Import Packages

In [1]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt, seaborn as sns
%matplotlib inline
```

Read Data

In [2]:
```
playStore_df = pd.read_csv('googleplaystore.csv')
```

In [3]:
```
playStore_df.head()
```

Out[3]:

	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	
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	D
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0	Everyone	
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Everyone	De

In [4]:
```
playStore_df.shape
```

Out[4]:
```
(10841, 13)
```

In [5]:
```
playStore_df.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
```

In [6]:
```
playStore_df.isnull().sum()
```

Out[6]:
```
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
```

Data Cleaning

In [7]:
```
playStore_df.dropna(how='any',inplace=True)
```

In [8]:
```
playStore_df.isnull().sum()
```

Out[8]:
```
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
```

In [9]:
```
playStore_df.dtypes
```

Out[9]:
```
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 [10]:
```
playStore_df.head()
```

Out[10]:

	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	
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	[
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0	Everyone	
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Everyone	De

Size Column Cleaning

In [11]:
```
def change_size(size):
    if 'M' in size:
        x = size[:-1]
        x = float(x)*1000
        return(x)
    elif 'k' == size[-1:]:
        x = size[:-1]
        x = float(x)
        return(x)
    else:
        return None
```

In [12]:
```
playStore_df['Size'] = playStore_df['Size'].map(change_size)
```

In [13]:
```
playStore_df.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            7723 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]:
```
playStore_df.describe()
```

Out[14]:

	Rating	Size
count	9360.000000	7723.000000
mean	4.191838	22970.456105
std	0.515263	23449.628935
min	1.000000	8.500000
25%	4.000000	5300.000000
50%	4.300000	14000.000000
75%	4.500000	33000.000000
max	5.000000	100000.000000

In [15]:
```
playStore_df['Size'].isnull().sum()
```

Out[15]:
```
1637
```

In [16]:
```
#  Filling Na value in size column
playStore_df.Size.fillna(method='ffill',inplace=True)
```

In [17]:
```
playStore_df.dtypes
```

Out[17]:
```
App               object
Category          object
Rating           float64
Reviews           object
Size             float64
Installs          object
Type              object
Price             object
Content Rating    object
Genres            object
Last Updated      object
Current Ver       object
Android Ver       object
dtype: object
```

Cleaning Review Column

In [18]:
```
playStore_df.Reviews = playStore_df.Reviews.astype('int')
```

In [19]:
```
playStore_df.Reviews.describe()
```

Out[19]:
```
count    9.360000e+03
mean     5.143767e+05
std      3.145023e+06
min      1.000000e+00
25%      1.867500e+02
50%      5.955000e+03
75%      8.162750e+04
max      7.815831e+07
Name: Reviews, dtype: float64
```

Cleaning Install Column

In [20]:
```
playStore_df.Installs.value_counts()
```

Out[20]:
```
1,000,000+        1576
10,000,000+       1252
100,000+          1150
10,000+           1009
5,000,000+         752
1,000+             712
500,000+           537
50,000+            466
5,000+             431
100,000,000+       409
100+               309
50,000,000+        289
500+               201
500,000,000+        72
10+                 69
1,000,000,000+      58
50+                 56
5+                   9
1+                   3
Name: Installs, dtype: int64
```

In [21]:
```
# Need to remove + & , Using def

def clean_install(val):
    return int(val.replace(",","").replace("+",""))
```

In [22]:
```
playStore_df.Installs = playStore_df.Installs.map(clean_install)
```

In [23]:
```
playStore_df.Installs.value_counts()
```

Out[23]:
```
1000000       1576
10000000      1252
100000        1150
10000         1009
5000000        752
1000           712
500000         537
50000          466
5000           431
100000000      409
100            309
50000000       289
500            201
500000000       72
10              69
1000000000      58
50              56
5                9
1                3
Name: Installs, dtype: int64
```

In [24]:
```
playStore_df.Installs.describe()
```

Out[24]:
```
count    9.360000e+03
mean     1.790875e+07
std      9.126637e+07
min      1.000000e+00
25%      1.000000e+04
50%      5.000000e+05
75%      5.000000e+06
max      1.000000e+09
Name: Installs, dtype: float64
```

Cleaning price column

In [25]:
```
playStore_df.Price.value_counts(5)[:5]
```

Out[25]:
```
0        0.931090
$2.99    0.012179
$0.99    0.011325
$4.99    0.007479
$1.99    0.006303
Name: Price, dtype: float64
```

there is $ sign and 0. So we need some conditional cleaning

1. first, let's modify the column to take 0 if value is 0, else take the first letter onwards

In [26]:
```
playStore_df['Price'] = playStore_df['Price'].map(lambda x: 0 if x == '0' else float(x[1:]))
```

In [27]:
```
playStore_df['Price'].head(5)
```

Out[27]:
```
0    0.0
1    0.0
2    0.0
3    0.0
4    0.0
Name: Price, dtype: float64
```

Sanity Check

1. Average rating should be between 1 and 5, as only these values are allowed to have on the play store
2. Drop any rows that have been outside from range

In [28]:
```
playStore_df.Rating.describe()
```

Out[28]:
```
count    9360.000000
mean        4.191838
std         0.515263
min         1.000000
25%         4.000000
50%         4.300000
75%         4.500000
max         5.000000
Name: Rating, dtype: float64
```

1. Rating looks lood as Min = 1 and Max = 5
2. Need to check the rating value beyond Range

Cleaning Review Column

In [29]:
```
# Check the length which review greater than Install
len(playStore_df[playStore_df.Reviews > playStore_df.Installs])
```

Out[29]:
```
7
```

In [30]:
```
playStore_df[playStore_df.Reviews > playStore_df.Installs]
```

Out[30]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres
2454	KBA-EZ Health Guide	MEDICAL	5.0	4	25000.0	1	Free	0.00	Everyone	Medical
4663	Alarmy (Sleep If U Can) - Pro	LIFESTYLE	4.8	10249	30000.0	10000	Paid	2.49	Everyone	Lifestyle
5917	Ra Ga Ba	GAME	5.0	2	20000.0	1	Paid	1.49	Everyone	Arcade
6700	Brick Breaker BR	GAME	5.0	7	19000.0	5	Free	0.00	Everyone	Arcade
7402	Trovami se ci riesci	GAME	5.0	11	6100.0	10	Free	0.00	Everyone	Arcade
8591	DN Blog	SOCIAL	5.0	20	4200.0	10	Free	0.00	Teen	Social
10697	Mu.F.O.	GAME	5.0	2	16000.0	1	Paid	0.99	Everyone	Arcade

In [31]:
```
playStore_df = playStore_df[playStore_df.Reviews <= playStore_df.Installs].copy()
```

In [32]:
```
playStore_df.shape
```

Out[32]: (9353, 13)

Free App Analysis

For 'FREE' app price shold not more than zero. Any such App would be dropped

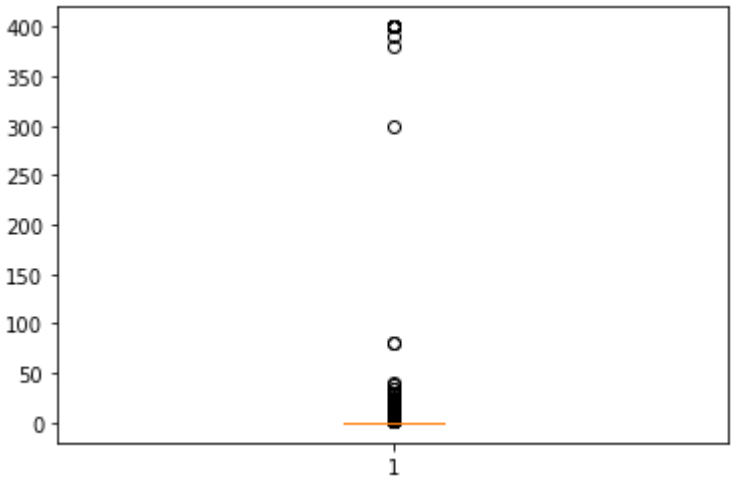
In [33]:
```
len(playStore_df[(playStore_df.Type == 'Free') & (playStore_df.Price > 0)])
```

Out[33]: 0

Perform Univariate Analysis

boxplot for price

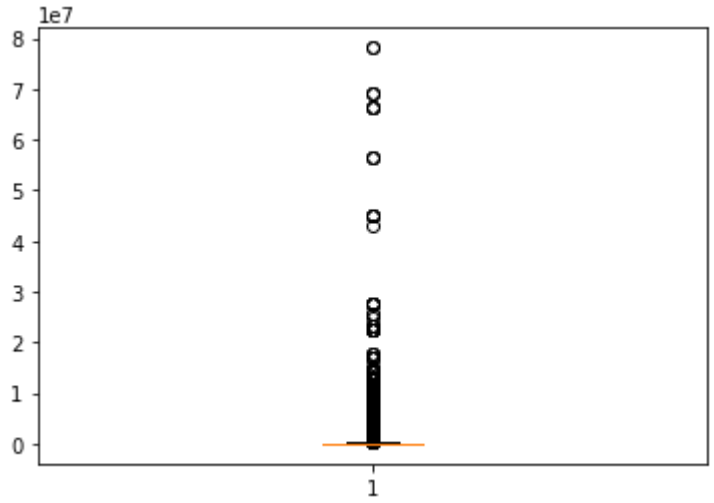
In [34]:
```
plt.boxplot(playStore_df.Price)
plt.show()
```



1. Ans for price-There is some outlier

Boxplot for Review

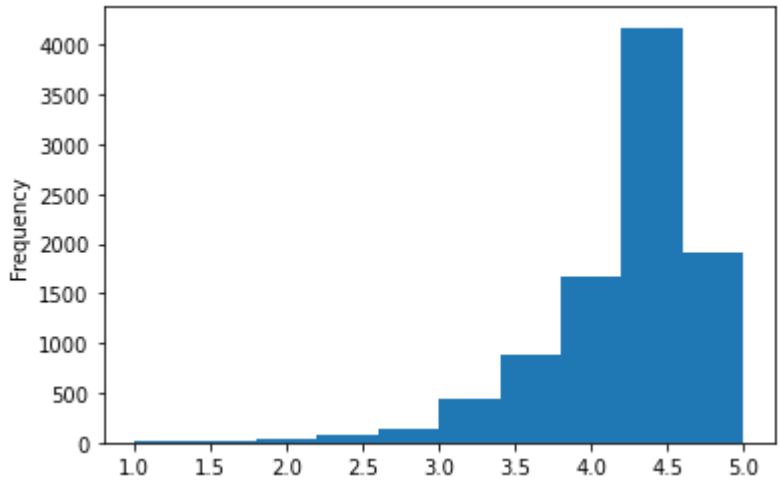
In [35]:
```
plt.boxplot(playStore_df.Reviews)
plt.show()
```



2. Ans for Review There is some value which have very high value

Histogram for rating

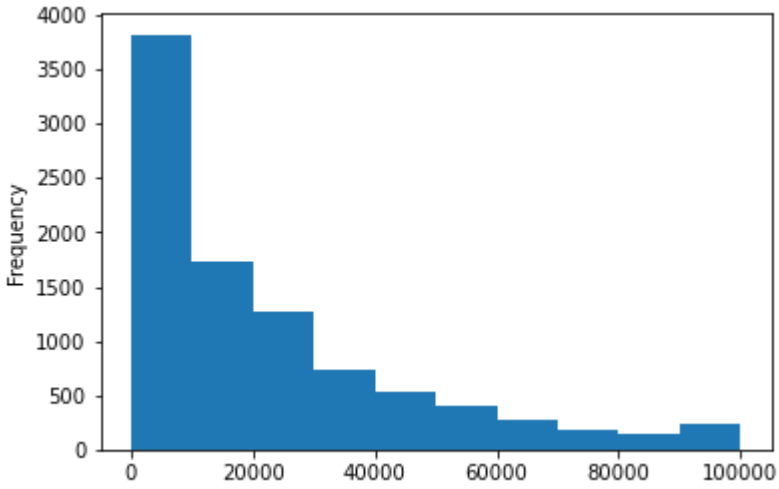
In [36]:
```
playStore_df.Rating.plot.hist()
plt.show()
```



3. Ans for Rating- This is right skewed . and ahve more apps fro higher ratings

Histogram for size

In [37]:
```
playStore_df.Size.plot.hist()
plt.show()
```



4. Ans for size- This is left skewed .less size has more user

Somethings seems abnormal in price column

In [38]:
```
len(playStore_df[playStore_df.Price > 200])
```

Out[38]: 15

In [39]:
```
playStore_df[playStore_df.Price > 200]
```

Out[39]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
4197	most expensive app (H)	FAMILY	4.3	6	1500.0	100	Paid	399.99	Everyone	Ente
4362	💎 I'm rich	LIFESTYLE	3.8	718	26000.0	10000	Paid	399.99	Everyone	
4367	I'm Rich - Trump Edition	LIFESTYLE	3.6	275	7300.0	10000	Paid	400.00	Everyone	
5351	I am rich	LIFESTYLE	3.8	3547	1800.0	100000	Paid	399.99	Everyone	
5354	I am Rich Plus	FAMILY	4.0	856	8700.0	10000	Paid	399.99	Everyone	Ente
5355	I am rich VIP	LIFESTYLE	3.8	411	2600.0	10000	Paid	299.99	Everyone	
5356	I Am Rich Premium	FINANCE	4.1	1867	4700.0	50000	Paid	399.99	Everyone	
5357	I am extremely Rich	LIFESTYLE	2.9	41	2900.0	1000	Paid	379.99	Everyone	
5358	I am Rich!	FINANCE	3.8	93	22000.0	1000	Paid	399.99	Everyone	
5359	I am rich(premium)	FINANCE	3.5	472	965.0	5000	Paid	399.99	Everyone	
5362	I Am Rich Pro	FAMILY	4.4	201	2700.0	5000	Paid	399.99	Everyone	Ente
5364	I am rich (Most expensive app)	FINANCE	4.1	129	2700.0	1000	Paid	399.99	Teen	
5366	I Am Rich	FAMILY	3.6	217	4900.0	10000	Paid	389.99	Everyone	Ente
5369	I am Rich	FINANCE	4.3	180	3800.0	5000	Paid	399.99	Everyone	
5373	I AM RICH PRO PLUS	FINANCE	4.0	36	41000.0	1000	Paid	399.99	Everyone	

In [40]:
```
playStore_df = playStore_df[playStore_df.Price <= 200].copy()

playStore_df.shape
```

Out[40]:
```
(9338, 13)
```

Drop the record for 2 Million Reviews

In [41]:
```
playStore_df = playStore_df[playStore_df.Reviews <= 2000000]
playStore_df.shape
```

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

Drop very high Install

Find out different percentiles

In [42]:
```
len(playStore_df[playStore_df.Installs >= 1000000000])
```

Out[42]:
```
6
```

In [43]:
```
playStore_df.Installs.quantile([0.10,0.25,0.50,0.70,0.90,0.95,0.99])
```

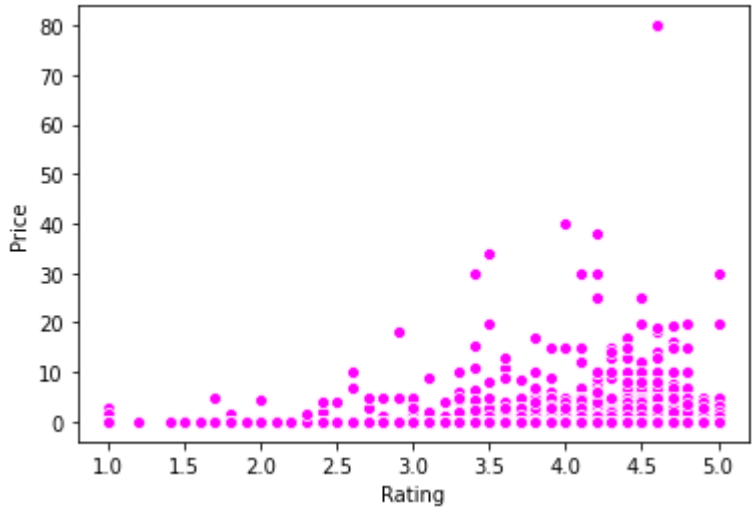
Out[43]:
```
0.10         1000.0
0.25        10000.0
0.50       500000.0
0.70      1000000.0
0.90     10000000.0
0.95     10000000.0
0.99    100000000.0
Name: Installs, dtype: float64
```

From the above number of install value. It looks likes there are just 1% app having more than 100 M installs. These apps might be actual. but for skeness of data we need to drop these value

Bivariate Analysis

1. scatter plot/joinplot for Rating vs. Price

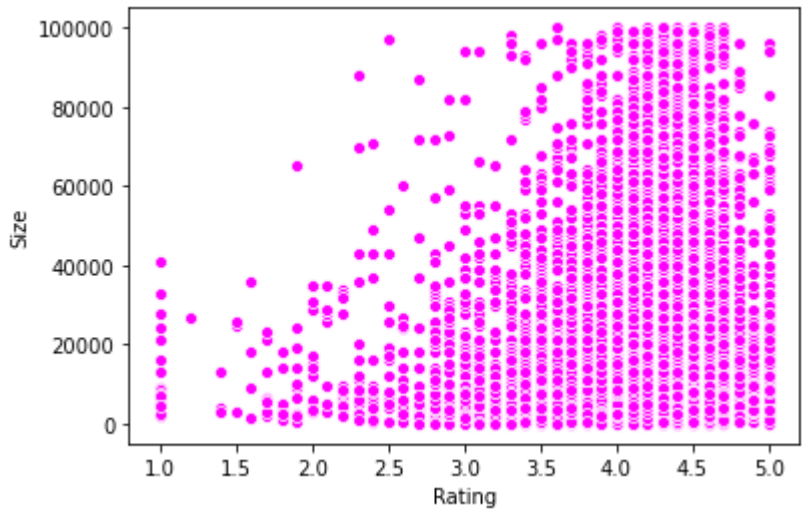
In [44]:
```
sns.scatterplot(x=playStore_df['Rating'],y=playStore_df['Price'],color='magenta',data=playStore_df)
plt.savefig('Rating_Price_scatterplot.jpg')
```



we obserbe that price going to increase with rating

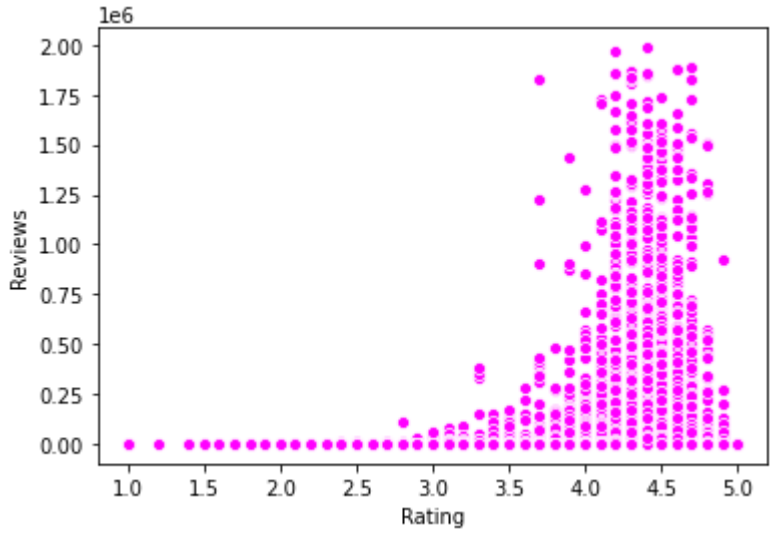
1. scatter plot/joinplot for Rating vs. Size

In [45]:
```
sns.scatterplot(x=playStore_df['Rating'],y = playStore_df['Size'],color='magenta',data=playStore_df)
plt.savefig('Rating_size_scatterplot.jpg')
```

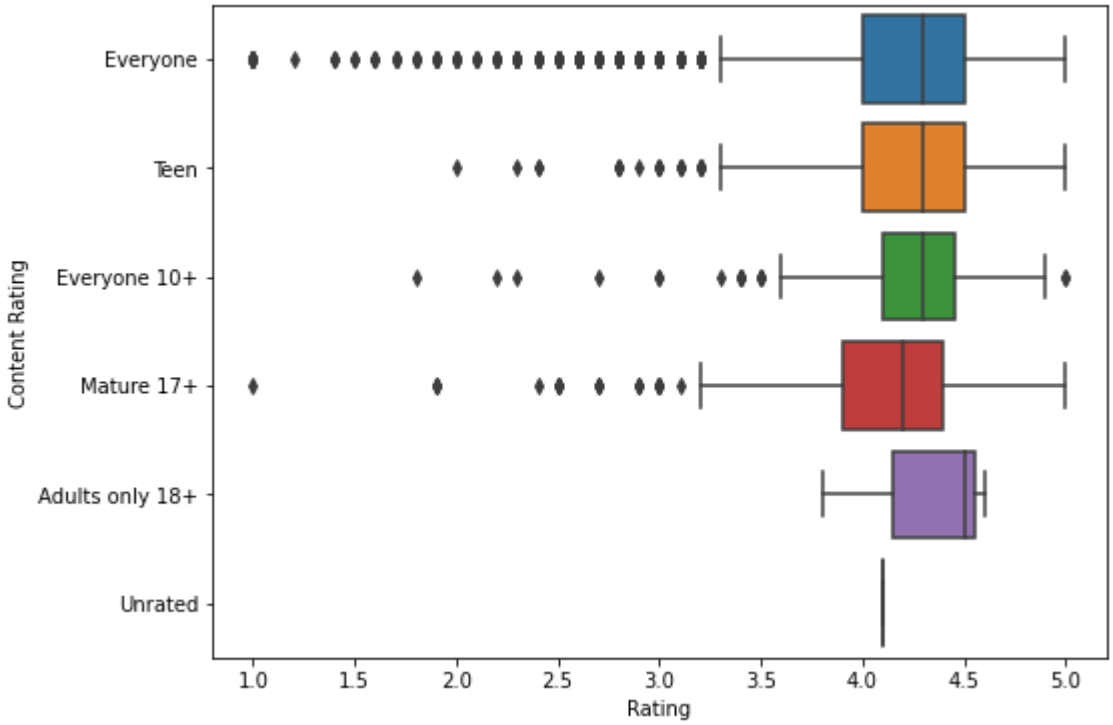


1. scatter plot/joinplot for Rating vs. Reviews

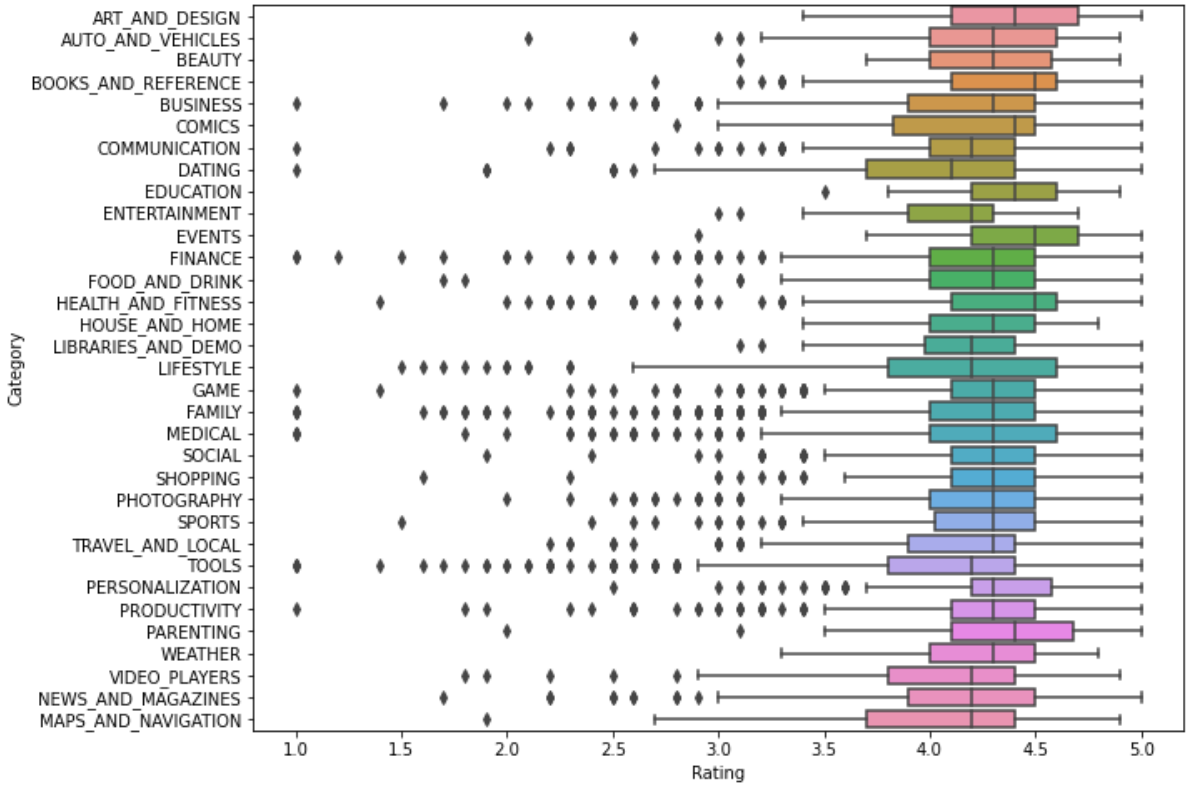
In [46]:
```
sns.scatterplot(x = playStore_df['Rating'],y = playStore_df['Reviews'],color =
'magenta',data=playStore_df)
plt.savefig('Rating_Review_scatterplot.jpg')
```



In [47]:
```
plt.figure(figsize=[8,6])
sns.boxplot(x = playStore_df['Rating'],y = playStore_df['Content Rating'])
plt.savefig('Rating_ContentRating_Boxplot.jpg')
```



In [48]:
```
plt.figure(figsize=[10,8])
sns.boxplot(x = playStore_df['Rating'], y =playStore_df['Category'])
plt.savefig('Rating_Category_Boxplot.jpg')
```



Data Procssing

Making copy of entire data sheet

In [49]:
```
inp1 = playStore_df.copy()
```

Install column Re-cleaning

In [50]:
```
inp1.Installs.describe()
```

Out[50]:
```
count    8.885000e+03
mean     6.267379e+06
std      3.539960e+07
min      5.000000e+00
25%      1.000000e+04
50%      5.000000e+05
75%      5.000000e+06
max      1.000000e+09
Name: Installs, dtype: float64
```

In [51]:
```
inp1.Installs = inp1.Installs.apply(np.log1p)
```

In [52]:
```
inp1.Installs.describe()
```

Out[52]:
```
count    8885.000000
mean       11.987075
std         3.623147
min         1.791759
25%         9.210440
50%        13.122365
75%        15.424949
max        20.723266
Name: Installs, dtype: float64
```

Review column Re-cleaning

In [53]:
```
inp1.Reviews.describe()
```

Out[53]:
```
count    8.885000e+03
mean     1.049148e+05
std      2.674675e+05
min      1.000000e+00
25%      1.590000e+02
50%      4.290000e+03
75%      5.689700e+04
max      1.986068e+06
Name: Reviews, dtype: float64
```

In [54]:
```
inp1.Reviews = inp1.Reviews.apply(np.log1p)
```

In [55]:
```
inp1.Reviews.describe()
```

Out[55]:
```
count    8885.000000
mean        8.025321
std         3.570637
min         0.693147
25%         5.075174
50%         8.364275
75%        10.949015
max        14.501668
Name: Reviews, dtype: float64
```

Drop the column App, Last Updated, Current Version, and Android Version

In [56]:
```
inp1.drop(['App','Last Updated','Current Ver','Android Ver'],axis=1,inplace=True)
```

In [57]:
```
inp1.shape
```

Out[57]:
```
(8885, 9)
```

Getting dummy variables for Category, Genres, Content Rating

In [58]:
```
inp1.dtypes
```

Out[58]:
```
Category           object
Rating            float64
Reviews           float64
Size              float64
Installs          float64
Type               object
Price             float64
Content Rating     object
Genres             object
dtype: object
```

In [59]:
```
inp2 = pd.get_dummies(inp1,drop_first=True)
```

In [60]:
```
inp2.columns
```

Out[60]:
```
Index(['Rating', 'Reviews', 'Size', 'Installs', 'Price',
       'Category_AUTO_AND_VEHICLES', 'Category_BEAUTY',
       'Category_BOOKS_AND_REFERENCE', 'Category_BUSINESS', 'Category_COMIC
S',
       ...
       'Genres_Tools', 'Genres_Tools;Education', 'Genres_Travel & Local',
       'Genres_Travel & Local;Action & Adventure', 'Genres_Trivia',
       'Genres_Video Players & Editors',
       'Genres_Video Players & Editors;Creativity',
       'Genres_Video Players & Editors;Music & Video', 'Genres_Weather',
       'Genres_Word'],
      dtype='object', length=157)
```

Train-Test split Method

In [61]:
```
 df_train, df_test = train_test_split(inp2,train_size = 0.7, random_state = 10
0)
```

In [62]:
```
df_train.shape,df_test.shape
```

Out[62]:
```
((6219, 157), (2666, 157))
```

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

In [63]:
```
y_train = df_train.pop('Rating')
x_train = df_train
```

In [64]:
```
y_test = df_test.pop('Rating')
x_test = df_train
```

Model Building

and import packages

In [65]:
```
from sklearn.linear_model import LinearRegression
```

In [66]:
```
model = LinearRegression()
```

In [67]:
```
model.fit(x_train,y_train)
```

Out[67]:
```
LinearRegression()
```

To find Report the R2 on the train set

Import packages

In [68]:
```
from sklearn.metrics import r2_score
```

In [69]:
```
y_train_pred = model.predict(x_train)

r2_score(y_train,y_train_pred)
```

Out[69]:
```
0.16609972164460496
```

In [70]:
```
y_test_pred = model.predict(x_test)

r2_score(y_train,y_train_pred)
```

Out[70]:
```
0.16609972164460496
```

In [71]:
```
model.score(x_test,y_test_pred)
```

Out[71]:
```
1.0
```

In [72]:
```
model.score(x_train,y_train_pred)
```

Out[72]:
```
1.0
```

In [ ]:
```

```