:

```
dataapp["Price"]=dataapp["Price"].astype(int)
```

5) Sanity checks:

5.1) Average rating should be between 1 and 5 as only these values are allowed on the play store. Drop the rows that have a value outside this range.

5.2)Reviews should not be more than installs as only those who installed can review the app. If there are any such records, drop them.

5.3)For free apps (type = “Free”), the price should not be >0. Drop any such rows.

In [25]:

```
dataapp.shape
```

Out[25]:

```
(9360, 13)
```

In [26]:

```
dataapp.drop(dataapp[(dataapp["Reviews"]<1) & (dataapp["Reviews"]>5)].index,inplac
```

In [27]:

```
dataapp.shape
```

Out[27]:

```
(9360, 13)
```

In [28]:

```
dataapp.drop(dataapp[dataapp["Reviews"] > dataapp["Installs"]].index, inplace=True
```

In [29]:

```
dataapp.shape
```

Out[29]:

```
(9353, 13)
```

In [30]:

```
dataapp.drop(dataapp[(dataapp["Type"]=="Free") & (dataapp["Price"]>0)].index, inpl
```

In [31]:

```
dataapp.shape
```

Out[31]:

```
(9353, 13)
```

5). Performing univariate analysis:

Boxplot for Price

Are there any outliers? Think about the price of usual apps on Play Store.

Boxplot for Reviews

Are there any apps with very high number of reviews? Do the values seem right?

Histogram for Rating

How are the ratings distributed? Is it more toward higher ratings?

Histogram for Size

Note down your observations for the plots made above. Which of these seem to have outliers?

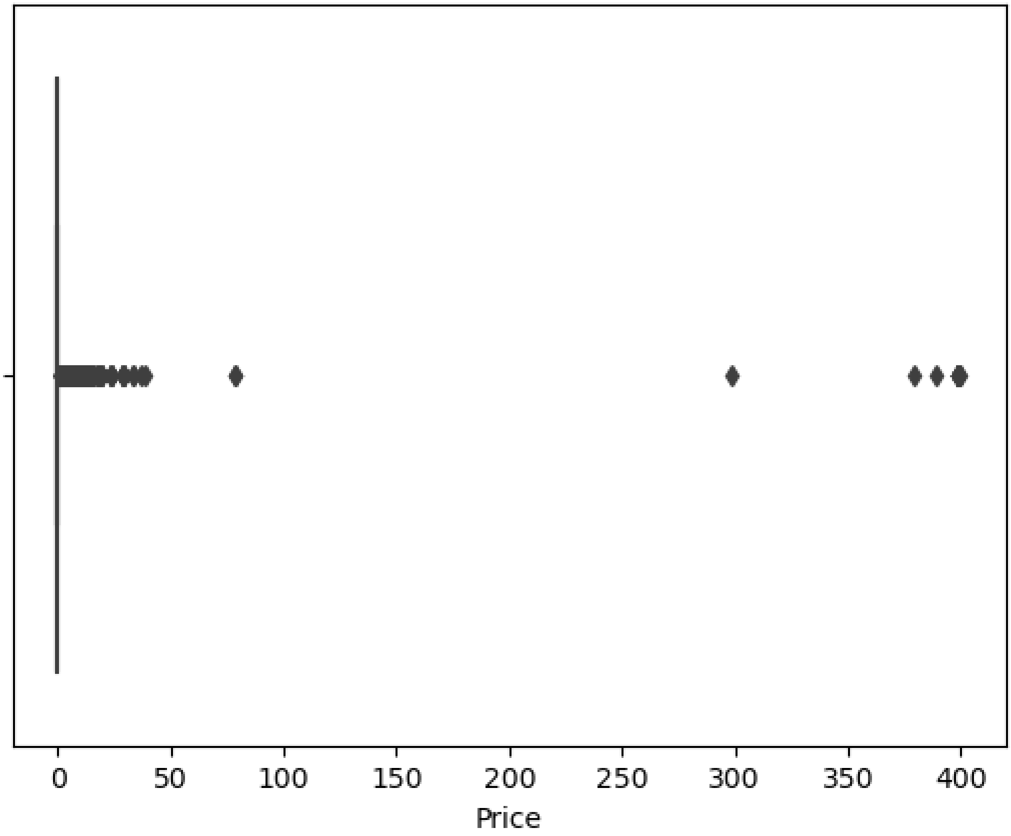
In [32]:

```
sns.boxplot(dataapp["Price"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarnin
g: Pass the following variable as a keyword arg: x. From version 0.12, the only va
lid positional argument will be `data`, and passing other arguments without an exp
licit keyword will result in an error or misinterpretation.
  warnings.warn(
```

Out[32]:

```
<AxesSubplot:xlabel='Price'>
```



From the above boxplot, 60 and above prices are Outliers

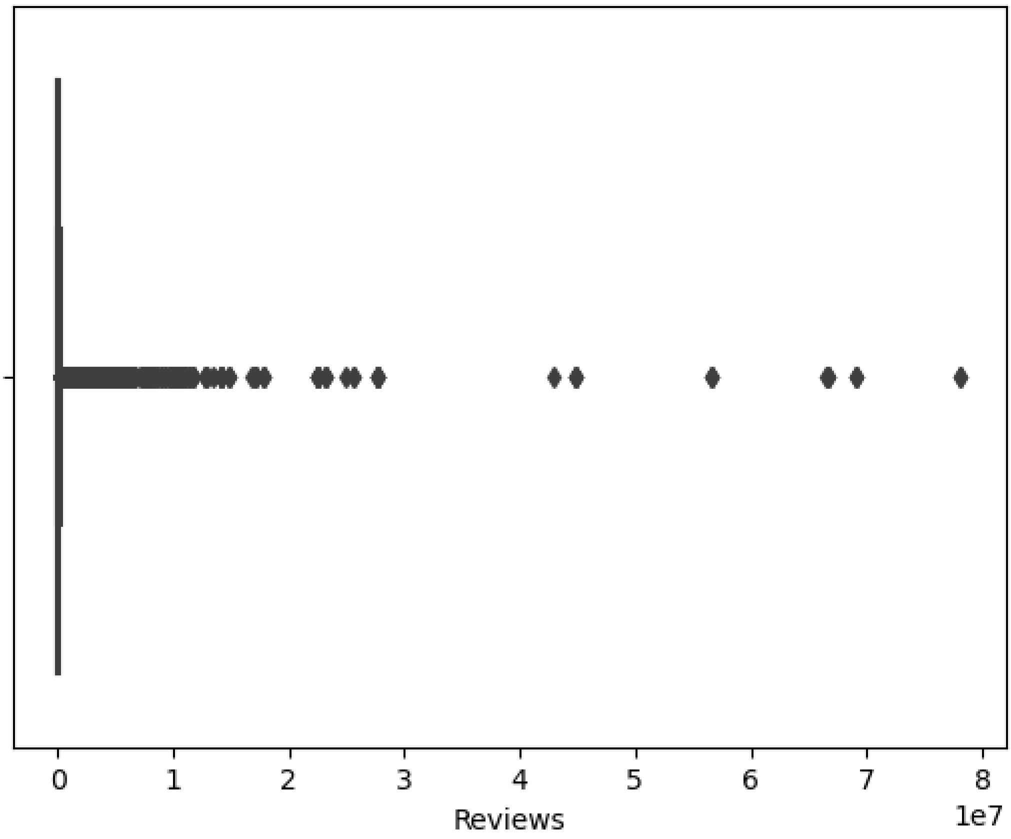
In [33]:

```
sns.boxplot(dataapp["Reviews"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarnin
g: Pass the following variable as a keyword arg: x. From version 0.12, the only va
lid positional argument will be `data`, and passing other arguments without an exp
licit keyword will result in an error or misinterpretation.
  warnings.warn(
```

Out[33]:

```
<AxesSubplot:xlabel='Reviews'>
```

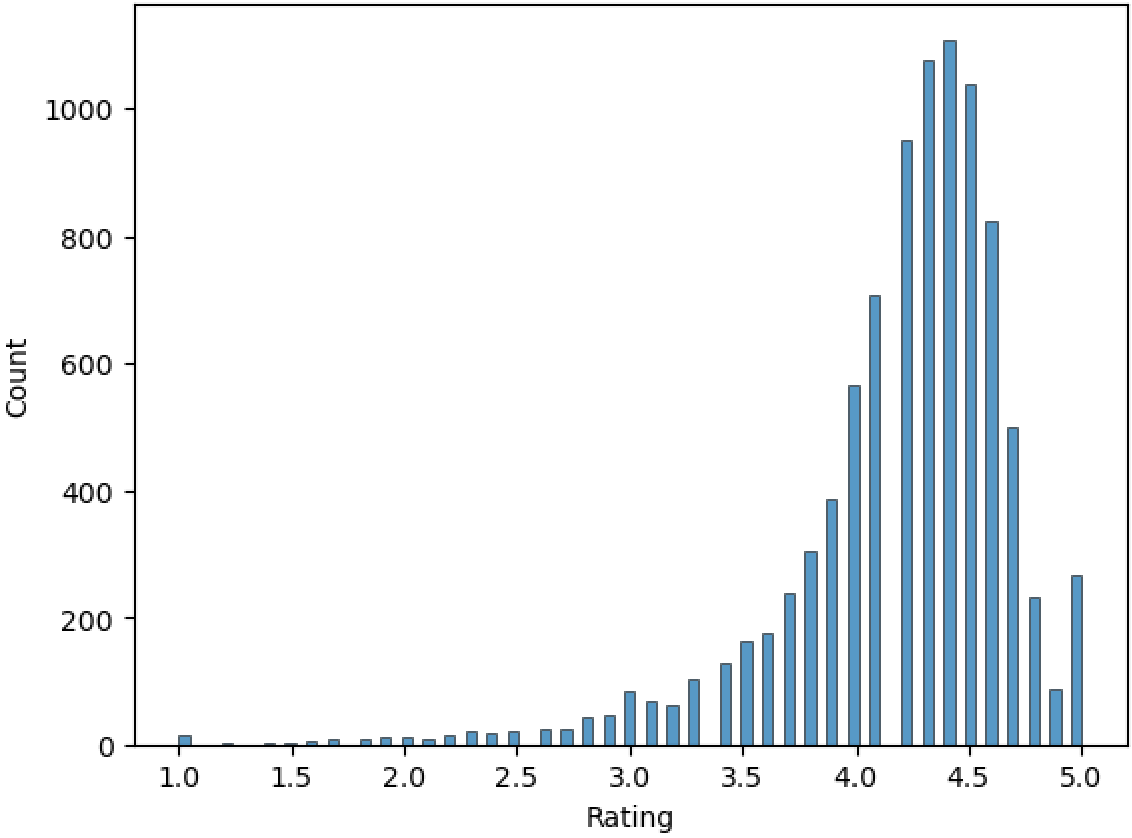


In [34]:

```
sns.histplot(dataapp["Rating"])
```

Out[34]:

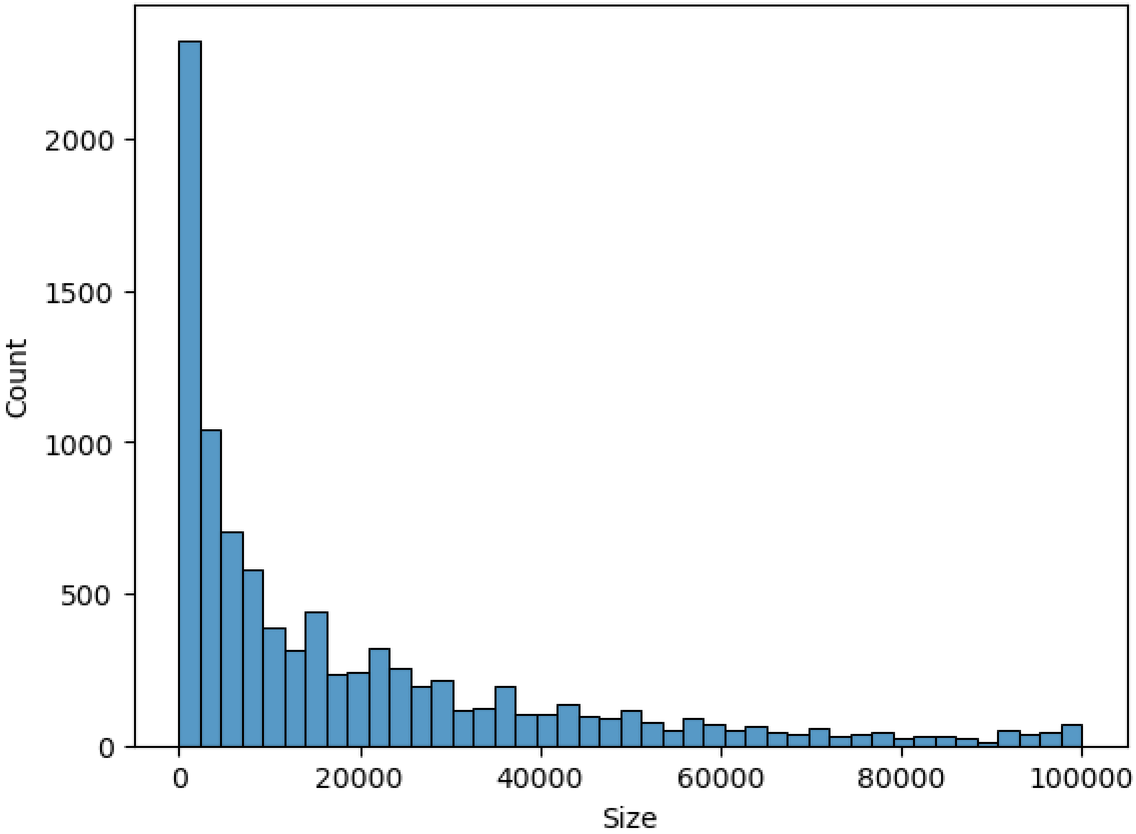
```
<AxesSubplot:xlabel='Rating', ylabel='Count'>
```



some apps are havinb higher rating between 4 and 5

```
In [35]: sns.histplot(dataapp["Size"])
```

```
Out[35]: <AxesSubplot:xlabel='Size', ylabel='Count'>
```



In [36]:
```
#most apps are having less size
```

In [37]:
```
dataapp.shape
```

Out[37]:
```
(9353, 13)
```

6) Outlier treatment:

Price: From the box plot, it seems like there are some apps with very high price. A price of $200 for an application on the Play Store is very high and suspicious!

Check out the records with very high price

Is 200 indeed a high price?

Drop these as most seem to be junk apps

Reviews: Very few apps have very high number of reviews. These are all star apps that don’t help with the analysis and, in fact, will skew it. Drop records having more than 2 million reviews.

Installs: There seems to be some outliers in this field too. Apps having very high number of installs should be dropped from the analysis.

Find out the different percentiles – 10, 25, 50, 70, 90, 95, 99

Decide a threshold as cutoff for outlier and drop records having values more than that

In [38]:
```
dataapp.drop(dataapp[dataapp["Price"]> 200].index, inplace=True)
```

In [39]:
```
dataapp.shape
```

Out[39]:
```
(9338, 13)
```

In [40]:
```
dataapp.drop(dataapp[dataapp['Reviews'] > 2000000].index, inplace = True)
```

In [41]:
```
dataapp.shape
```

Out[41]:
```
(8885, 13)
```

In [42]:
```
dataapp.quantile([.1, .25, .5, .70, .90, .95, .99], axis = 0)
```

Out[42]:

	Rating	Reviews	Size	Installs	Price
0.10	3.5	18.00	0.0	1000.0	0.0
0.25	4.0	159.00	2600.0	10000.0	0.0
0.50	4.3	4290.00	9500.0	500000.0	0.0
0.70	4.5	35930.40	23000.0	1000000.0	0.0
0.90	4.7	296771.00	50000.0	10000000.0	0.0
0.95	4.8	637298.00	68000.0	10000000.0	1.0
0.99	5.0	1462800.88	95000.0	100000000.0	7.0

dropping more than 10000000 Install value

In [43]:
```
dataapp.drop(dataapp[dataapp['Installs'] > 10000000].index, inplace = True)
```

In [44]:
```
dataapp.shape
```

Out[44]:
```
(8496, 13)
```

7). Bivariate analysis: Let’s look at how the available predictors relate to the variable of interest, i.e., our target variable rating. Make scatter plots (for numeric features) and box plots (for character features) to assess the relations between rating and the other features.

1) Make scatter plot/joinplot for Rating vs. Price

What pattern do you observe? Does rating increase with price?

2) Make scatter plot/joinplot for Rating vs. Size

Are heavier apps rated better?

3) Make scatter plot/joinplot for Rating vs. Reviews

Does more review mean a better rating always?

4) Make boxplot for Rating vs. Content Rating

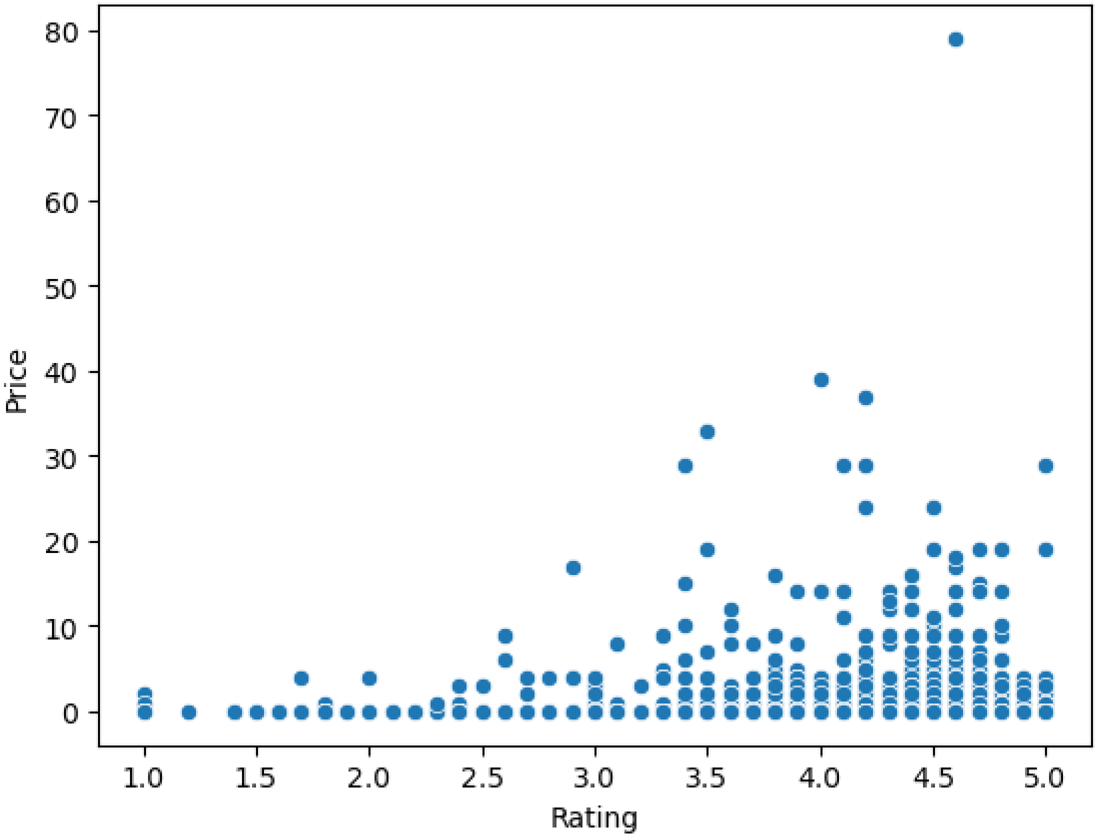
Is there any difference in the ratings? Are some types liked better?

5) Make boxplot for Ratings vs. Category

Which genre has the best ratings?

In [47]:
```
sns.scatterplot(x='Rating', y='Price',data=dataapp)
```

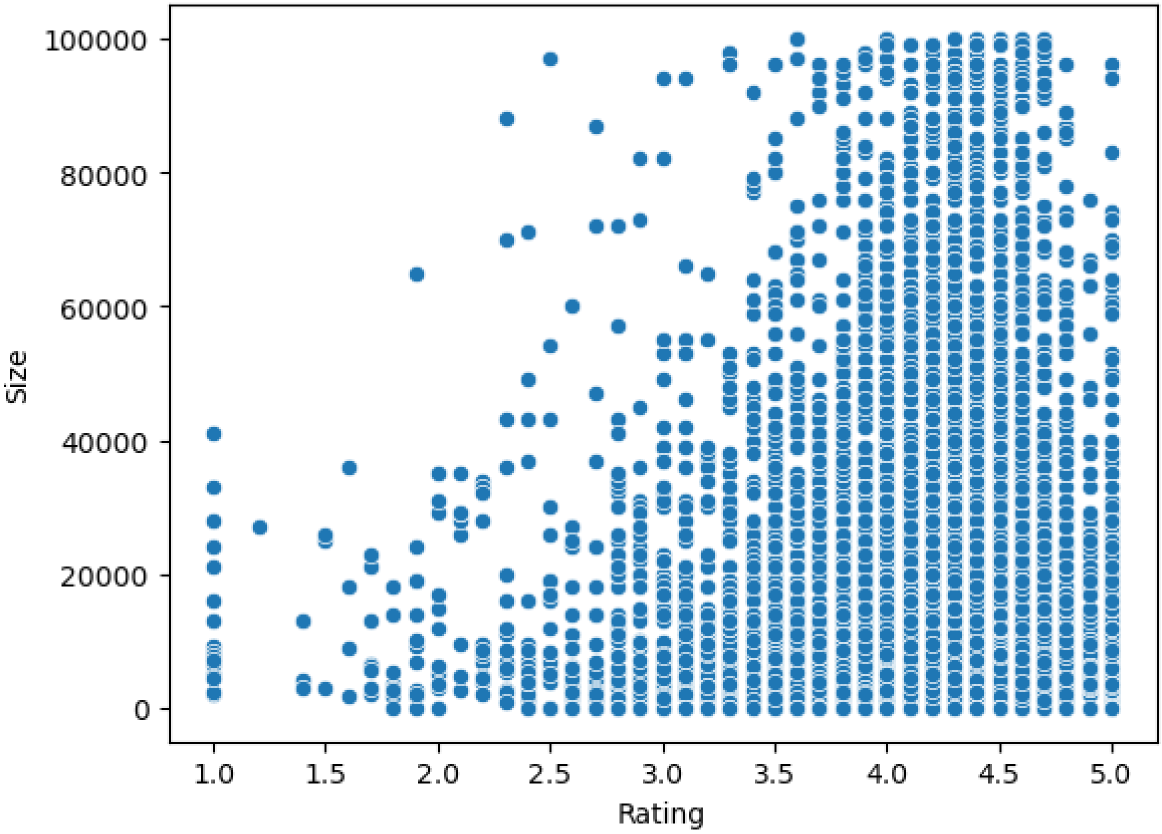
Out[47]:
```
<AxesSubplot:xlabel='Rating', ylabel='Price'>
```



analysis shows that rating has some effect with price

In [48]:
```
sns.scatterplot(x='Rating',y='Size',data=dataapp)
```

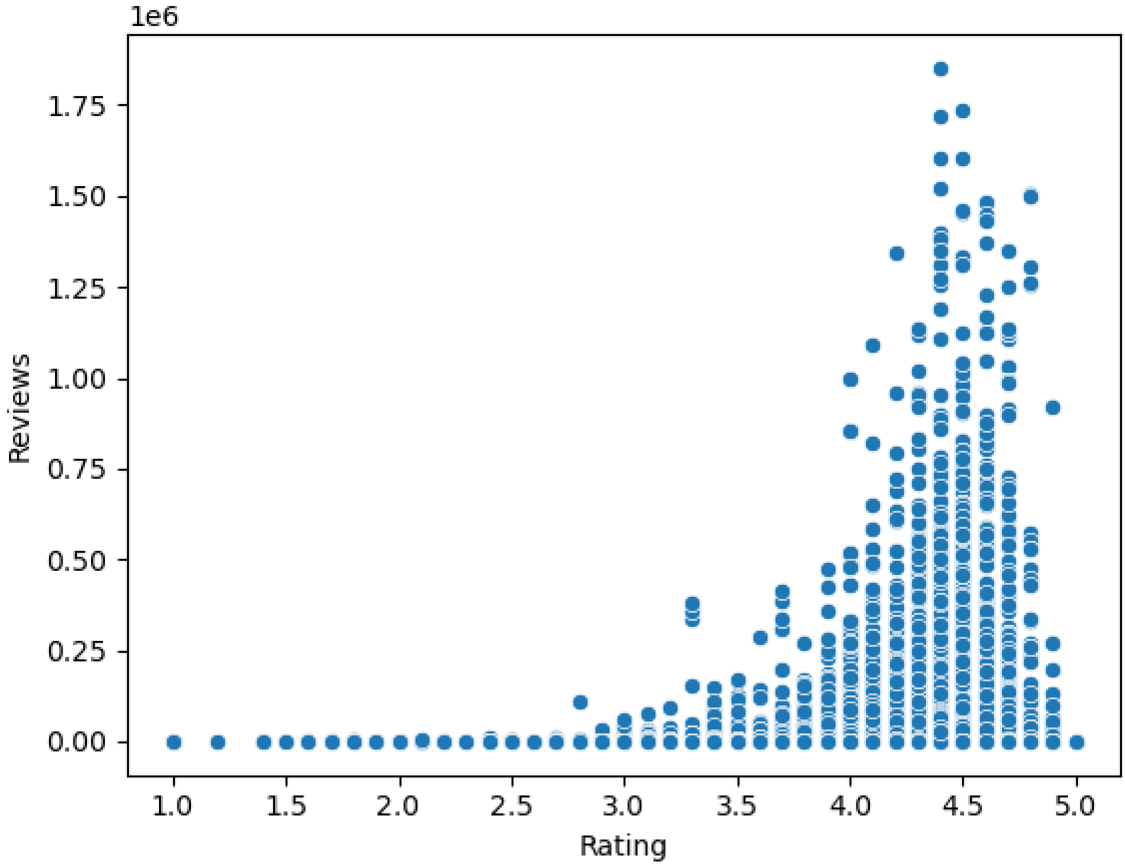
Out[48]:
```
<AxesSubplot:xlabel='Rating', ylabel='Size'>
```



analysis shows that as rating increases with increase in size

In [49]:
```
sns.scatterplot(x='Rating',y='Reviews',data=dataapp)
```

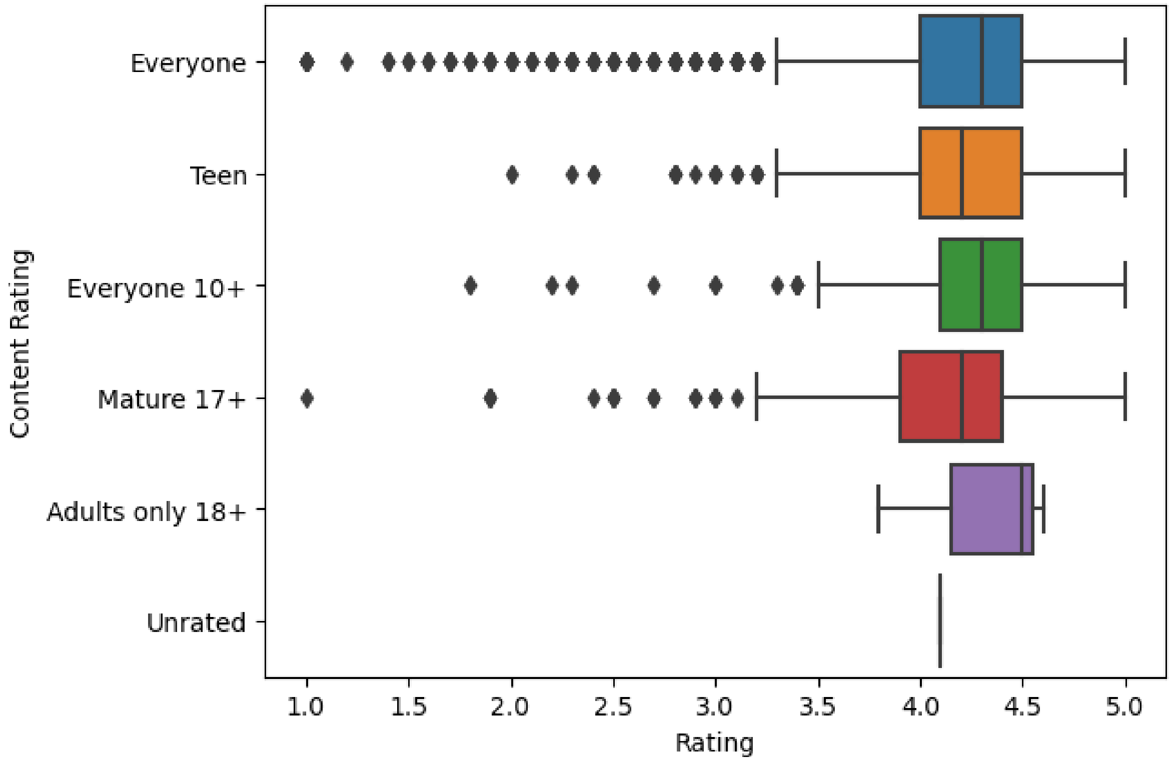
Out[49]:
```
<AxesSubplot:xlabel='Rating', ylabel='Reviews'>
```



```
In [ ]: #analysis shows rating increases with increase in reviews..
```

```
In [50]: sns.boxplot(x="Rating", y="Content Rating", data=dataapp)
```

```
Out[50]: <AxesSubplot:xlabel='Rating', ylabel='Content Rating'>
```

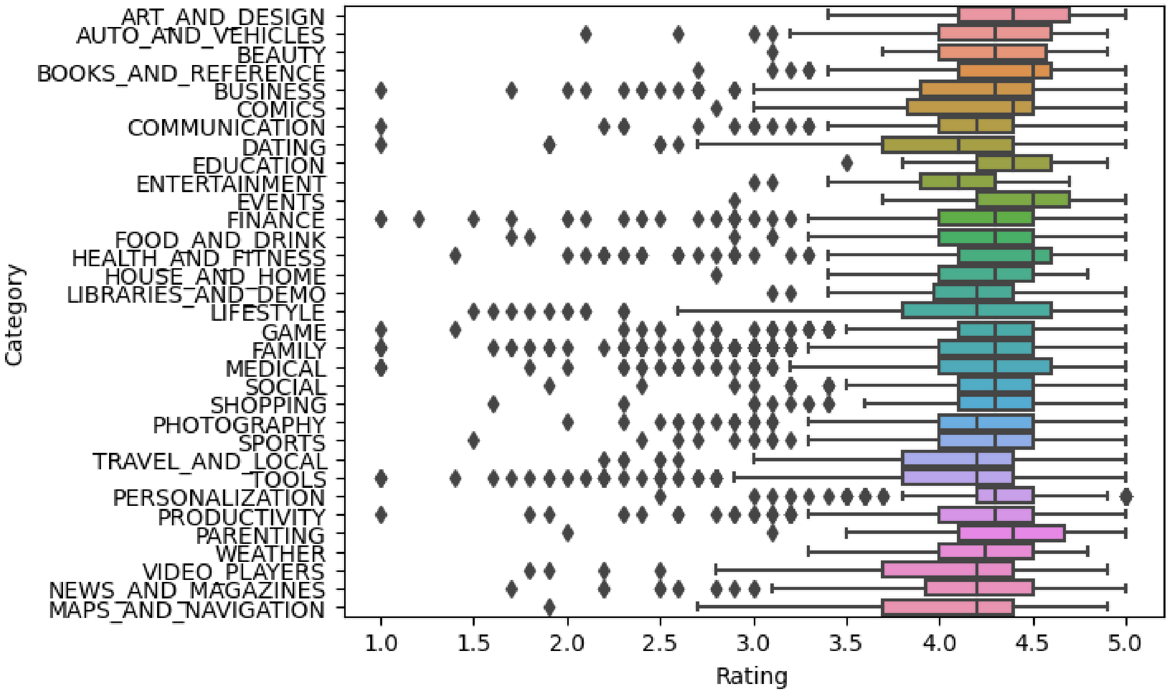


Those apps which are categorised in content rating for everyone have more bad

ratings compare to other sections because of number of oulier count, while 18+ apps have better ratings as they don't have any outlier.

In [51]:
```
sns.boxplot(x="Rating", y="Category", data=dataapp)
```

Out[51]:
```
<AxesSubplot:xlabel='Rating', ylabel='Category'>
```



event has more rating as it contain less outliers.

8. Data preprocessing

For the steps below, create a copy of the dataframe to make all the edits. Name it inp1.

1) Reviews and Install have some values that are still relatively very high. Before building a linear regression model, you need to reduce the skew. Apply log transformation (np.log1p) to Reviews and Installs.

2) Drop columns App, Last Updated, Current Ver, and Android Ver. These variables are not useful for our task.

3) Get dummy columns for Category, Genres, and Content Rating. This needs to be done as the models do not understand categorical data, and all data should be numeric. Dummy encoding is one way to convert character fields to numeric. Name of dataframe should be inp2.

In [52]:
```
inp1 = dataapp
```

In [53]:
```
inp1.head()
```

Out[53]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19000.0	10000	Free	0	Everyone	Ar
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14000.0	500000	Free	0	Everyone	Desi
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8700.0	5000000	Free	0	Everyone	Ar
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2800.0	100000	Free	0	Everyone	Desig
5	Paper flowers instructions	ART_AND_DESIGN	4.4	167	5600.0	50000	Free	0	Everyone	Ar

Reviews and Installs column still have some relatively high values, before building the linear regression model we need to reduce the skew will do log transformation for columns.

In [54]:
```
inp1.skew()
```

```
C:\Users\91918\AppData\Local\Temp\ipykernel_56156\3545313420.py:1: FutureWarning:
Dropping of nuisance columns in DataFrame reductions (with 'numeric_only=None') is
deprecated; in a future version this will raise TypeError.  Select only valid colu
mns before calling the reduction.
  inp1.skew()
```

Out[54]:
```
Rating      -1.749753
Reviews      4.576494
Size         1.655917
Installs     1.543697
Price       18.074542
dtype: float64
```

In [55]:
```
#) apply log transformation to Reviews
reviewskew = np.log1p(inp1['Reviews'])
inp1['Reviews'] = reviewskew
```

In [56]:
```
reviewskew.skew()
```

Out[56]:
```
-0.20039949659264134
```

In [57]:
```
#) apply log transformation to Installs
installsskew = np.log1p(inp1['Installs'])
inp1['Installs']
```

Out[57]:
```
0           10000
1          500000
2         5000000
4          100000
5           50000
           ...   
10834         500
10836        5000
10837         100
10839        1000
10840    10000000
Name: Installs, Length: 8496, dtype: int32
```

In [58]:
```
installsskew.skew()
```

Out[58]:
```
-0.5097286542754812
```

In [59]:
```
inp1.head()
```

Out[59]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	5.075174	19000.0	10000	Free	0	Everyone	/
1	Coloring book moana	ART_AND_DESIGN	3.9	6.875232	14000.0	500000	Free	0	Everyone	De
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	11.379520	8700.0	5000000	Free	0	Everyone	/
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	6.875232	2800.0	100000	Free	0	Everyone	Desi
5	Paper flowers instructions	ART_AND_DESIGN	4.4	5.123964	5600.0	50000	Free	0	Everyone	/

In [60]:
```
#Dropping the columns- App, Last Updated, Current Ver, Type, & Andriod Ver as these
inp1.drop(['App','Last Updated','Current Ver','Andriod Ver','Type'], axis= 1, inpl
```

In [61]:
```
inp1.head()
```

Out[61]:

	Category	Rating	Reviews	Size	Installs	Price	Content Rating	Genres
0	ART_AND_DESIGN	4.1	5.075174	19000.0	10000	0	Everyone	Art & Design
1	ART_AND_DESIGN	3.9	6.875232	14000.0	500000	0	Everyone	Art & Design;Pretend Play
2	ART_AND_DESIGN	4.7	11.379520	8700.0	5000000	0	Everyone	Art & Design
4	ART_AND_DESIGN	4.3	6.875232	2800.0	100000	0	Everyone	Art & Design;Creativity
5	ART_AND_DESIGN	4.4	5.123964	5600.0	50000	0	Everyone	Art & Design

In [62]:
```
inp1.shape
```

Out[62]:
```
(8496, 8)
```

In [65]:
```
# create a copy of dataframe
inp2 = inp1
```

In [66]:
```
inp2.head()
```

Out[66]:

	Category	Rating	Reviews	Size	Installs	Price	Content Rating	Genres
0	ART_AND_DESIGN	4.1	5.075174	19000.0	10000	0	Everyone	Art & Design
1	ART_AND_DESIGN	3.9	6.875232	14000.0	500000	0	Everyone	Art & Design;Pretend Play
2	ART_AND_DESIGN	4.7	11.379520	8700.0	5000000	0	Everyone	Art & Design
4	ART_AND_DESIGN	4.3	6.875232	2800.0	100000	0	Everyone	Art & Design;Creativity
5	ART_AND_DESIGN	4.4	5.123964	5600.0	50000	0	Everyone	Art & Design

In [67]:
```
#get unique values in column category
inp2['Category'].unique()
```

Out[67]:
```
array(['ART_AND_DESIGN', 'AUTO_AND_VEHICLES', 'BEAUTY',
       'BOOKS_AND_REFERENCE', 'BUSINESS', 'COMICS', 'COMMUNICATION',
       'DATING', 'EDUCATION', 'ENTERTAINMENT', 'EVENTS', 'FINANCE',
       'FOOD_AND_DRINK', 'HEALTH_AND_FITNESS', 'HOUSE_AND_HOME',
       'LIBRARIES_AND_DEMO', 'LIFESTYLE', 'GAME', 'FAMILY', 'MEDICAL',
       'SOCIAL', 'SHOPPING', 'PHOTOGRAPHY', 'SPORTS', 'TRAVEL_AND_LOCAL',
       'TOOLS', 'PERSONALIZATION', 'PRODUCTIVITY', 'PARENTING', 'WEATHER',
       'VIDEO_PLAYERS', 'NEWS_AND_MAGAZINES', 'MAPS_AND_NAVIGATION'],
      dtype=object)
```

In [68]:
```
inp2.Category = pd.Categorical(inp2.Category)

x = inp2[['Category']]
del inp2['Category']

dummies = pd.get_dummies(x, prefix = 'Category')
```

```
inp2 = pd.concat([inp2,dummies], axis=1)
inp2.head()
```

Out[68]:

	Rating	Reviews	Size	Installs	Price	Content Rating	Genres	Category_ART_AND_DESI
0	4.1	5.075174	19000.0	10000	0	Everyone	Art & Design	
1	3.9	6.875232	14000.0	500000	0	Everyone	Art & Design;Pretend Play	
2	4.7	11.379520	8700.0	5000000	0	Everyone	Art & Design	
4	4.3	6.875232	2800.0	100000	0	Everyone	Art & Design;Creativity	
5	4.4	5.123964	5600.0	50000	0	Everyone	Art & Design	

5 rows × 40 columns

In [69]:

```
#get unique values in Column Genres
inp2["Genres"].unique()
```

Out[69]:

```
array(['Art & Design', 'Art & Design;Pretend Play',
       'Art & Design;Creativity', 'Auto & Vehicles', 'Beauty',
       'Books & Reference', 'Business', 'Comics', 'Comics;Creativity',
       'Communication', 'Dating', 'Education', 'Education;Creativity',
       'Education;Education', 'Education;Music & Video',
       'Education;Action & Adventure', 'Education;Pretend Play',
       'Education;Brain Games', 'Entertainment',
       'Entertainment;Brain Games', 'Entertainment;Creativity',
       'Entertainment;Music & Video', 'Events', 'Finance', 'Food & Drink',
       'Health & Fitness', 'House & Home', 'Libraries & Demo',
       'Lifestyle', 'Lifestyle;Pretend Play', 'Card', 'Casual', 'Puzzle',
       'Action', 'Arcade', 'Word', 'Racing', 'Casual;Creativity',
       'Sports', 'Board', 'Simulation', 'Role Playing', 'Adventure',
       'Strategy', 'Simulation;Education', 'Action;Action & Adventure',
       'Trivia', 'Casual;Brain Games', 'Simulation;Action & Adventure',
       'Educational;Creativity', 'Puzzle;Brain Games',
       'Educational;Education', 'Card;Brain Games',
       'Educational;Brain Games', 'Educational;Pretend Play',
       'Casual;Action & Adventure', 'Entertainment;Education',
       'Casual;Education', 'Casual;Pretend Play', 'Music;Music & Video',
       'Racing;Action & Adventure', 'Arcade;Pretend Play',
       'Adventure;Action & Adventure', 'Role Playing;Action & Adventure',
       'Simulation;Pretend Play', 'Puzzle;Creativity',
       'Sports;Action & Adventure', 'Educational;Action & Adventure',
       'Arcade;Action & Adventure', 'Entertainment;Action & Adventure',
       'Puzzle;Action & Adventure', 'Strategy;Action & Adventure',
       'Music & Audio;Music & Video', 'Health & Fitness;Education',
       'Adventure;Education', 'Board;Brain Games',
       'Board;Action & Adventure', 'Board;Pretend Play',
       'Casual;Music & Video', 'Role Playing;Pretend Play',
       'Entertainment;Pretend Play', 'Video Players & Editors;Creativity',
       'Card;Action & Adventure', 'Medical', 'Social', 'Shopping',
       'Photography', 'Travel & Local',
       'Travel & Local;Action & Adventure', 'Tools', 'Tools;Education',
       'Personalization', 'Productivity', 'Parenting',
       'Parenting;Music & Video', 'Parenting;Brain Games',
       'Parenting;Education', 'Weather', 'Video Players & Editors',
       'Video Players & Editors;Music & Video', 'News & Magazines',
       'Maps & Navigation', 'Health & Fitness;Action & Adventure',
       'Music', 'Educational', 'Casino', 'Adventure;Brain Games',
       'Lifestyle;Education', 'Books & Reference;Education',
       'Puzzle;Education', 'Role Playing;Brain Games',
       'Strategy;Education', 'Racing;Pretend Play',
       'Communication;Creativity', 'Strategy;Creativity'], dtype=object)
```

There are too many categories under Genres. Hence, we will try to reduce some categories which have very few samples under them and put them under one new common category i.e. "Other"

In [71]:

```
#Create an empty list
lists = []
# We need to reduce some categories that dont have any impact on making model
#Get the total genres count and genres count less than 20 append those into the lis
for i in inp2.Genres.value_counts().index:
    if inp2.Genres.value_counts()[i]<20:
        lists.append(i)
```

```
#changing the genres which are in the list to other
inp2.Genres = ['Other' if i in lists else i for i in inp2.Genres]
```

In [73]:
```
inp2["Genres"].unique()
```

Out[73]:
```
array(['Art & Design', 'Other', 'Auto & Vehicles', 'Beauty',
       'Books & Reference', 'Business', 'Comics', 'Communication',
       'Dating', 'Education', 'Education;Education',
       'Education;Pretend Play', 'Entertainment',
       'Entertainment;Music & Video', 'Events', 'Finance', 'Food & Drink',
       'Health & Fitness', 'House & Home', 'Libraries & Demo',
       'Lifestyle', 'Card', 'Casual', 'Puzzle', 'Action', 'Arcade',
       'Word', 'Racing', 'Sports', 'Board', 'Simulation', 'Role Playing',
       'Adventure', 'Strategy', 'Trivia', 'Educational;Education',
       'Casual;Pretend Play', 'Medical', 'Social', 'Shopping',
       'Photography', 'Travel & Local', 'Tools', 'Personalization',
       'Productivity', 'Parenting', 'Weather', 'Video Players & Editors',
       'News & Magazines', 'Maps & Navigation', 'Educational', 'Casino'],
      dtype=object)
```

In [74]:
```
#Storing the genres column into x varible and delete the genres col from dataframe
#And concat the encoded cols to the dataframe inp2
inp2.Genres = pd.Categorical(inp2['Genres'])
x = inp2[["Genres"]]
del inp2['Genres']
dummies = pd.get_dummies(x, prefix = 'Genres')
inp2 = pd.concat([inp2,dummies], axis=1)
```

In [75]:
```
inp2.head()
```

Out[75]:

	Rating	Reviews	Size	Installs	Price	Content Rating	Category_ART_AND_DESIGN	Category_AU
0	4.1	5.075174	19000.0	10000	0	Everyone	1	
1	3.9	6.875232	14000.0	500000	0	Everyone	1	
2	4.7	11.379520	8700.0	5000000	0	Everyone	1	
4	4.3	6.875232	2800.0	100000	0	Everyone	1	
5	4.4	5.123964	5600.0	50000	0	Everyone	1	

5 rows × 91 columns

In [76]:
```
inp2.shape
```

Out[76]:
```
(8496, 91)
```

In [77]:
```
#getting the unique values
inp2["Content Rating"].unique()
```

Out[77]:
```
array(['Everyone', 'Teen', 'Everyone 10+', 'Mature 17+',
       'Adults only 18+', 'Unrated'], dtype=object)
```

In [78]:
```
#Applying one hot encoding
#Storing the Content Rating column into x varible and delete the Content Rating co
#And concat the encoded cols to the dataframe inp2
inp2['Content Rating'] = pd.Categorical(inp2['Content Rating'])

x = inp2[['Content Rating']]
```

```
del inp2['Content Rating']

dummies = pd.get_dummies(x, prefix = 'Content Rating')
inp2 = pd.concat([inp2,dummies], axis=1)
inp2.head()
```

Out[78]:

	Rating	Reviews	Size	Installs	Price	Category_ART_AND_DESIGN	Category_AUTO_AND_V
0	4.1	5.075174	19000.0	10000	0	1	
1	3.9	6.875232	14000.0	500000	0	1	
2	4.7	11.379520	8700.0	5000000	0	1	
4	4.3	6.875232	2800.0	100000	0	1	
5	4.4	5.123964	5600.0	50000	0	1	

5 rows × 96 columns

In [79]:

```
inp2.shape
```

Out[79]:

```
(8496, 96)
```

9) Train test split and apply 70-30 split. Name the new dataframes df_train and df_test.

10)Separate the dataframes into X_train, y_train, X_test, and y_test.

In [80]:

```
#importing the neccessary libraries from sklearn to split the data and and for mode
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error as mse
from sklearn import metrics
```

In [81]:

```
#Creating the variable X and Y which contains the X features as independent feature
df2 = inp2
X = df2.drop('Rating',axis=1)
y = df2['Rating']

#Dividing the X and y into test and train data
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.3, random_sta
```

11. Model building Use linear regression as the technique Report the R2 on the train set

In [82]:

```
#Create a linear reggression obj by calling the linear reggressor algorithm
lin_reggressor = LinearRegression()
lin_reggressor.fit(X_train,y_train)
```

Out[82]:

```
LinearRegression()
```

In [83]:

```
R2_Score_train_data = round(lin_reggressor.score(X_train,y_train),3)
print("The R2 value of the Training Set is : {}".format(R2_Score_train_data))
```

```
The R2 value of the Training Set is : 0.074
```

In [84]:

```
# test the output by changing values, like 3750
y_pred = lin_reggressor.predict(X_test)
R2_Score_test_data =metrics.r2_score(y_test,y_pred)
R2_Score_test_data
```

Out[84]:

```
0.06257564620467992
```

12. Make predictions on test set and report R2.

In [85]:

```
R2_Score_test_data = round(lin_reggressor.score(X_test,y_test),3)
print("The R2 value of the Training Set is : {}".format(R2_Score_test_data))
```

```
The R2 value of the Training Set is : 0.063
```