EDA on Playstore App Review

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Business Context

The playstore apps has enormous potential to drive app-making business success. Actionable insights can be drawn for developers to work on and capture the android market. Each app (row) has value for category, ratimg, size, and more. Another dataset contain customer reviews of the android apps. Explotre and analyse the data to discover key factors responsible for app engagement and success.

Problem Statement

- The Play Store apps data has enormous potential to drive app-making businesses to success. Actionable insights can be drawn for developers to work on and capture the Android market.
- Each app (row) has values for catergory, rating, size, and more. Another dataset contains customer reviews of the android apps.
- Explore and analyze the data to discover key factors responsible for app engagement and success.

Github Link

https://github.com/rahulinchal/Play-Store-App-Review (https://github.com/rahulinchal/Play-Store-App-Review)

Importing Important packages

In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
from matplotlib import pyplot as plt

# importing the datetime library
from datetime import datetime

# Ignoring warnings
import warnings
warnings.filterwarnings('ignore')
```

Exploring Play Store Data

Loading the dataset

In [2]:
```
ps = pd.read_csv("https://raw.githubusercontent.com/rahulinchal/EDA-on-Play-Store
ps.head()
```

Out[2]:

	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	Desig

Data Description

- **App**: Contains the name of the app with a short description (optional).
- **Category** : It gives the category to the app.
- **Rating**: It contains the average rating the respective app received from its users.
- **Reviews**: It contains the number of users that have dropped a review for the respective app.
- **Size**: It contains the the disk space required to install the respective app.

- **Installs**: It gives the rounded figure of number of times the respective app was downloaded.
- **Type**: It states whether an app is free to use or paid.
- **Price**: It gives the price payable to install the app. For free type apps, the price is zero.
- **Content rating**: It states whether or not an app is suitable for all age groups or not.
- **Genres**: It gives the genre(s) to which the respective app belongs.
- **Last updated**: It gives the day in which the latest update was released.
- **Current Ver**: It gives the current version of the respective app.
- **Android Ver**: It gives the android version of the respective app.

In [3]:
```
# Getting the information
ps.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 [4]:
```
# Getting the shape
ps.shape
```

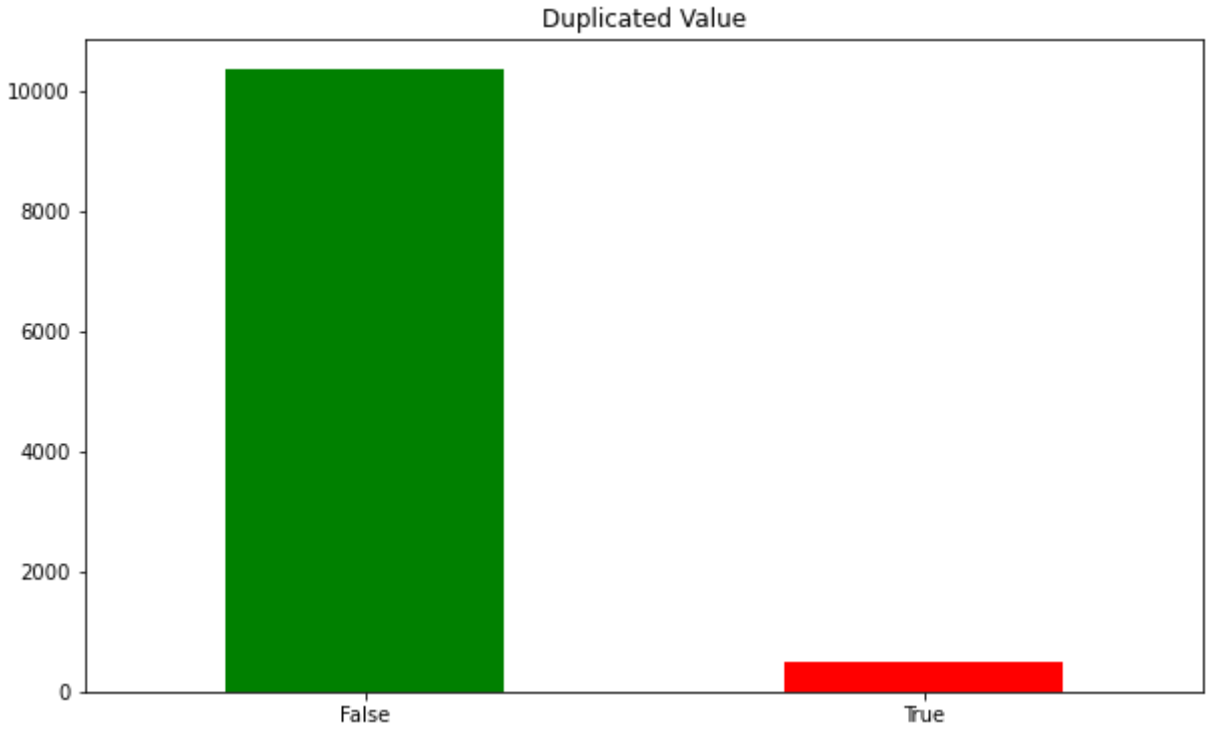
Out[4]:
```
(10841, 13)
```

In [5]:
```
# Finding the duplicated value
dup = ps.duplicated().value_counts()
dup
```

Out[5]:
```
False    10358
True       483
dtype: int64
```

In [6]:
```
# Visualizing through bar graph
plt.figure(figsize = (10,6))
dup.plot(kind = 'bar', color = ['g','r'])
plt.xticks(rotation = 360)
plt.title("Duplicated Value")
```

Out[6]:
```
Text(0.5, 1.0, 'Duplicated Value')
```



In [7]:
```
# Droping the duplicated value
ps = ps.drop_duplicates()
ps.duplicated().value_counts()
```

Out[7]:
```
False    10358
dtype: int64
```

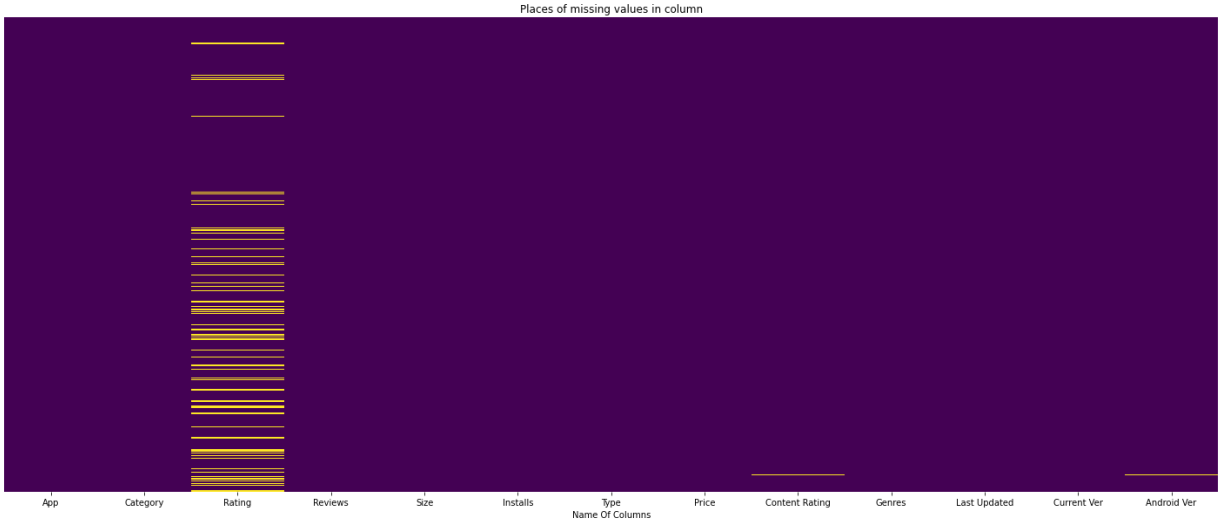
Finding the null values

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

Out[8]:
```
App                0
Category           0
Rating          1465
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
```

In [9]:
```
# Visulaizing null values through heatmap.
plt.figure(figsize=(25, 10))
sns.heatmap(ps.isnull(), cbar=False, yticklabels=False,cmap='viridis')
plt.xlabel("Name Of Columns")
plt.title("Places of missing values in column")
```

Out[9]:
```
Text(0.5, 1.0, 'Places of missing values in column')
```



In [10]:
```
# Finding the unique values
print(ps.apply(lambda col: col.unique()))
```

```
App               [Photo Editor & Candy Camera & Grid & ScrapBoo...
Category          [ART_AND_DESIGN, AUTO_AND_VEHICLES, BEAUTY, BO...
Rating            [4.1, 3.9, 4.7, 4.5, 4.3, 4.4, 3.8, 4.2, 4.6, ...
Reviews           [159, 967, 87510, 215644, 167, 178, 36815, 137...
Size              [19M, 14M, 8.7M, 25M, 2.8M, 5.6M, 29M, 33M, 3....
Installs          [10,000+, 500,000+, 5,000,000+, 50,000,000+, 1...
Type                                          [Free, Paid, nan, 0]
Price             [0, $4.99, $3.99, $6.99, $1.49, $2.99, $7.99, ...
Content Rating    [Everyone, Teen, Everyone 10+, Mature 17+, Adu...
Genres            [Art & Design, Art & Design;Pretend Play, Art ...
Last Updated      [January 7, 2018, January 15, 2018, August 1, ...
Current Ver       [1.0.0, 2.0.0, 1.2.4, Varies with device, 1.1,...
Android Ver       [4.0.3 and up, 4.2 and up, 4.4 and up, 2.3 and...
dtype: object
```

In [11]:
```
ps['Type'].value_counts()
```

Out[11]:
```
Free    9591
Paid     765
0          1
Name: Type, dtype: int64
```

In [12]:
```
ps['Type'].unique()
```

Out[12]:
```
array(['Free', 'Paid', nan, '0'], dtype=object)
```

In [13]:
```
ps[ps['Type'].isnull()]
```

Out[13]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	La Updat
9148	Command & Conquer: Rivals	FAMILY	NaN	0	Varies with device	0	NaN	0	Everyone 10+	Strategy	June 2 20

Since the Nan value in Type belongs to price 0 which means it shoud be of Type Free

In [14]:
```
ps['Type'].replace(np.nan, 'Free', inplace = True)
```

In [15]:
```
# Hence the null value is being replaced
ps[ps['Type'].isnull()]
```

Out[15]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver

Treating the null values in Rating column

In [16]:
```
# How many null values are there
ps['Rating'].isnull().sum()
```

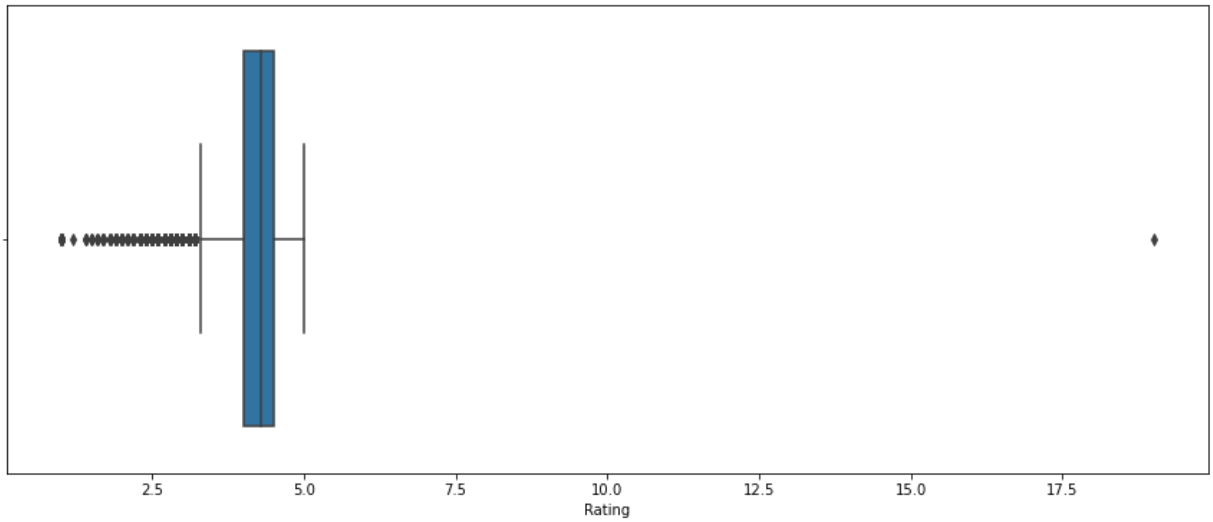
Out[16]: 1465

In [17]:
```
# Lets find the mean and median of it
mean_rating = ps['Rating'].mean()
median_rating = ps['Rating'].median()
round(mean_rating, 1), round(median_rating, 2)
```

Out[17]: (4.2, 4.3)

In [18]:
```
# lets chech the boxplot fot its outliers
plt.figure(figsize = (15,6))
sns.boxplot(ps['Rating'])
```

Out[18]: <AxesSubplot:xlabel='Rating'>



Since there are a lot of outliers and we know that mean is affected by Outliers and not the median, hence we will replace the null values with median

In [19]:
```
ps['Rating'].replace(np.nan, ps['Rating'].median(), inplace = True)
```

In [20]:
```
# Checking for null values now
ps['Rating'].isnull().sum()
```

Out[20]: 0

Hence all the null values are replaced with median and now lets take care of outliers.

In [21]:
```
# Listng all the bottom 5 values
sorted(ps['Rating'])[-5 :]
```

Out[21]: [5.0, 5.0, 5.0, 5.0, 19.0]

In [22]:
```
ps[ps['Rating'] == 19.0]
```

Out[22]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres
10472	Life Made WI-Fi Touchscreen Photo Frame	1.9	19.0	3.0M	1,000+	Free	0	Everyone	NaN	February 11, 2018

Since the rating cannot be 19 and also category cannot be 1.9

The entire row is misplaced because of one value of category column is missing so its better to drop the entire row.

In [23]:
```
# Checking the shape before dropping
ps.shape
```

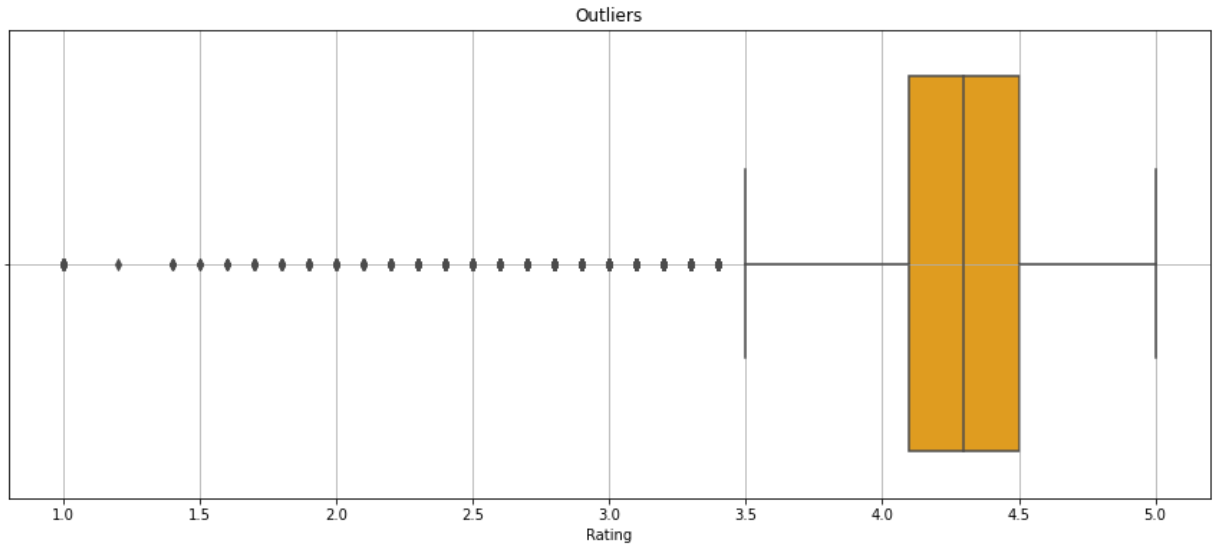
Out[23]: (10358, 13)

In [24]:
```
# Dropping the row number 10472
ps = ps.drop(10472)
```

In [25]:
```
# Checking the shape after dropping
ps.shape
```

Out[25]: (10357, 13)

In [26]:
```
# lets chech the boxplot fot its outliers
plt.figure(figsize = (15,6))
sns.boxplot(ps['Rating'], color = 'orange')
plt.title("Outliers")
plt.grid()
```



Observation

Since according to the formula there may be outliers but the rating usually range between 1 to 5 and we can see that there are no values beyond the range. So not dropping the outliers.

Checking for null values for Current Version and Android Version

In [27]:
```
ps.isnull().sum()
```

Out[27]:
```
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       8
Android Ver       2
dtype: int64
```

In [28]:
```
ps['Current Ver'].unique()
```

Out[28]:
```
array(['1.0.0', '2.0.0', '1.2.4', ..., '1.0.612928', '0.3.4', '2.0.148.0'],
      dtype=object)
```

In [29]:
```
ps
```

Out[29]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	C
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Ev
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Ev
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0	Ev
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Ev
...	...	...	...	...	...	...	...	...	
10836	Sya9a Maroc - FR	FAMILY	4.5	38	53M	5,000+	Free	0	Ev
10837	Fr. Mike Schmitz Audio Teachings	FAMILY	5.0	4	3.6M	100+	Free	0	Ev
10838	Parkinson Exercices FR	MEDICAL	4.3	3	9.5M	1,000+	Free	0	Ev
10839	The SCP Foundation DB fr nn5n	BOOKS_AND_REFERENCE	4.5	114	Varies with device	1,000+	Free	0	
10840	iHoroscope - 2018 Daily Horoscope & Astrology	LIFESTYLE	4.5	398307	19M	10,000,000+	Free	0	Ev

10357 rows × 13 columns

Since there are only 8 null values in current version and 2 in android version hence either we can replace it or drop it. lets replace it with Varies with device.

In [30]:
```
ps['Current Ver'].replace(np.nan, 'Varies with device', inplace = True)
ps['Android Ver'].replace(np.nan, 'Varies with device', inplace = True)
```

In [31]:
```
ps.isnull().sum()
```

Out[31]:
```
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
```

Let's change the date time format

In [32]:
```
# The datetime.strptime funtion applied to the values in the last updated column

ps['Last Updated'] = ps['Last Updated'].apply(lambda x: datetime.strptime(x,'%B %
ps.head()
```

Out[32]:

	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	Desig

In [33]:
```
ps.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  object        
 6   Type            10357 non-null  object        
 7   Price           10357 non-null  object        
 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(1), object(11)
memory usage: 1.1+ MB
```

The column Installs contain unnecessary characters like come (,) and plus (+) which has to be removed.

In [34]:
```
ps['Installs'].value_counts()
```

Out[34]:
```
1,000,000+        1488
10,000,000+       1132
100,000+          1129
10,000+           1033
1,000+             890
100+               710
5,000,000+         683
500,000+           517
50,000+            474
5,000+             469
10+                385
100,000,000+       369
500+               328
50,000,000+        272
50+                204
5+                  82
1+                  67
500,000,000+        61
1,000,000,000+      49
0+                  14
0                    1
Name: Installs, dtype: int64
```

In [35]:
```
ps['Installs'] = ps['Installs'].str.replace(r"[+,]", '')
ps['Installs'].value_counts()
```

Out[35]:
```
1000000       1488
10000000      1132
100000        1129
10000         1033
1000           890
100            710
5000000        683
500000         517
50000          474
5000           469
10             385
100000000      369
500            328
50000000       272
50             204
5               82
1               67
500000000       61
1000000000      49
0               15
Name: Installs, dtype: int64
```

In [36]:
```
# Changing the datatype of Installs from object to int
ps['Installs'] = ps['Installs'].astype(int)
```

In [37]:
```
ps.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  int32
 6   Type            10357 non-null  object
 7   Price           10357 non-null  object
 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(1), int32(1), object(10)
memory usage: 1.1+ MB
```

Defining a function to convert all the entries in KB to MB and then converting them to float datatype.

- We can see that the values in the Size column contains data with different units. 'M' stands for MB and 'k' stands for KB. To easily analyse this column, it is necessary to convert all the values to a single unit. In this case, we will convert all the units to MB.
- We know that 1MB = 1024KB, to convert KB to MB, we must divide all the values which are in KB by 1024.

In [38]:
```
def kb_to_mb(val):
  try:
    if 'M' in val:
      return float(val[:-1])
    elif 'k' in val:
      return round(float(val[:-1])/1024, 2)
    else:
      return val
  except:
    return val
```

In [39]:
```
# The kb_to_mb funtion applied to the size column

ps['Size'] = ps['Size'].apply(lambda x: kb_to_mb(x))
ps.head()
```

Out[39]:

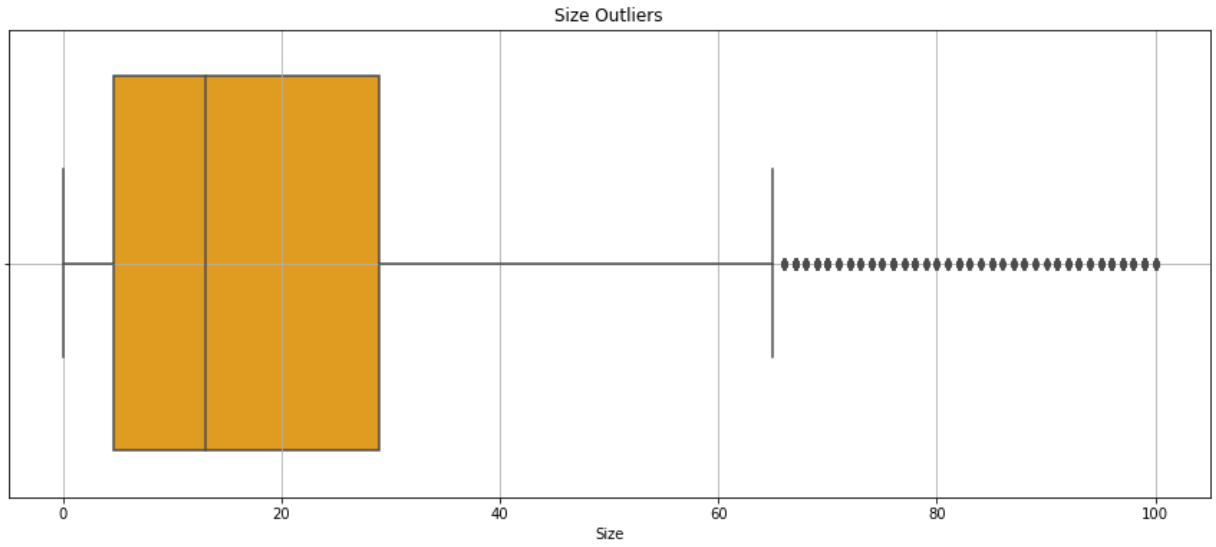
	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19.0	10000	Free	0	Everyone	Art &
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0	Everyone	Design;
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7	5000000	Free	0	Everyone	Art &
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25.0	50000000	Free	0	Teen	Art &
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8	100000	Free	0	Everyone	Design;C

In [40]:
```
ps['Size'].value_counts()
```

Out[40]:
```
Varies with device    1526
11.0                   188
13.0                   186
12.0                   186
14.0                   182
                      ...
0.48                     1
0.1                      1
0.56                     1
0.75                     1
0.66                     1
Name: Size, Length: 274, dtype: int64
```

In [41]:
```
# Plottinfg the boxplot for the Size column except 'Varies with Device'
size_new = ps[ps['Size'] != 'Varies with device']['Size']

plt.figure(figsize = (15,6))
sns.boxplot(size_new, color = 'orange')
plt.title("Size Outliers")
plt.grid()
```



There are outliers but we cannot remove them as they are the size of an app which can be as high as 100 mb and as low as 1mb also

In [42]:
```
ps.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  int32
 6   Type            10357 non-null  object
 7   Price           10357 non-null  object
 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(1), int32(1), object(10)
memory usage: 1.1+ MB
```

The price column contain dollar sign which is a special character hence have to drop it because the machine wont understand the dollar sign as currency.

Also Changing the type of Price column from object to float

In [43]:
```
ps['Price'].unique()
```

Out[43]:
```
array(['0', '$4.99', '$3.99', '$6.99', '$1.49', '$2.99', '$7.99', '$5.99',
       '$3.49', '$1.99', '$9.99', '$7.49', '$0.99', '$9.00', '$5.49',
       '$10.00', '$24.99', '$11.99', '$79.99', '$16.99', '$14.99',
       '$1.00', '$29.99', '$12.99', '$2.49', '$10.99', '$1.50', '$19.99',
       '$15.99', '$33.99', '$74.99', '$39.99', '$3.95', '$4.49', '$1.70',
       '$8.99', '$2.00', '$3.88', '$25.99', '$399.99', '$17.99',
       '$400.00', '$3.02', '$1.76', '$4.84', '$4.77', '$1.61', '$2.50',
       '$1.59', '$6.49', '$1.29', '$5.00', '$13.99', '$299.99', '$379.99',
       '$37.99', '$18.99', '$389.99', '$19.90', '$8.49', '$1.75',
       '$14.00', '$4.85', '$46.99', '$109.99', '$154.99', '$3.08',
       '$2.59', '$4.80', '$1.96', '$19.40', '$3.90', '$4.59', '$15.46',
       '$3.04', '$4.29', '$2.60', '$3.28', '$4.60', '$28.99', '$2.95',
       '$2.90', '$1.97', '$200.00', '$89.99', '$2.56', '$30.99', '$3.61',
       '$394.99', '$1.26', '$1.20', '$1.04'], dtype=object)
```

In [44]:
```
ps['Price'] = ps['Price'].str.replace(r"[$]", '')
ps['Price'].unique()
```

Out[44]:
```
array(['0', '4.99', '3.99', '6.99', '1.49', '2.99', '7.99', '5.99',
       '3.49', '1.99', '9.99', '7.49', '0.99', '9.00', '5.49', '10.00',
       '24.99', '11.99', '79.99', '16.99', '14.99', '1.00', '29.99',
       '12.99', '2.49', '10.99', '1.50', '19.99', '15.99', '33.99',
       '74.99', '39.99', '3.95', '4.49', '1.70', '8.99', '2.00', '3.88',
       '25.99', '399.99', '17.99', '400.00', '3.02', '1.76', '4.84',
       '4.77', '1.61', '2.50', '1.59', '6.49', '1.29', '5.00', '13.99',
       '299.99', '379.99', '37.99', '18.99', '389.99', '19.90', '8.49',
       '1.75', '14.00', '4.85', '46.99', '109.99', '154.99', '3.08',
       '2.59', '4.80', '1.96', '19.40', '3.90', '4.59', '15.46', '3.04',
       '4.29', '2.60', '3.28', '4.60', '28.99', '2.95', '2.90', '1.97',
       '200.00', '89.99', '2.56', '30.99', '3.61', '394.99', '1.26',
       '1.20', '1.04'], dtype=object)
```

In [45]:
```
ps['Price'] = ps['Price'].astype(float)
```

Also changing the datatype of Reviews to float

In [46]:
```
ps['Reviews'] = ps['Reviews'].astype(float)
ps.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  float64       
 4   Size            10357 non-null  object        
 5   Installs        10357 non-null  int32         
 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), int32(1), object(8)
memory usage: 1.1+ MB
```

Describing the Play Store columns

In [47]:
```
ps.describe().style.background_gradient()
```

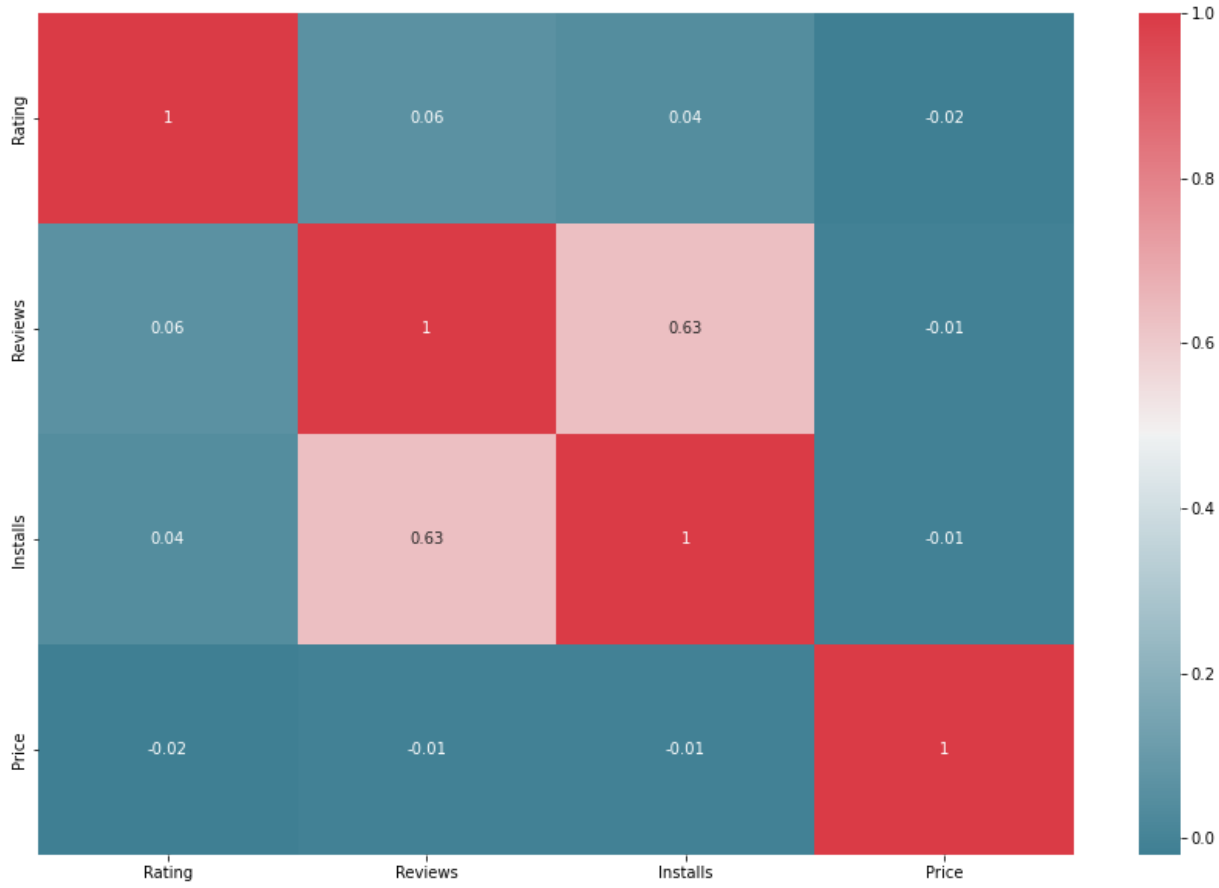
Out[47]:

	Rating	Reviews	Installs	Price
count	10357.000000	10357.000000	10357.000000	10357.000000
mean	4.203737	405904.610602	14157759.440668	1.030800
std	0.485594	2696777.836748	80239553.869017	16.278625
min	1.000000	0.000000	0.000000	0.000000
25%	4.100000	32.000000	1000.000000	0.000000
50%	4.300000	1680.000000	100000.000000	0.000000
75%	4.500000	46416.000000	1000000.000000	0.000000
max	5.000000	78158306.000000	1000000000.000000	400.000000

Correlation

In [48]:
```
plt.figure(figsize=(15,10))
cmap = sns.diverging_palette(220, 10, as_cmap=True)
sns.heatmap(np.round(ps.corr(),2),annot=True, cmap=cmap)
```

Out[48]: <AxesSubplot:>



Exploratory Data Analysis

Univariate Analysis

1. Which Category is most preffered by people?

In [95]:
```
ps.head()
```

Out[95]:

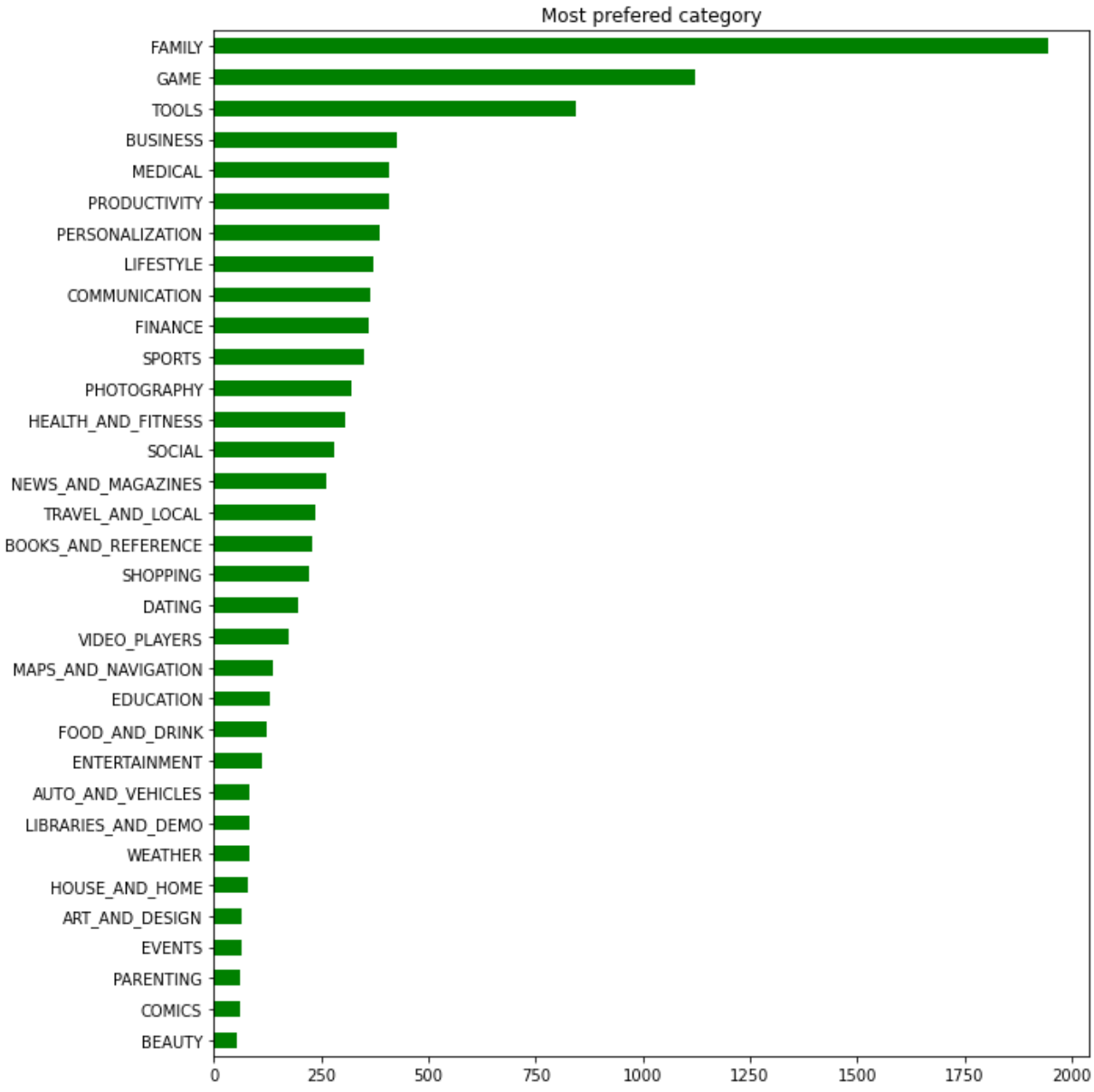
	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159.0	19.0	10000	Free	0.0	Everyone	Art &
1	Coloring book moana	ART_AND_DESIGN	3.9	967.0	14.0	500000	Free	0.0	Everyone	Design;
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510.0	8.7	5000000	Free	0.0	Everyone	Art &
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644.0	25.0	50000000	Free	0.0	Teen	Art &
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967.0	2.8	100000	Free	0.0	Everyone	Design;C

In [50]:
```
ps['Category'].value_counts()
```

Out[50]:
```
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
```

In [51]:
```
plt.figure(figsize = (10,12))
ps['Category'].value_counts().plot(kind = 'barh', color = 'g').invert_yaxis()
plt.title('Most prefered category')
```

Out[51]: Text(0.5, 1.0, 'Most prefered category')



Observation

- Looks like people like Family category for downloading the app.
- Second best category is gaming.

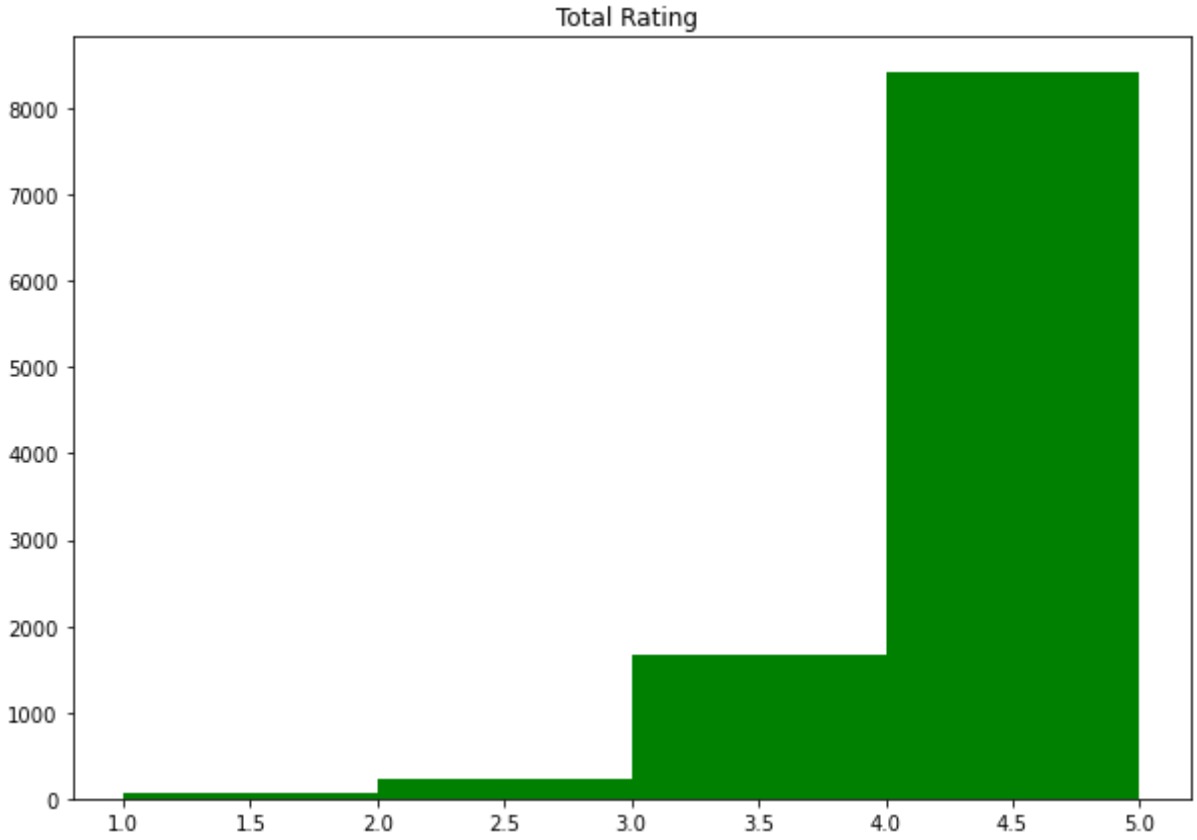
2. What is the overall ratings for an app?

In [52]:
```
ps['Rating'].value_counts()
```

Out[52]:
```
4.3    2481
4.4    1032
4.5     977
4.2     888
4.6     768
4.1     657
4.0     539
4.7     484
3.9     372
3.8     293
5.0     271
3.7     231
4.8     228
3.6     169
3.5     157
3.4     127
3.3     101
4.9      87
3.0      82
3.1      69
3.2      64
2.9      45
2.8      40
2.6      24
2.7      23
2.5      20
2.3      20
2.4      19
1.0      16
2.2      14
1.9      12
2.0      12
1.7       8
1.8       8
2.1       8
1.6       4
1.4       3
1.5       3
1.2       1
Name: Rating, dtype: int64
```

In [53]:
```
fig, ax = plt.subplots(figsize =(10, 7))
ax.hist(ps['Rating'], bins = [1, 2, 3, 4, 5], color = 'g')
plt.title("Total Rating ")
```

Out[53]: Text(0.5, 1.0, 'Total Rating ')



Observation

- Almost more than 80% of the app in playstore lies between the range of 4 - 5

3. How many Installation happened?

In [54]:
```
ps.head()
```

Out[54]:

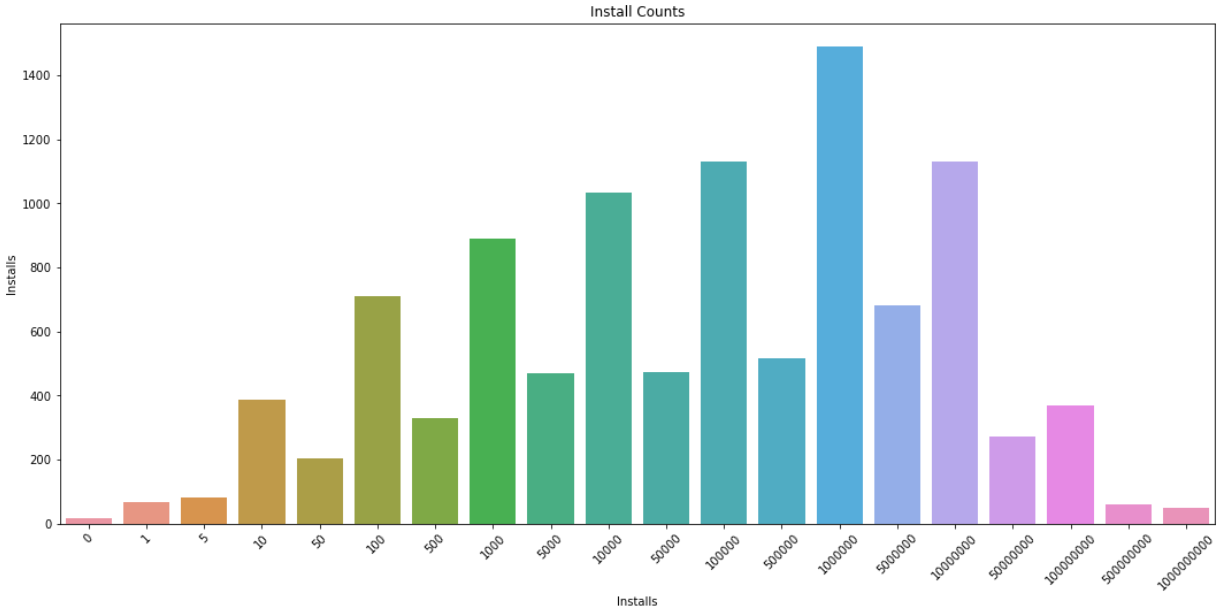
	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159.0	19.0	10000	Free	0.0	Everyone	Art &
1	Coloring book moana	ART_AND_DESIGN	3.9	967.0	14.0	500000	Free	0.0	Everyone	Design;
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510.0	8.7	5000000	Free	0.0	Everyone	Art &
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644.0	25.0	50000000	Free	0.0	Teen	Art &
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967.0	2.8	100000	Free	0.0	Everyone	Design;C

In [55]:
```
ps['Installs'].value_counts().reset_index()
```

Out[55]:

	index	Installs
0	1000000	1488
1	10000000	1132
2	100000	1129
3	10000	1033
4	1000	890
5	100	710
6	5000000	683
7	500000	517
8	50000	474
9	5000	469
10	10	385
11	100000000	369
12	500	328
13	50000000	272
14	50	204
15	5	82
16	1	67
17	500000000	61
18	1000000000	49
19	0	15

In [56]:
```
plt.figure(figsize = (18,8))
sns.barplot(data = ps, x = ps['Installs'].value_counts().keys(), y = ps['Installs
plt.xticks(rotation = 45)
plt.title("Install Counts")
plt.xlabel("Installs");
```



Observations

- There are 1488 apps with more than 10,00,000 downloads/ Installs.
- almost same amount of apps have 1,00,00 and 100,00,000 downloads/ Installs.

4. Find the top free apps

In [57]:
```
ps.head()
```

Out[57]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159.0	19.0	10000	Free	0.0	Everyone	Art &
1	Coloring book moana	ART_AND_DESIGN	3.9	967.0	14.0	500000	Free	0.0	Everyone	Design;
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510.0	8.7	5000000	Free	0.0	Everyone	Art &
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644.0	25.0	50000000	Free	0.0	Teen	Art &
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967.0	2.8	100000	Free	0.0	Everyone	Design;C

In [58]:
```
# Filtering out free apps
free_apps = ps[ps['Type'] == 'Free']
free_apps['Type'].value_counts()
```

Out[58]:
```
Free    9592
Name: Type, dtype: int64
```

In [59]:
```
# Sorting it with Installs
top_free_apps = free_apps[free_apps['Installs'] == free_apps['Installs'].max()]
top_free_apps.head()
```

Out[59]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	C
152	Google Play Books	BOOKS_AND_REFERENCE	3.9	1433233.0	Varies with device	1000000000	Free	0.0	
335	Messenger – Text and Video Chat for Free	COMMUNICATION	4.0	56642847.0	Varies with device	1000000000	Free	0.0	Ev
336	WhatsApp Messenger	COMMUNICATION	4.4	69119316.0	Varies with device	1000000000	Free	0.0	Ev
338	Google Chrome: Fast & Secure	COMMUNICATION	4.3	9642995.0	Varies with device	1000000000	Free	0.0	Ev
340	Gmail	COMMUNICATION	4.3	4604324.0	Varies with device	1000000000	Free	0.0	Ev

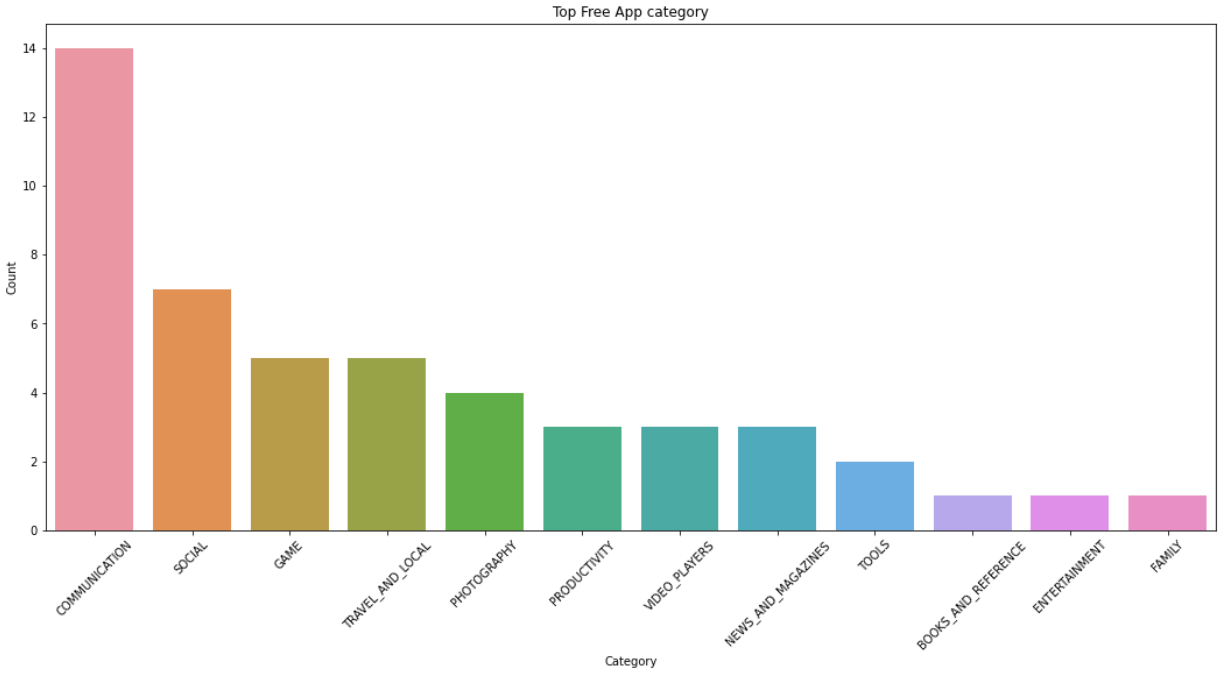
In [60]:
```
top_free_apps.shape
```

Out[60]:
```
(49, 13)
```

In [61]:
```
top_free_apps['Category'].value_counts()
```

Out[61]:
```
COMMUNICATION          14
SOCIAL                  7
GAME                    5
TRAVEL_AND_LOCAL        5
PHOTOGRAPHY             4
PRODUCTIVITY            3
VIDEO_PLAYERS           3
NEWS_AND_MAGAZINES      3
TOOLS                   2
BOOKS_AND_REFERENCE     1
ENTERTAINMENT           1
FAMILY                  1
Name: Category, dtype: int64
```

In [62]:
```
# Visualizing using barplot
plt.figure(figsize = (18,8))
sns.barplot(data = top_free_apps, x = top_free_apps['Category'].value_counts().ke
            y = top_free_apps['Category'].value_counts())
plt.xticks(rotation = 45)
plt.title("Top Free App category")
plt.xlabel("Category")
plt.ylabel("Count")
plt.show()
```



Observation

- Communication is the category which has a lot of interest of people when it comes to free apps.
- Followed by the social category apps.

5. Find the top Paid apps

In [63]:
```
ps['Type'].unique()
```

Out[63]:
```
array(['Free', 'Paid'], dtype=object)
```

In [64]:
```
# Filtering out paid apps
paid_apps = ps[ps['Type'] == 'Paid']
paid_apps['Type'].value_counts()
```

Out[64]:
```
Paid    765
Name: Type, dtype: int64
```

In [65]:
```
paid_apps.sort_values(["Price"],
                      axis = 0, ascending = False,
                      inplace = True,
                      na_position = "first")
paid_apps
```

Out[65]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating
4367	I'm Rich - Trump Edition	LIFESTYLE	3.6	275.0	7.3	10000	Paid	400.00	Everyone
5362	I Am Rich Pro	FAMILY	4.4	201.0	2.7	5000	Paid	399.99	Everyone
5358	I am Rich!	FINANCE	3.8	93.0	22.0	1000	Paid	399.99	Everyone
4362	💎 I'm rich	LIFESTYLE	3.8	718.0	26.0	10000	Paid	399.99	Everyone
5364	I am rich (Most expensive app)	FINANCE	4.1	129.0	2.7	1000	Paid	399.99	Teen
...	...	...	...	...	...	...	...	...	...
6929	Color Changer Pro [root]	PERSONALIZATION	4.5	69.0	0.93	1000	Paid	0.99	Everyone
6919	HD Widgets	PERSONALIZATION	4.3	58614.0	26.0	1000000	Paid	0.99	Everyone
6897	Watch Face BW Inter	PERSONALIZATION	3.1	112.0	8.8	1000	Paid	0.99	Everyone
6766	Little Magnet BT Pro	TOOLS	4.6	251.0	3.8	1000	Paid	0.99	Everyone
6088	Wolf of the BF:Commando MOBILE	GAME	3.4	32.0	27.0	1000	Paid	0.99	Everyone 10+

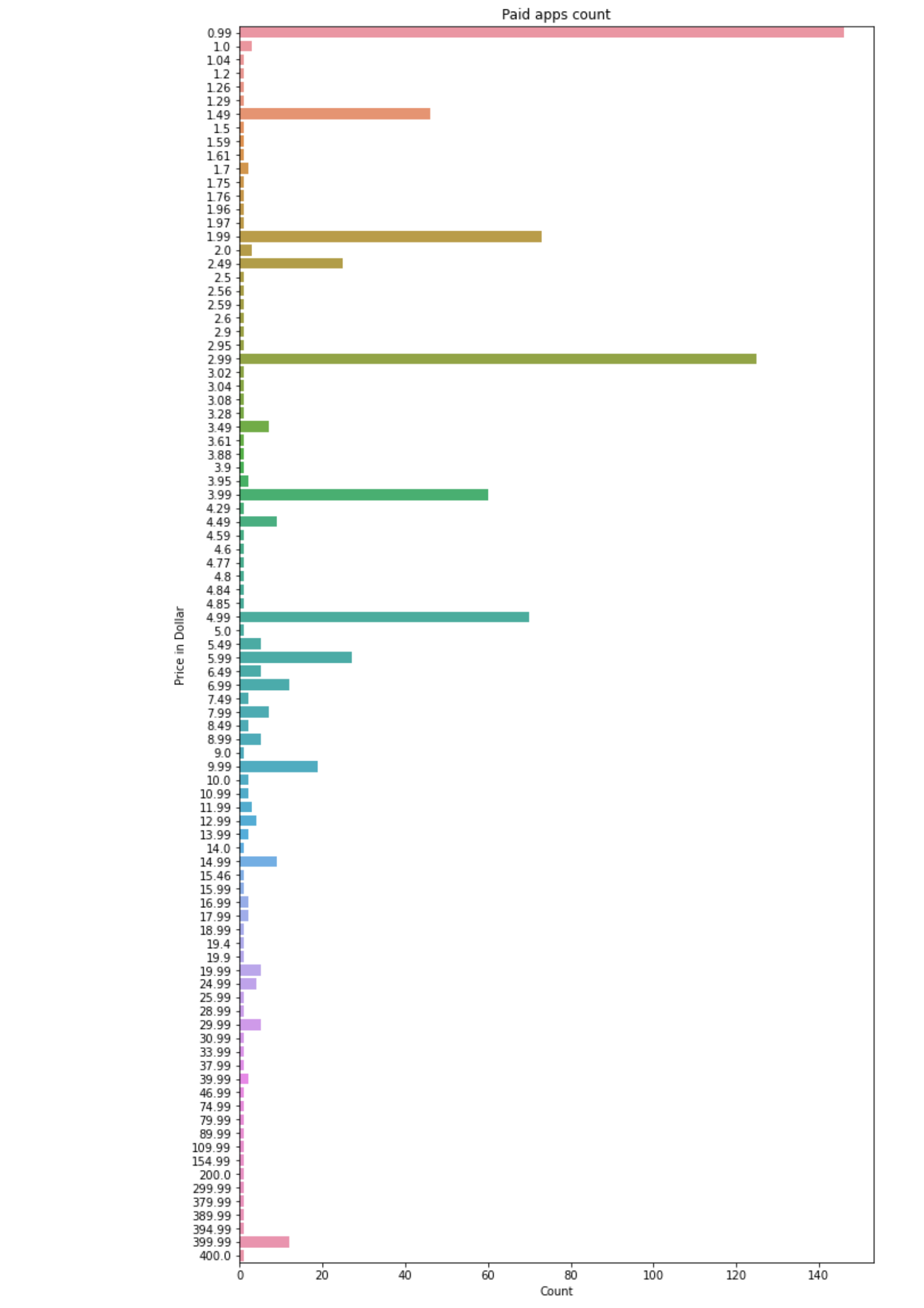
765 rows × 13 columns

In [66]:
```
paid_apps['Price'].value_counts()
```

Out[66]:
```
0.99      146
2.99      125
1.99       73
4.99       70
3.99       60
         ...
109.99      1
154.99      1
3.90        1
3.88        1
400.00      1
Name: Price, Length: 91, dtype: int64
```

In [67]:

```
plt.figure(figsize = (10,20))
sns.barplot(data = paid_apps, x = paid_apps['Price'].value_counts(),
                              y = paid_apps['Price'].value_counts().keys(), orie
plt.title("Paid apps count")
plt.xlabel("Count")
plt.ylabel("Price in Dollar")
plt.show()
```


Paid apps count
Price in Dollar
0.99
1.0
1.04
1.2
1.26
1.29
1.49
1.5
1.59
1.61
1.7
1.75
1.76
1.96
1.97
1.99
2.0
2.49
2.5
2.56
2.59
2.6
2.9
2.95
2.99
3.02
3.04
3.08
3.28
3.49
3.61
3.88
3.9
3.95
3.99
4.29
4.49
4.59
4.6
4.77
4.8
4.84
4.85
4.99
5.0
5.49
5.99
6.49
6.99
7.49
7.99
8.49
8.99
9.0
9.99
10.0
10.99
11.99
12.99
13.99
14.0
14.99
15.46
15.99
16.99
17.99
18.99
19.4
19.9
19.99
24.99
25.99
28.99
29.99
30.99
33.99
37.99
39.99
46.99
74.99
79.99
89.99
109.99
154.99
200.0
299.99
379.99
389.99
394.99
399.99
400.0
0
20
40
60
80
100
120
140
Count

Observation

- The paid apps charge the users a certain amount to download and install the app. This amount varies from one app to another.
- There are a lot of apps that charge a small amount whereas some apps charge a larger amount. In this case the price to download an app varies from USD 0.99 to USD 400.
- In order to select the top paid apps, it won't be fair to look just into the numer of installs. This is because the apps that charge a lower installation fee will be installed by more number of people in general.
- Here a better way to determine the top apps in the paid category is by finding the revenue it generated through app installs.
- This is given by:

6. Content Rating

In [68]:
```
ps.head()
```

Out[68]:

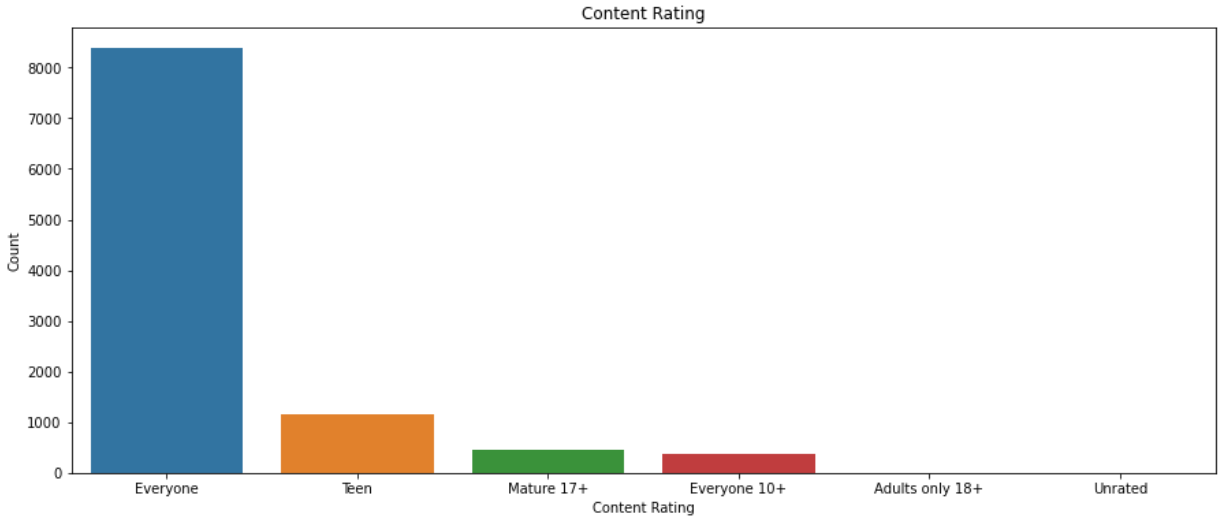
	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159.0	19.0	10000	Free	0.0	Everyone	Art &
1	Coloring book moana	ART_AND_DESIGN	3.9	967.0	14.0	500000	Free	0.0	Everyone	Design;
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510.0	8.7	5000000	Free	0.0	Everyone	Art &
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644.0	25.0	50000000	Free	0.0	Teen	Art &
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967.0	2.8	100000	Free	0.0	Everyone	Design;C

In [69]:
```
ps['Content Rating'].value_counts()
```

Out[69]:
```
Everyone           8382
Teen               1146
Mature 17+          447
Everyone 10+        377
Adults only 18+       3
Unrated               2
Name: Content Rating, dtype: int64
```

In [70]:
```
# Visualzing with the graph
plt.figure(figsize = (15,6))
sns.barplot(data = ps, x = ps['Content Rating'].value_counts().keys(), y = ps['C
plt.title("Content Rating")
plt.xlabel("Content Rating")
plt.ylabel("Count")
```

Out[70]:
```
Text(0, 0.5, 'Count')
```



Observation

- It looks like most of the apps are made for everyone and the real source of income for them is Ads.

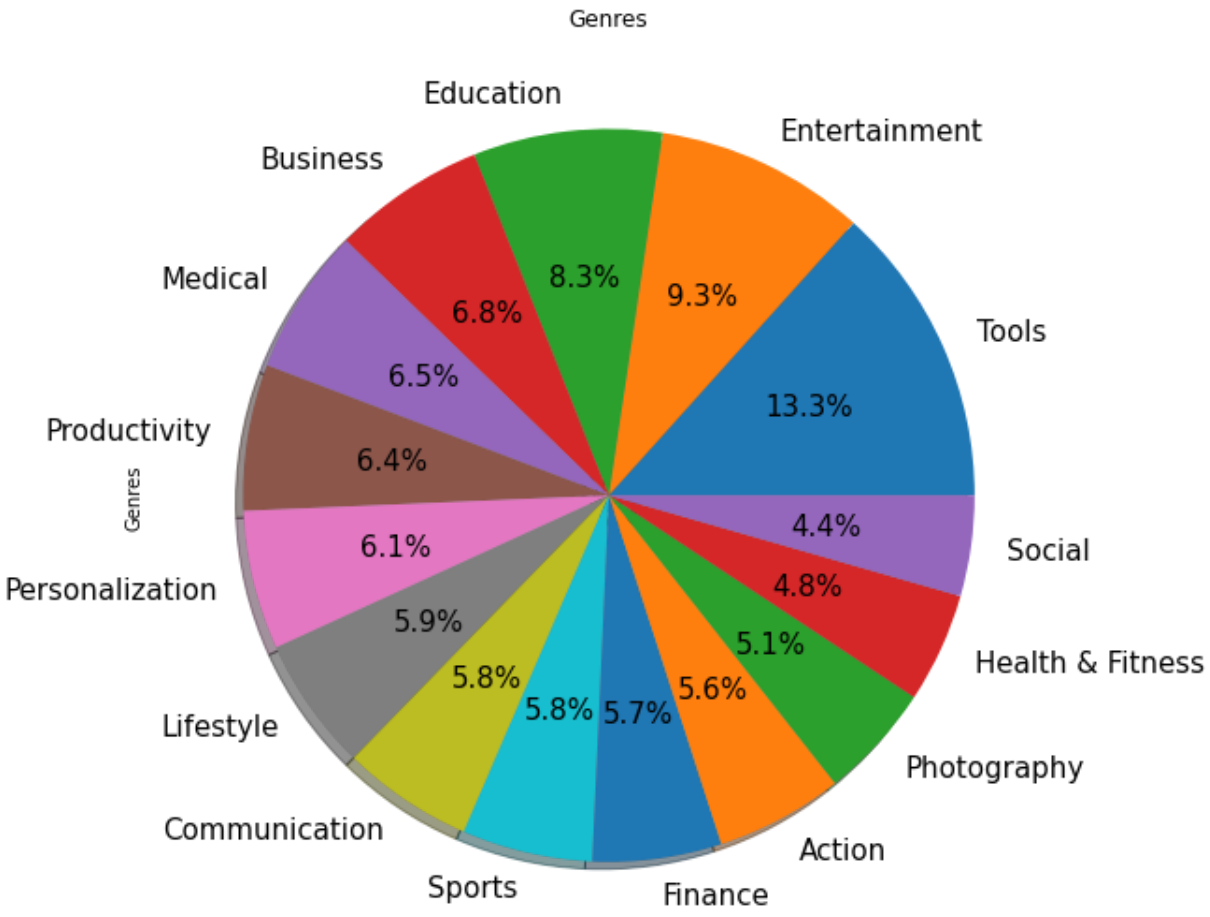
7. Genres

In [71]:
```
ps['Genres'].value_counts().iloc[:15]
```

Out[71]:
```
Tools                842
Entertainment        588
Education            527
Business             427
Medical              408
Productivity         407
Personalization      388
Lifestyle            372
Communication        366
Sports               364
Finance              360
Action               356
Photography          322
Health & Fitness     306
Social               280
Name: Genres, dtype: int64
```

In [72]:
```
# Visualizing using pie chart.
textprops = {"fontsize":15} # Font size of text in pie chart
plt.figure(figsize = (9,9)) # fixing pie chart size
ps['Genres'].value_counts().iloc[:15].plot(kind = 'pie', shadow = True, autopct=
plt.title("Genres")
```

Out[72]: Text(0.5, 1.0, 'Genres')



Observation

- Looks like the most liked Genre is Tools but other than that every other app has equal weightage of likings

Bivariate Analysis

1. Find the top profitable app in terms of revenue

In [73]:
```
paid_apps.head()
```

Out[73]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres
4367	I'm Rich - Trump Edition	LIFESTYLE	3.6	275.0	7.3	10000	Paid	400.00	Everyone	Lifestyle
5362	I Am Rich Pro	FAMILY	4.4	201.0	2.7	5000	Paid	399.99	Everyone	Entertainment
5358	I am Rich!	FINANCE	3.8	93.0	22.0	1000	Paid	399.99	Everyone	Finance
4362	💎 I'm rich	LIFESTYLE	3.8	718.0	26.0	10000	Paid	399.99	Everyone	Lifestyle
5364	I am rich (Most expensive app)	FINANCE	4.1	129.0	2.7	1000	Paid	399.99	Teen	Finance

In [74]:
```
# Creating a column called revenue
paid_apps['Revenue'] = paid_apps['Price'] * paid_apps['Installs']
paid_apps.head()
```

Out[74]:

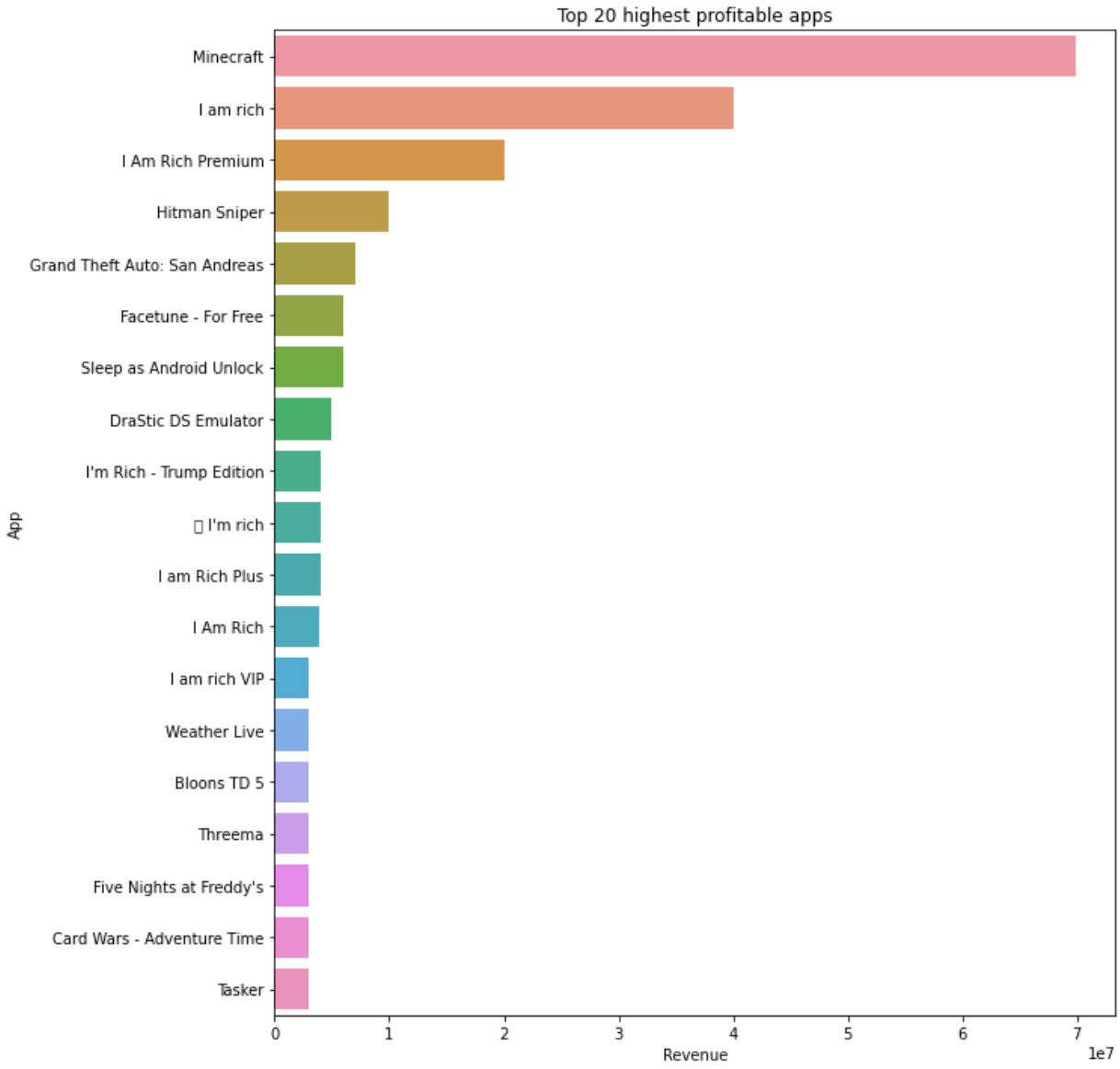
	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres
4367	I'm Rich - Trump Edition	LIFESTYLE	3.6	275.0	7.3	10000	Paid	400.00	Everyone	Lifestyle
5362	I Am Rich Pro	FAMILY	4.4	201.0	2.7	5000	Paid	399.99	Everyone	Entertainment
5358	I am Rich!	FINANCE	3.8	93.0	22.0	1000	Paid	399.99	Everyone	Finance
4362	💎 I'm rich	LIFESTYLE	3.8	718.0	26.0	10000	Paid	399.99	Everyone	Lifestyle
5364	I am rich (Most expensive app)	FINANCE	4.1	129.0	2.7	1000	Paid	399.99	Teen	Finance

In [75]:
```
# Sorting the Revenie column in decending order
top_paid_apps = paid_apps.sort_values(["Revenue"],
                axis = 0, ascending = False)
top_paid_apps.head()
```

Out[75]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Gen
2241	Minecraft	FAMILY	4.5	2376564.0	Varies with device	10000000	Paid	6.99	Everyone 10+	Arcade;Act & Advent
4347	Minecraft	FAMILY	4.5	2375336.0	Varies with device	10000000	Paid	6.99	Everyone 10+	Arcade;Act & Advent
5351	I am rich	LIFESTYLE	3.8	3547.0	1.8	100000	Paid	399.99	Everyone	Lifes
5356	I Am Rich Premium	FINANCE	4.1	1867.0	4.7	50000	Paid	399.99	Everyone	Finar
4034	Hitman Sniper	GAME	4.6	408292.0	29.0	10000000	Paid	0.99	Mature 17+	Act

In [76]:
```
plt.figure(figsize = (10,12))
sns.barplot(data = top_paid_apps, y =top_paid_apps['App'].iloc[:20],  x = top_pa
plt.title("Top 20 highest profitable apps")
plt.show()
```

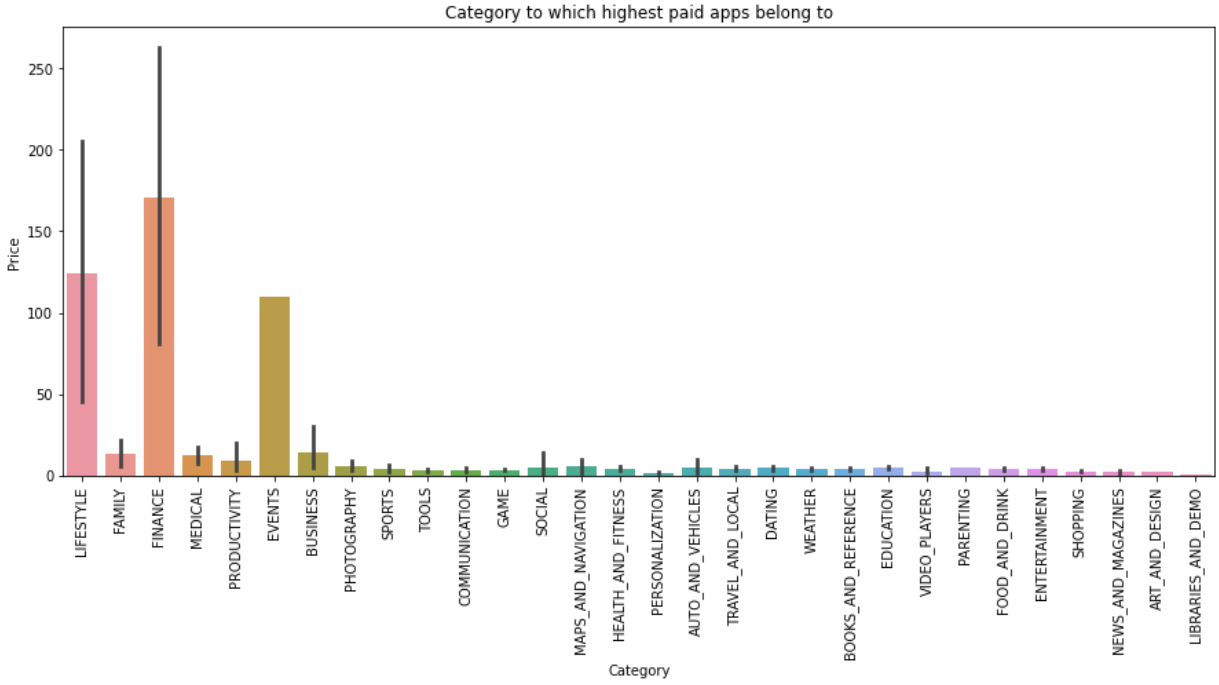


Observation

- Minecraft is the most profitable paid application followed by I'm rich

2. What are the categories in which the top paid apps belong to?

In [77]:
```
plt.figure(figsize = (15,6))
sns.barplot(data = paid_apps, x = paid_apps["Category"],
            y = paid_apps['Price'])
plt.xticks(rotation = 90)
plt.title("Category to which highest paid apps belong to")
plt.show()
```



Observation

- The highest revenue generating category is Finance

Exploring User Review data

Loading the dataset

In [78]:
```
ur = pd.read_csv("https://raw.githubusercontent.com/rahulinchal/EDA-on-Play-Store
ur.head()
```

Out[78]:

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
0	10 Best Foods for You	I like eat delicious food. That's I'm cooking ...	Positive	1.00	0.533333
1	10 Best Foods for You	This help eating healthy exercise regular basis	Positive	0.25	0.288462
2	10 Best Foods for You	NaN	NaN	NaN	NaN
3	10 Best Foods for You	Works great especially going grocery store	Positive	0.40	0.875000
4	10 Best Foods for You	Best idea us	Positive	1.00	0.300000

In [79]:
```
# Checking Shape
ur.shape
```

Out[79]:
```
(64295, 5)
```

In [80]:
```
# Checking info
ur.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 64295 entries, 0 to 64294
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype  
---  ------                  --------------  -----  
 0   App                     64295 non-null  object 
 1   Translated_Review       37427 non-null  object 
 2   Sentiment               37432 non-null  object 
 3   Sentiment_Polarity      37432 non-null  float64
 4   Sentiment_Subjectivity  37432 non-null  float64
dtypes: float64(2), object(3)
memory usage: 2.5+ MB
```

In [81]:
```
# FInding mathematical calulation for numerical data
ur.describe().style.background_gradient()
```

Out[81]:

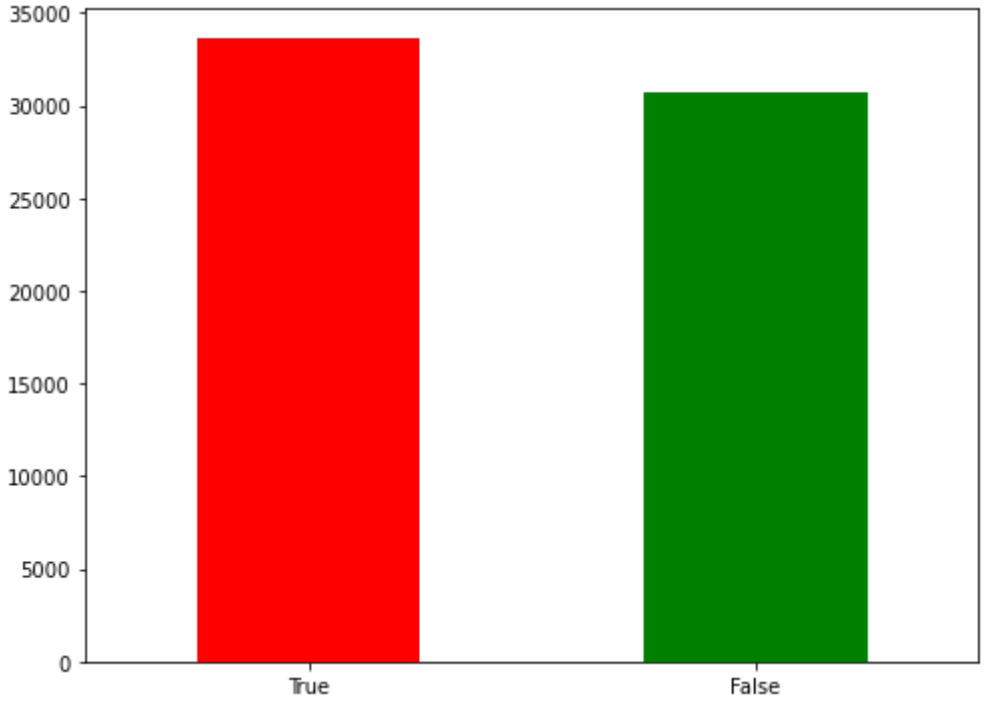
	Sentiment_Polarity	Sentiment_Subjectivity
count	37432.000000	37432.000000
mean	0.182146	0.492704
std	0.351301	0.259949
min	-1.000000	0.000000
25%	0.000000	0.357143
50%	0.150000	0.514286
75%	0.400000	0.650000
max	1.000000	1.000000

In [82]:
```
# Finding the duplicated value
dup = ur.duplicated().value_counts()
dup
```

Out[82]:
```
True     33616
False    30679
dtype: int64
```

In [83]:
```
# Visualizing the duplicated value
plt.figure(figsize = (8,6))
dup.plot(kind = 'bar', color = ['r','g'])
plt.xticks(rotation = 360)
```

Out[83]:
```
(array([0, 1]), [Text(0, 0, 'True'), Text(1, 0, 'False')])
```



In [84]:
```
# Droping the duplicated value
ur = ur.drop_duplicates()
ur.duplicated().value_counts()
```

Out[84]:
```
False    30679
dtype: int64
```

In [85]:
```
# Checking the shape after dropping the duplicated value
ur.shape
```

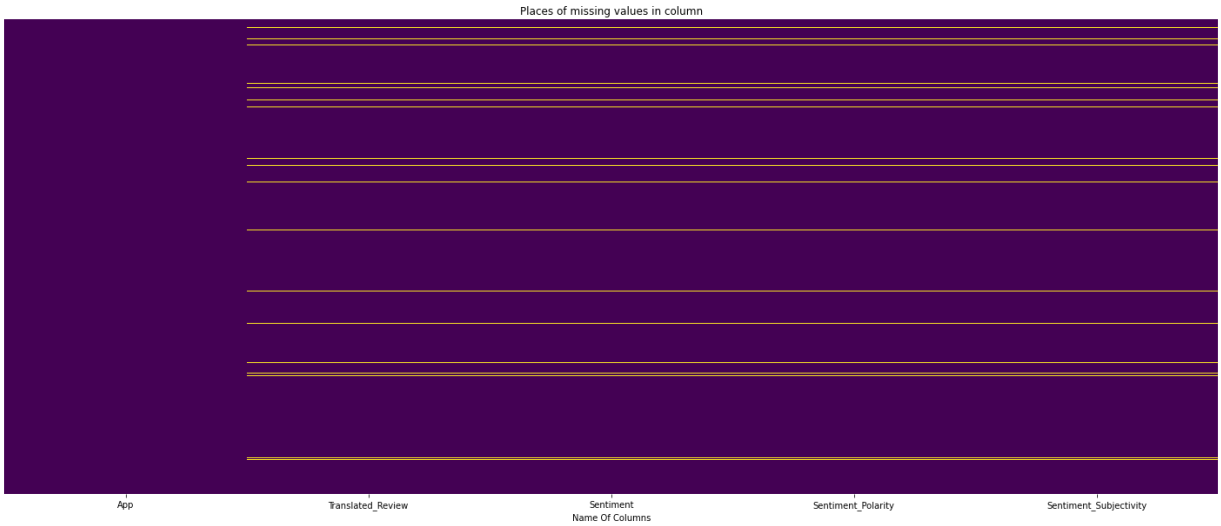
Out[85]:
```
(30679, 5)
```

In [86]:
```
# Checking for null value
ur.isnull().sum()
```

Out[86]:
```
App                        0
Translated_Review        987
Sentiment                982
Sentiment_Polarity       982
Sentiment_Subjectivity   982
dtype: int64
```

In [87]:
```
# Visulaizing null values through heatmap.
plt.figure(figsize=(25, 10))
sns.heatmap(ur.isnull(), cbar=False, yticklabels=False,cmap='viridis')
plt.xlabel("Name Of Columns")
plt.title("Places of missing values in column")
```

Out[87]:
```
Text(0.5, 1.0, 'Places of missing values in column')
```



There are a lot of NaN values and we cannot just drop it.

In [89]:
```
ur[ur['Translated_Review'].isnull()]
```

Out[89]:

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
2	10 Best Foods for You	NaN	NaN	NaN	NaN
268	11st	NaN	Neutral	0.0	0.0
362	1LINE – One Line with One Touch	NaN	NaN	NaN	NaN
405	2018Emoji Keyboard 😂 Emoticons Lite - sticker&gif	NaN	NaN	NaN	NaN
539	2Date Dating App, Love and matching	NaN	NaN	NaN	NaN
...	...	...	...	...	...
64082	Hotspot Shield Free VPN Proxy & Wi-Fi Security	NaN	NaN	NaN	NaN
64119	Hotstar	NaN	NaN	NaN	NaN
64156	Hotwire Hotel & Car Rental App	NaN	NaN	NaN	NaN
64202	Housing-Real Estate & Property	NaN	NaN	NaN	NaN
64236	Houzz Interior Design Ideas	NaN	NaN	NaN	NaN

987 rows × 5 columns

We can say that the apps which do not have a review (NaN value insted) tend to have NaN values in the columns Sentiment, Sentiment_Polarity, and Sentiment_Subjectivity in the majority of the cases.

In [90]:
```
# The rows corresponding to the NaN values in the translated_review column, where

ur[ur['Translated_Review'].isnull() & ur['Sentiment'].notna()]
```

Out[90]:

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
268	11st	NaN	Neutral	0.0	0.0
15048	Birds Sounds Ringtones & Wallpapers	NaN	Neutral	0.0	0.0
22092	Calorie Counter - MyFitnessPal	NaN	Neutral	0.0	0.0
31623	DC Comics	NaN	Neutral	0.0	0.0
52500	Garden Photo Frames - Garden Photo Editor	NaN	Neutral	0.0	0.0

In the few exceptional cases where the values of remaining columns are non null for null values in the translated_Review column, there seems to be errors. This is because the Sentiment, sentiment ploarity and sentiment subjectivity of the review can be determined if and only if there is a corresponding review.

Hence these values are wrong and can be deleted altogather.

In [91]:
```
# Dropping all the null values
ur = ur.dropna()
```

In [92]:
```
# Now checking the shape
ur.shape
```

Out[92]:
```
(29692, 5)
```

In [93]:
```
# Lets check for the null values
ur.isnull().sum()
```

Out[93]:
```
App                       0
Translated_Review         0
Sentiment                 0
Sentiment_Polarity        0
Sentiment_Subjectivity    0
dtype: int64
```

Now there are no null value we can start analyzing the data

In [94]:
```
ur.head()
```

Out[94]:

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
0	10 Best Foods for You	I like eat delicious food. That's I'm cooking ...	Positive	1.00	0.533333
1	10 Best Foods for You	This help eating healthy exercise regular basis	Positive	0.25	0.288462
3	10 Best Foods for You	Works great especially going grocery store	Positive	0.40	0.875000
4	10 Best Foods for You	Best idea us	Positive	1.00	0.300000
5	10 Best Foods for You	Best way	Positive	1.00	0.300000

Exploratory Data Analysis

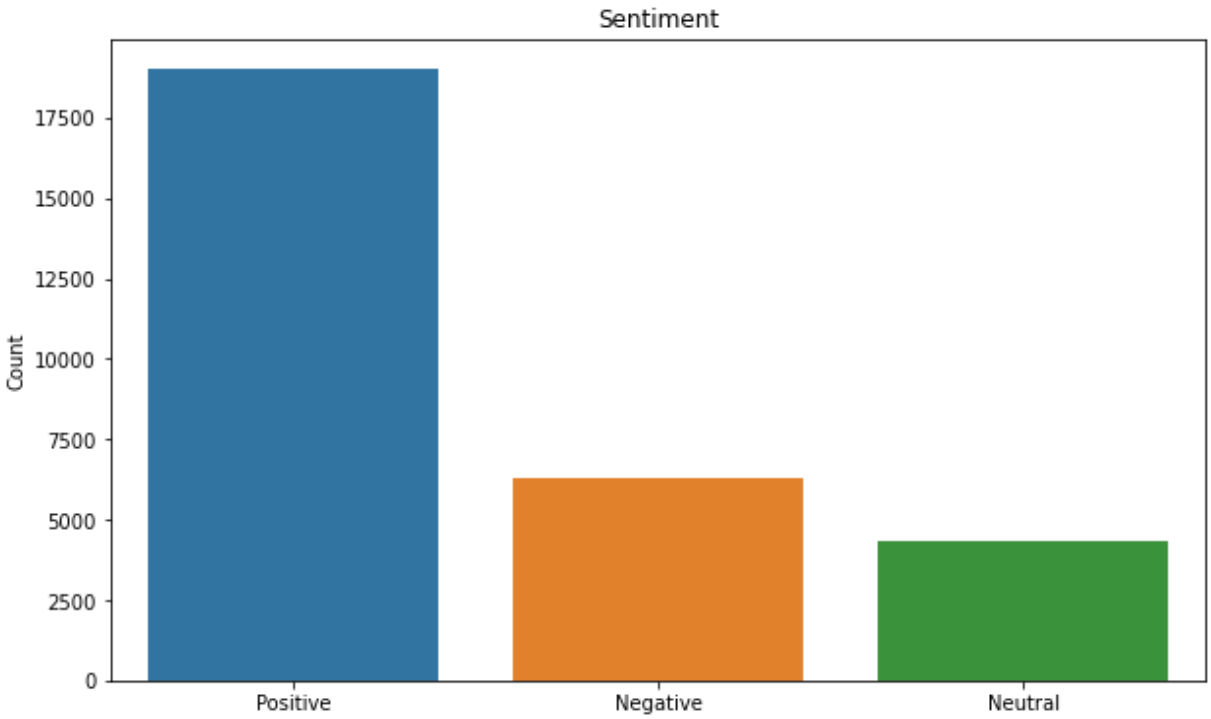
Univariate Analysis

1. What are the sentiment type for the apps?

In [96]:
```
ur['Sentiment'].value_counts()
```

Out[96]:
```
Positive    19015
Negative     6321
Neutral      4356
Name: Sentiment, dtype: int64
```

In [97]:
```
plt.figure(figsize = (10,6))
sns.barplot(data = ur, x = ur['Sentiment'].value_counts().keys(), y =ur['Sentimer
plt.title("Sentiment")
plt.ylabel("Count")
plt.show()
```



Observation

Looks like most of the app has positive response from the user

2. Top apps with Sentiment

In [98]:
```
ur.head()
```

Out[98]:

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
0	10 Best Foods for You	I like eat delicious food. That's I'm cooking ...	Positive	1.00	0.533333
1	10 Best Foods for You	This help eating healthy exercise regular basis	Positive	0.25	0.288462
3	10 Best Foods for You	Works great especially going grocery store	Positive	0.40	0.875000
4	10 Best Foods for You	Best idea us	Positive	1.00	0.300000
5	10 Best Foods for You	Best way	Positive	1.00	0.300000

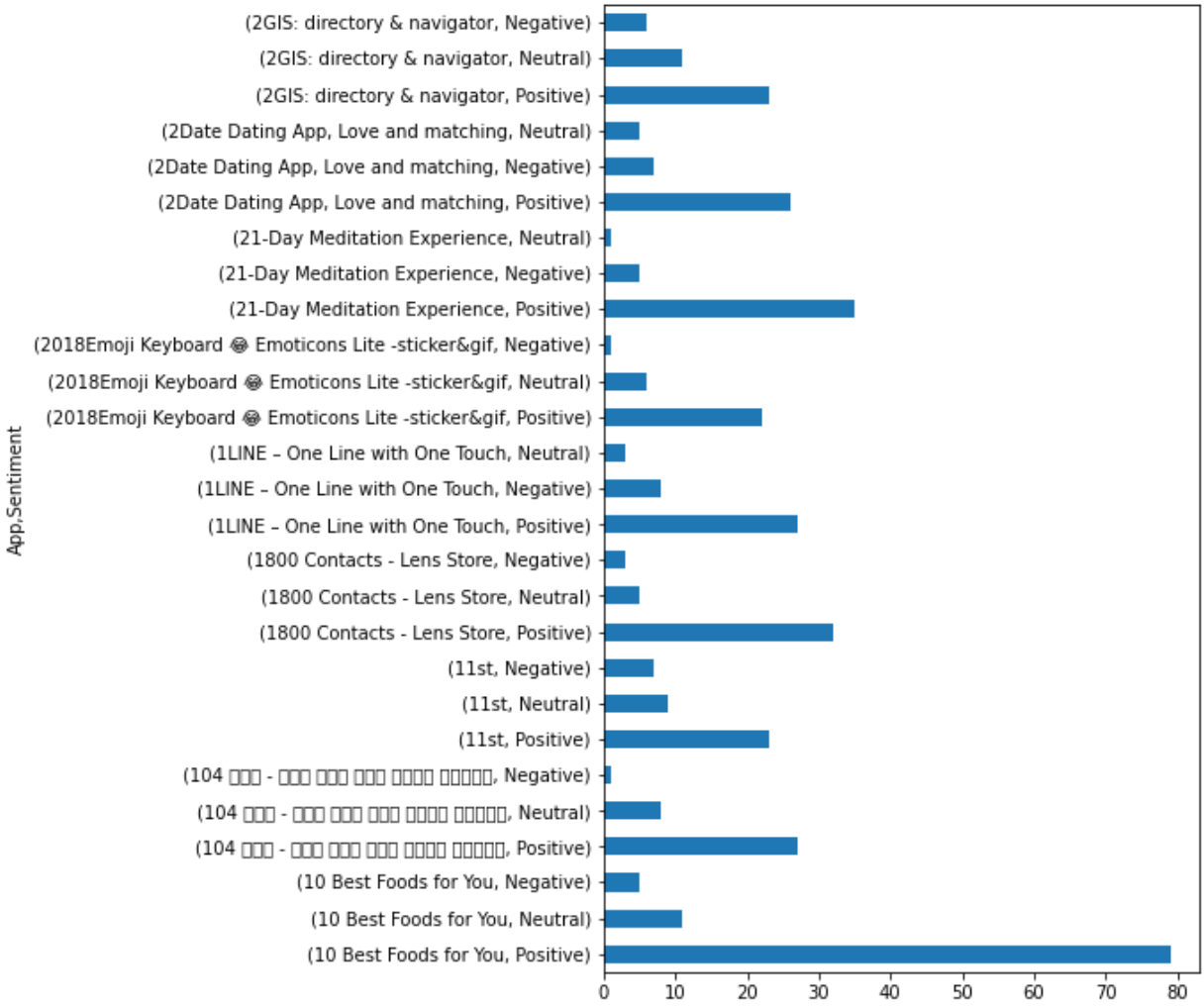
In [99]:
```
app_sentiment = ur.groupby(['App'])['Sentiment'].value_counts().iloc[:27]
app_sentiment
```

Out[99]:

```
App                                                Sentiment
10 Best Foods for You                              Positive     79
                                                   Neutral      11
                                                   Negative      5
104 找工作 - 找工作 找打工 找兼職 履歷健檢 履歷診療室                        Positive
27
                                                   Neutral       8
                                                   Negative      1
11st                                               Positive     23
                                                   Neutral       9
                                                   Negative      7
1800 Contacts - Lens Store                         Positive     32
                                                   Neutral       5
                                                   Negative      3
1LINE – One Line with One Touch                    Positive     27
                                                   Negative      8
                                                   Neutral       3
2018Emoji Keyboard 😂 Emoticons Lite -sticker&gif  Positive     22
                                                   Neutral       6
                                                   Negative      1
21-Day Meditation Experience                       Positive     35
                                                   Negative      5
                                                   Neutral       1
2Date Dating App, Love and matching                Positive     26
                                                   Negative      7
                                                   Neutral       5
2GIS: directory & navigator                        Positive     23
                                                   Neutral      11
                                                   Negative      6
Name: Sentiment, dtype: int64
```

In [100]:
```
plt.figure(figsize = (6,10))
app_sentiment.plot(kind = 'barh')
```

Out[100]: <AxesSubplot:ylabel='App,Sentiment'>



Observation

Looks like the app 10 Best fooods for you has highest positive review

3. Find the top 10 positive sentiment apps

In [101]:
```
ur.head()
```

Out[101]:

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
0	10 Best Foods for You	I like eat delicious food. That's I'm cooking ...	Positive	1.00	0.533333
1	10 Best Foods for You	This help eating healthy exercise regular basis	Positive	0.25	0.288462
3	10 Best Foods for You	Works great especially going grocery store	Positive	0.40	0.875000
4	10 Best Foods for You	Best idea us	Positive	1.00	0.300000
5	10 Best Foods for You	Best way	Positive	1.00	0.300000

In [102]:
```
positive_sentiment = ur[ur['Sentiment'] == 'Positive']
positive_sentiment.head()
```

Out[102]:

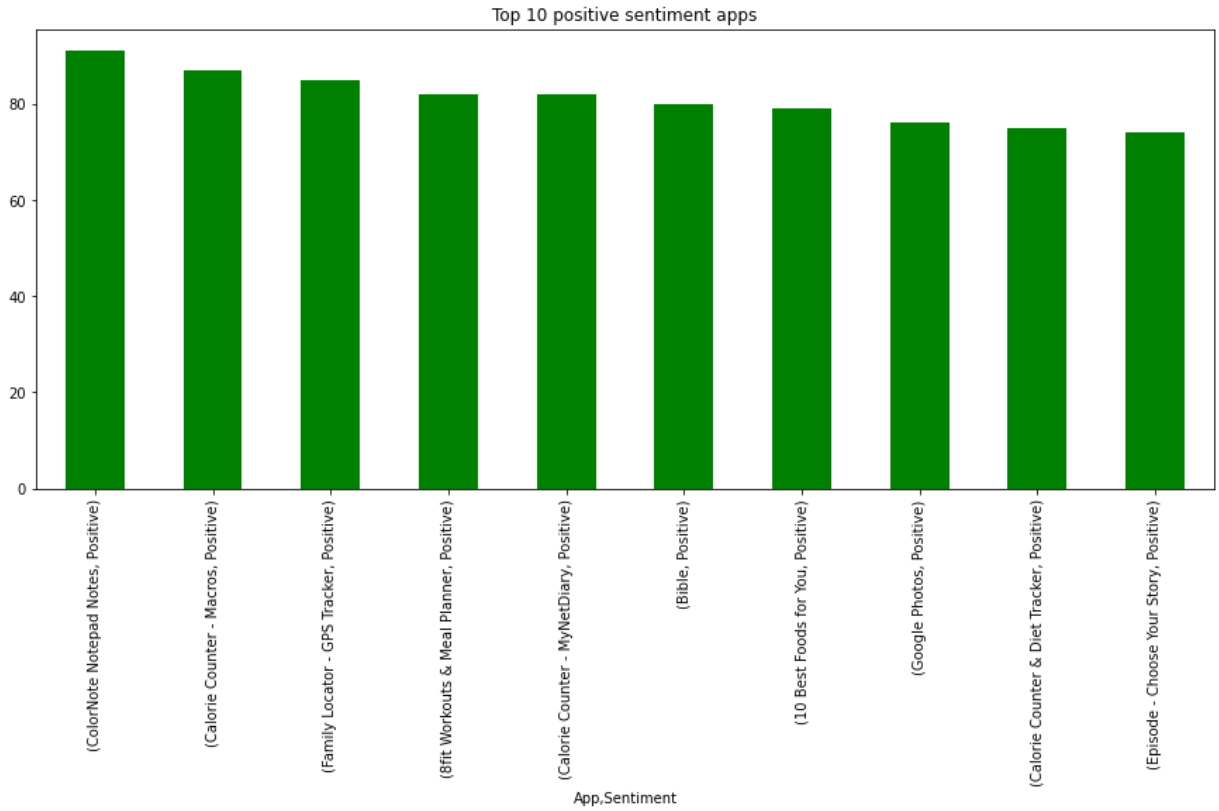
	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
0	10 Best Foods for You	I like eat delicious food. That's I'm cooking ...	Positive	1.00	0.533333
1	10 Best Foods for You	This help eating healthy exercise regular basis	Positive	0.25	0.288462
3	10 Best Foods for You	Works great especially going grocery store	Positive	0.40	0.875000
4	10 Best Foods for You	Best idea us	Positive	1.00	0.300000
5	10 Best Foods for You	Best way	Positive	1.00	0.300000

In [103]:
```
top_positive_sentiment = positive_sentiment.groupby('App')['Sentiment'].value_cou
top_positive_sentiment
```

Out[103]:
```
App                              Sentiment
ColorNote Notepad Notes          Positive     91
Calorie Counter - Macros         Positive     87
Family Locator - GPS Tracker     Positive     85
8fit Workouts & Meal Planner     Positive     82
Calorie Counter - MyNetDiary     Positive     82
Bible                            Positive     80
10 Best Foods for You            Positive     79
Google Photos                    Positive     76
Calorie Counter & Diet Tracker   Positive     75
Episode - Choose Your Story      Positive     74
Name: Sentiment, dtype: int64
```

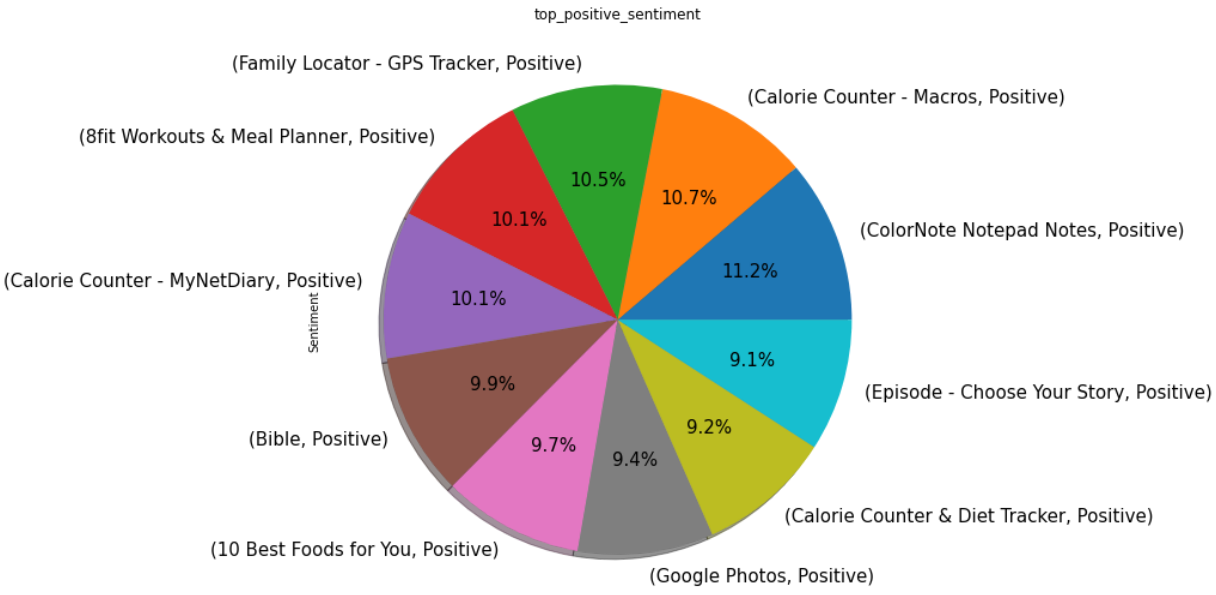
In [104]:
```
plt.figure(figsize = (15,6))
top_positive_sentiment.plot(kind = 'bar', color = 'g')
plt.title("Top 10 positive sentiment apps")
```

Out[104]: Text(0.5, 1.0, 'Top 10 positive sentiment apps')



In [105]:
```
# Visualizing using pie chart.
textprops = {"fontsize":15} # Font size of text in pie chart
plt.figure(figsize = (9,9)) # fixing pie chart size
top_positive_sentiment.plot(kind = 'pie', shadow = True, autopct='%1.1f%%', textp
plt.title("top_positive_sentiment")
```

Out[105]: Text(0.5, 1.0, 'top_positive_sentiment')



In [106]:
```
top_positive_sentiment.keys()
```

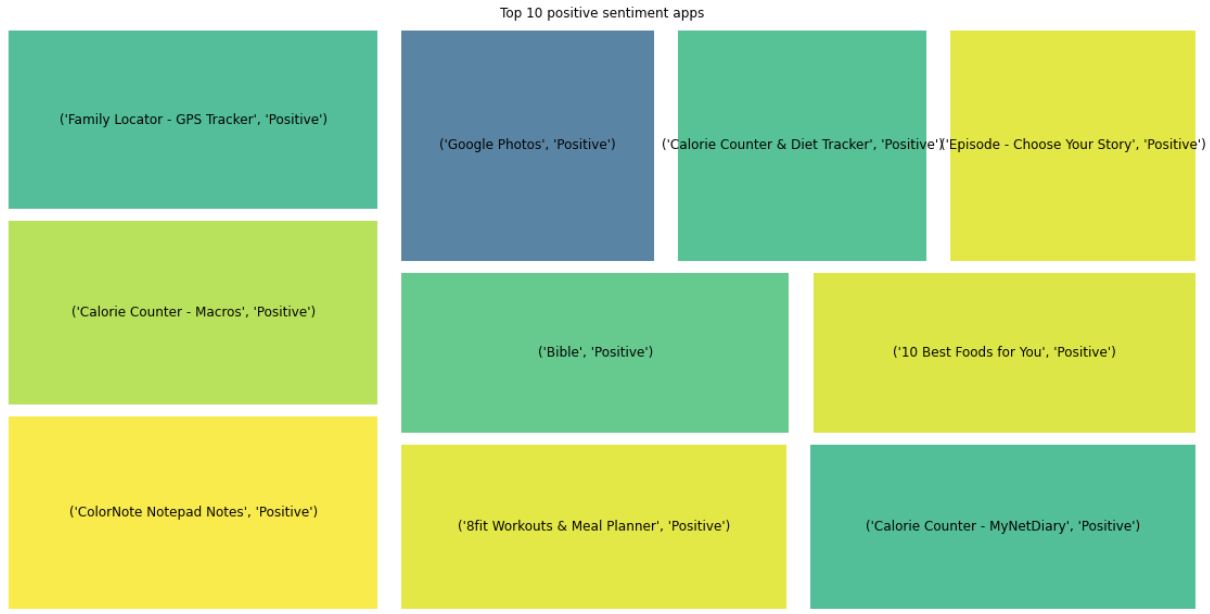
Out[106]:
```
MultiIndex([(       'ColorNote Notepad Notes', 'Positive'),
            (      'Calorie Counter - Macros', 'Positive'),
            (  'Family Locator - GPS Tracker', 'Positive'),
            (  '8fit Workouts & Meal Planner', 'Positive'),
            (  'Calorie Counter - MyNetDiary', 'Positive'),
            (                         'Bible', 'Positive'),
            (         '10 Best Foods for You', 'Positive'),
            (                 'Google Photos', 'Positive'),
            ('Calorie Counter & Diet Tracker', 'Positive'),
            (   'Episode - Choose Your Story', 'Positive')],
           names=['App', 'Sentiment'])
```

Trying tree map for this

In [107]:
```
import squarify
```

In [109]:
```
plt.figure(figsize = (20,10))
squarify.plot(sizes=top_positive_sentiment,alpha=0.8, label = top_positive_sentir
              pad=1, text_kwargs={'fontsize': 12})
plt.axis("off")
plt.title("Top 10 positive sentiment apps")
```

Out[109]:
```
Text(0.5, 1.0, 'Top 10 positive sentiment apps')
```



4. Find the top 10 Negetive sentiment apps

In [110]:
```
Negetive_sentiment = ur[ur['Sentiment'] == 'Negative']
Negetive_sentiment.head()
```

Out[110]:

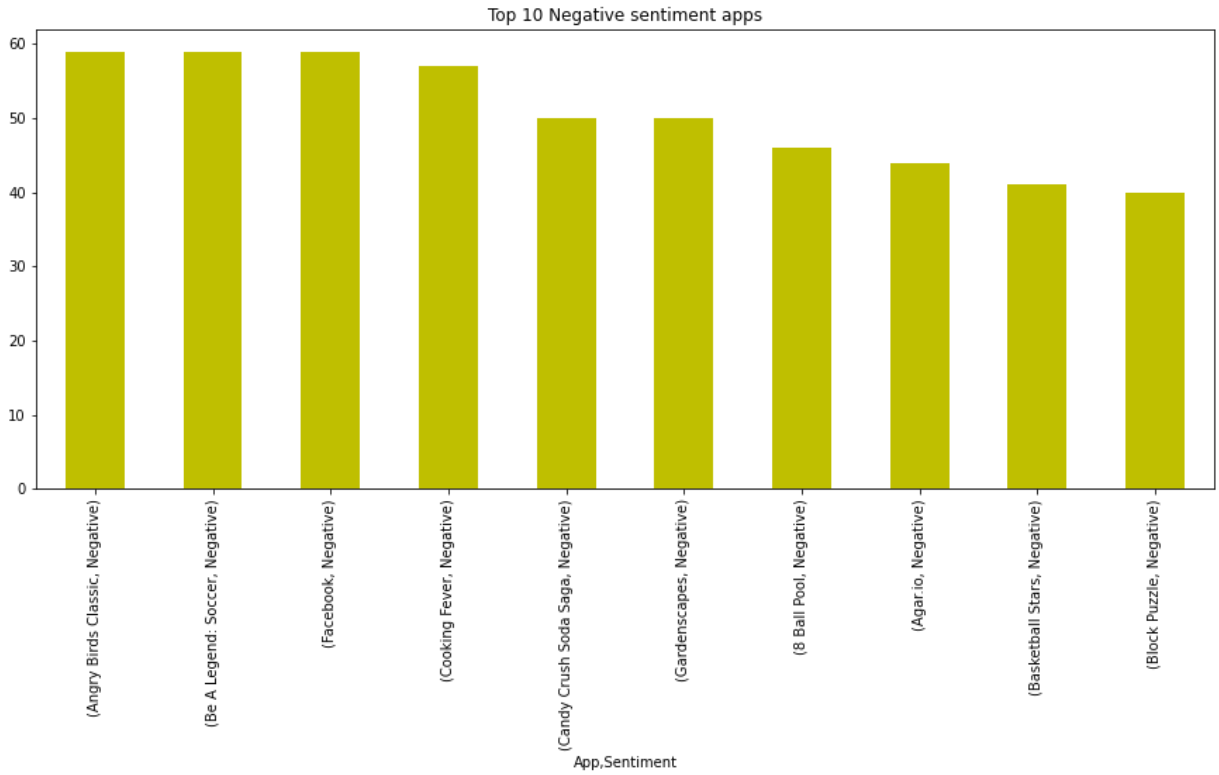
	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
32	10 Best Foods for You	No recipe book Unable recipe book.	Negative	-0.500	0.500
43	10 Best Foods for You	Waste time It needs internet time n ask calls ...	Negative	-0.200	0.000
68	10 Best Foods for You	Faltu plz waste ur time	Negative	-0.200	0.000
85	10 Best Foods for You	Crap Doesn't work	Negative	-0.800	0.800
95	10 Best Foods for You	Boring. I thought actually just texts that's i...	Negative	-0.325	0.475

In [111]:
```
top_negative_sentiment = Negetive_sentiment.groupby('App')['Sentiment'].value_cou
top_negative_sentiment
```

Out[111]:
```
App                   Sentiment
Angry Birds Classic   Negative     59
Be A Legend: Soccer   Negative     59
Facebook              Negative     59
Cooking Fever         Negative     57
Candy Crush Soda Saga Negative     50
Gardenscapes          Negative     50
8 Ball Pool           Negative     46
Agar.io               Negative     44
Basketball Stars      Negative     41
Block Puzzle          Negative     40
Name: Sentiment, dtype: int64
```

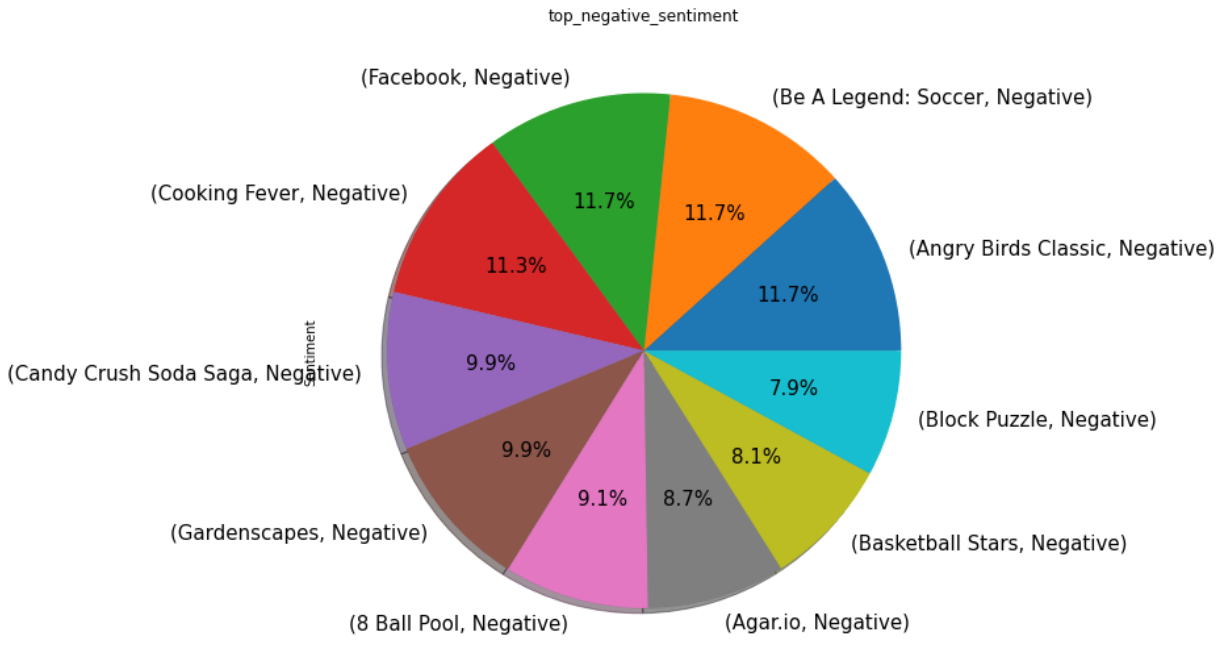
In [112]:
```
plt.figure(figsize = (15,6))
top_negative_sentiment.plot(kind = 'bar', color = 'y')
plt.title("Top 10 Negative sentiment apps")
```

Out[112]: Text(0.5, 1.0, 'Top 10 Negative sentiment apps')



In [113]:
```
# Visualizing using pie chart.
textprops = {"fontsize":15} # Font size of text in pie chart
plt.figure(figsize = (9,9)) # fixing pie chart size
top_negative_sentiment.plot(kind = 'pie', shadow = True, autopct='%1.1f%%', textp
plt.title("top_negative_sentiment")
```

Out[113]: Text(0.5, 1.0, 'top_negative_sentiment')



In [115]:
```
plt.figure(figsize = (20,10))
squarify.plot(sizes=top_negative_sentiment,alpha=0.8, label = top_positive_sentir
              pad=1, text_kwargs={'fontsize': 12})
plt.axis("off")
plt.title("Top 10 positive sentiment apps")
```

Out[115]:
```
Text(0.5, 1.0, 'Top 10 positive sentiment apps')
```

Conclusion

- Percentage of free apps = ~92%
- Percentage of apps with no age restrictions = ~82%
- Most competitive category: Family
- Category with the highest number of installs: Game
- Category with the highest average app installs: Communicaction
- Percentage of apps that are top rated = ~80%
- There are 20 free apps that have been installed over a billion times
- Minecraft is the only app in the paid category with over 10M installs. This app has also produced the most revenue only from the installation fee.
- The median size of all apps in the play store is 12 MB.
- The apps whose size varies with device has the highest number average app installs.
- The apps whose size is greater than 90 MB has the highest number of average user reviews, ie, they are more popular than the rest.
- Helix Jump has the highest number of positive reviews and Angry Birds Classic has the highest number of negative reviews.