In [2]:

```
import numpy as np
import pandas as pd
import seaborn as sb
import matplotlib.pyplot as plt
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.metrics import confusion_matrix, accuracy_score
from sklearn.linear_model import LogisticRegression
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.cluster import KMeans
import plotly.express as px
import scipy.stats as stats
```

In [4]:

```
data = pd.read_csv(r'C:\Users\Mannahil Miftah\Downloads\googleplaystore.csv')
data
```

Out[4]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	Art & Design;Pretend Play
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0	Everyone	Art & Design
3	Sketch - Draw & Paint	ART_AND_DESIGN	4.5	215644	25M	50,000,000+	Free	0	Teen	Art & Design
4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.3	967	2.8M	100,000+	Free	0	Everyone	Art & Design;Creativity
...	...	...	...	...	...	...	...	...	...	...
10836	Sya9a Maroc - FR	FAMILY	4.5	38	53M	5,000+	Free	0	Everyone	Education
10837	Fr. Mike Schmitz Audio Teachings	FAMILY	5.0	4	3.6M	100+	Free	0	Everyone	Education
10838	Parkinson Exercices FR	MEDICAL	NaN	3	9.5M	1,000+	Free	0	Everyone	Medical
10839	The SCP Foundation DB fr nn5n	BOOKS_AND_REFERENCE	4.5	114	Varies with device	1,000+	Free	0	Mature 17+	Books & Reference
10840	iHoroscope - 2018 Daily Horoscope	LIFESTYLE	4.5	398307	19M	10,000,000+	Free	0	Everyone	Lifestyle

& Astrology

App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres

10841 rows × 13 columns

Exploring Dataset

In [5]:

```
data.shape
```

Out[5]:

```
(10841, 13)
```

In [6]:

```
data.columns
```

Out[6]:

```
Index(['App', 'Category', 'Rating', 'Reviews', 'Size', 'Installs', 'Type',
       'Price', 'Content Rating', 'Genres', 'Last Updated', 'Current Ver',
       'Android Ver'],
      dtype='object')
```

In [7]:

```
data.dtypes
```

Out[7]:

```
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 [8]:

```
data.info
```

Out[8]:

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

       Rating Reviews                Size     Installs  Type Price  \
0         4.1     159                 19M      10,000+  Free     0
1         3.9     967                 14M     500,000+  Free     0
2         4.7   87510                8.7M   5,000,000+  Free     0
3         4.5  215644                 25M  50,000,000+  Free     0
```

```
4         4.3     967                2.8M     100,000+  Free     0
...       ...     ...                 ...          ...   ...   ...
10836     4.5      38                 53M       5,000+  Free     0
10837     5.0       4                3.6M         100+  Free     0
10838     NaN       3                9.5M       1,000+  Free     0
10839     4.5     114  Varies with device       1,000+  Free     0
10840     4.5  398307                 19M  10,000,000+  Free     0

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

              Current Ver         Android Ver
0                   1.0.0        4.0.3 and up
1                   2.0.0        4.0.3 and up
2                   1.2.4        4.0.3 and up
3      Varies with device          4.2 and up
4                     1.1          4.4 and up
...                   ...                 ...
10836                1.48          4.1 and up
10837                 1.0          4.1 and up
10838                 1.0          2.2 and up
10839  Varies with device  Varies with device
10840  Varies with device  Varies with device

[10841 rows x 13 columns]>
```

In [9]:

```
data.describe()
```

Out[9]:

	Rating
count	9367.000000
mean	4.193338
std	0.537431
min	1.000000
25%	4.000000
50%	4.300000
75%	4.500000
max	19.000000

Data Cleaning

In [10]:

```
#printing values of all attributes to identify if any attribute has ?

allColumns = data.columns
for c in allColumns:
    missed = data[c].isin(['?']).sum()
    if missed > 0:
        print(c, "\t", missed)
```

Analyzing category column

In [11]:

```
data['Category'].unique()
```

Out[11]:

```
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',
       '1.9'], dtype=object)
```

In [12]:

```
# removing 1.9 value and replacing it with NA(Not Applicable) as 1.9 is incorrect value

data[data['Category'] == '1.9']
```

Out[12]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andr
10472	Life Made WI-Fi Touchscreen Photo Frame	1.9	19.0	3.0M	1,000+	Free	0	Everyone	NaN	February 11, 2018	1.0.19	4.0 and up	N

In [13]:

```
# replacing the value

data['Category'] = data['Category'].str.replace("1.9","NA")
```

```
C:\Users\MANNAH~1\AppData\Local\Temp/ipykernel_15948/1889109757.py:3: FutureWarning: The
default value of regex will change from True to False in a future version.
  data['Category'] = data['Category'].str.replace("1.9","NA")
```

Analyzing rating column

In [14]:

```
data['Rating'].unique()
```

Out[14]:

```
array([ 4.1,  3.9,  4.7,  4.5,  4.3,  4.4,  3.8,  4.2,  4.6,  3.2,  4. ,
        nan,  4.8,  4.9,  3.6,  3.7,  3.3,  3.4,  3.5,  3.1,  5. ,  2.6,
        3. ,  1.9,  2.5,  2.8,  2.7,  1. ,  2.9,  2.3,  2.2,  1.7,  2. ,
        1.8,  2.4,  1.6,  2.1,  1.4,  1.5,  1.2, 19. ])
```

In [15]:

```
# changing the data type of reviews from object to numeric

data['Rating'] = pd.to_numeric(data['Rating'], errors='coerce')
data['Rating'].dtype
```

Out[15]:

```
dtype('float64')
```

In [16]:

```
# As we saw while exploring that rating contains nan values
# replacing nan values with mean of the column

data['Rating'] = data['Rating'].replace(np.nan, np.mean(data['Rating']))
```

In [17]:

```
# as we can see that nan values from the column are removed

data[data['Rating'] == np.nan]
```

Out[17]:

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

Ananlyzing review column

In [18]:

```
data['Reviews'].unique()
```

Out[18]:

```
array(['159', '967', '87510', ..., '603', '1195', '398307'], dtype=object)
```

In [19]:

```
# checking the record with 3.0M

data[data['Reviews'] =='3.0M']
```

Out[19]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andr
10472	Life Made WI-Fi Touchscreen Photo Frame	NA	19.0	3.0M	1,000+	Free	0	Everyone	NaN	February 11, 2018	1.0.19	4.0 and up	N

In [20]:

```
# replacing the value

data['Reviews'] = data.Reviews.replace("3.0M",3000000.0)

# changing data type

data['Reviews'] = data.Reviews.astype(float)
```

Analyzing size column

In [21]:

```
data['Size'].unique()
```

Out[21]:

```
array(['19M', '14M', '8.7M', '25M', '2.8M', '5.6M', '29M', '33M', '3.1M',
       '28M', '12M', '20M', '21M', '37M', '2.7M', '5.5M', '17M', '39M',
       '31M', '4.2M', '7.0M', '23M', '6.0M', '6.1M', '4.6M', '9.2M',
       '5.2M', '11M', '24M', 'Varies with device', '9.4M', '15M', '10M',
       '1.2M', '26M', '8.0M', '7.9M', '56M', '57M', '35M', '54M', '201k',
       '3.6M', '5.7M', '8.6M', '2.4M', '27M', '2.5M', '16M', '3.4M',
       '8.9M', '3.9M', '2.9M', '38M', '32M', '5.4M', '18M', '1.1M',
       '2.2M', '4.5M', '9.8M', '52M', '9.0M', '6.7M', '30M', '2.6M',
       '7.1M', '3.7M', '22M', '7.4M', '6.4M', '3.2M', '8.2M', '9.9M',
       '4.9M', '9.5M', '5.0M', '5.9M', '13M', '73M', '6.8M', '3.5M',
       '4.0M', '2.3M', '7.2M', '2.1M', '42M', '7.3M', '9.1M', '55M',
       '23k', '6.5M', '1.5M', '7.5M', '51M', '41M', '48M', '8.5M', '46M',
       '8.3M', '4.3M', '4.7M', '3.3M', '40M', '7.8M', '8.8M', '6.6M',
       '5.1M', '61M', '66M', '79k', '8.4M', '118k', '44M', '695k', '1.6M',
       '6.2M', '18k', '53M', '1.4M', '3.0M', '5.8M', '3.8M', '9.6M',
       '45M', '63M', '49M', '77M', '4.4M', '4.8M', '70M', '6.9M', '9.3M',
       '10.0M', '8.1M', '36M', '84M', '97M', '2.0M', '1.9M', '1.8M',
       '5.3M', '47M', '556k', '526k', '76M', '7.6M', '59M', '9.7M', '78M',
       '72M', '43M', '7.7M', '6.3M', '334k', '34M', '93M', '65M', '79M',
       '100M', '58M', '50M', '68M', '64M', '67M', '60M', '94M', '232k',
       '99M', '624k', '95M', '8.5k', '41k', '292k', '11k', '80M', '1.7M',
       '74M', '62M', '69M', '75M', '98M', '85M', '82M', '96M', '87M',
       '71M', '86M', '91M', '81M', '92M', '83M', '88M', '704k', '862k',
       '899k', '378k', '266k', '375k', '1.3M', '975k', '980k', '4.1M',
       '89M', '696k', '544k', '525k', '920k', '779k', '853k', '720k',
       '713k', '772k', '318k', '58k', '241k', '196k', '857k', '51k',
       '953k', '865k', '251k', '930k', '540k', '313k', '746k', '203k',
       '26k', '314k', '239k', '371k', '220k', '730k', '756k', '91k',
       '293k', '17k', '74k', '14k', '317k', '78k', '924k', '902k', '818k',
       '81k', '939k', '169k', '45k', '475k', '965k', '90M', '545k', '61k',
       '283k', '655k', '714k', '93k', '872k', '121k', '322k', '1.0M',
       '976k', '172k', '238k', '549k', '206k', '954k', '444k', '717k',
       '210k', '609k', '308k', '705k', '306k', '904k', '473k', '175k',
       '350k', '383k', '454k', '421k', '70k', '812k', '442k', '842k',
       '417k', '412k', '459k', '478k', '335k', '782k', '721k', '430k',
       '429k', '192k', '200k', '460k', '728k', '496k', '816k', '414k',
       '506k', '887k', '613k', '243k', '569k', '778k', '683k', '592k',
       '319k', '186k', '840k', '647k', '191k', '373k', '437k', '598k',
       '716k', '585k', '982k', '222k', '219k', '55k', '948k', '323k',
       '691k', '511k', '951k', '963k', '25k', '554k', '351k', '27k',
       '82k', '208k', '913k', '514k', '551k', '29k', '103k', '898k',
       '743k', '116k', '153k', '209k', '353k', '499k', '173k', '597k',
       '809k', '122k', '411k', '400k', '801k', '787k', '237k', '50k',
       '643k', '986k', '97k', '516k', '837k', '780k', '961k', '269k',
       '20k', '498k', '600k', '749k', '642k', '881k', '72k', '656k',
       '601k', '221k', '228k', '108k', '940k', '176k', '33k', '663k',
       '34k', '942k', '259k', '164k', '458k', '245k', '629k', '28k',
       '288k', '775k', '785k', '636k', '916k', '994k', '309k', '485k',
       '914k', '903k', '608k', '500k', '54k', '562k', '847k', '957k',
       '688k', '811k', '270k', '48k', '329k', '523k', '921k', '874k',
       '981k', '784k', '280k', '24k', '518k', '754k', '892k', '154k',
       '860k', '364k', '387k', '626k', '161k', '879k', '39k', '970k',
       '170k', '141k', '160k', '144k', '143k', '190k', '376k', '193k',
       '246k', '73k', '658k', '992k', '253k', '420k', '404k', '1,000+',
       '470k', '226k', '240k', '89k', '234k', '257k', '861k', '467k',
       '157k', '44k', '676k', '67k', '552k', '885k', '1020k', '582k',
       '619k'], dtype=object)
```

In [22]:

```
# removing M, k, 1,000+, 1000+ & Varies with device

data['Size'] = data['Size'].str.replace("M","000")
```

In [23]:

```
data['Size'] = data['Size'].str.replace("k","")
```

In [24]:

```
data['Size'] = data['Size'].str.replace("1,000+","1000")
```

```
C:\Users\MANNAH~1\AppData\Local\Temp/ipykernel_15948/1000057728.py:1: FutureWarning: The
default value of regex will change from True to False in a future version.
  data['Size'] = data['Size'].str.replace("1,000+","1000")
```

In [25]:

```
data['Size'] = data.Size.replace("1000+","1000")
```

In [26]:

```
data['Size'] = data['Size'].str.replace("Varies with device","NaN")
```

In [27]:

```
# changing the data type of the column

data['Size'] = data['Size'].astype(float)
data['Size'].dtype
```

Out[27]:

```
dtype('float64')
```

Analyzing installs column

In [28]:

```
data['Installs'].unique()
```

Out[28]:

```
array(['10,000+', '500,000+', '5,000,000+', '50,000,000+', '100,000+',
       '50,000+', '1,000,000+', '10,000,000+', '5,000+', '100,000,000+',
       '1,000,000,000+', '1,000+', '500,000,000+', '50+', '100+', '500+',
       '10+', '1+', '5+', '0+', '0', 'Free'], dtype=object)
```

In [29]:

```
# removing , + & Free

data['Installs'] = data['Installs'].str.replace(",","")
```

In [30]:

```
data['Installs'] = data['Installs'].str.replace("+","")
```

```
C:\Users\MANNAH~1\AppData\Local\Temp/ipykernel_15948/480341623.py:1: FutureWarning: The d
efault value of regex will change from True to False in a future version. In addition, si
ngle character regular expressions will *not* be treated as literal strings when regex=Tr
ue.
  data['Installs'] = data['Installs'].str.replace("+","")
```

In [32]:

```
data['Installs'] = data['Installs'].str.replace("Free","NaN")
```

In [33]:

```
# changing the data type of the column

data['Installs'] = data['Installs'].astype(float)
data['Installs'].dtype
```

Out[33]:

```
dtype('float64')
```

Analyzing Price column

In [34]:

```
data['Price'].unique()
```

Out[34]:

```
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', 'Everyone', '$1.20', '$1.04'], dtype=object)
```

In [35]:

```
# removing $ and Everyone

data['Price'] = data['Price'].str.replace("$","")
```

```
C:\Users\MANNAH~1\AppData\Local\Temp/ipykernel_15948/1928195240.py:3: FutureWarning: The
default value of regex will change from True to False in a future version. In addition, s
ingle character regular expressions will *not* be treated as literal strings when regex=T
rue.
  data['Price'] = data['Price'].str.replace("$","")
```

In [36]:

```
data['Price'] = data['Price'].str.replace("Everyone","NaN")
```

In [37]:

```
# changing the data type

data['Price'] = data['Price'].astype(float)
data['Price'].dtype
```

Out[37]:

```
dtype('float64')
```

Analyzing Last Updated & Genres column

In [38]:

```
data['Last Updated'].unique()
```

Out[38]:

```
array(['January 7, 2018', 'January 15, 2018', 'August 1, 2018', ...,
       'January 20, 2014', 'February 16, 2014', 'March 23, 2014'],
      dtype=object)
```

In [39]:

```
data['Genres'].unique()
```

Out[39]:

```
array(['Art & Design', 'Art & Design;Pretend Play',
       'Art & Design;Creativity', 'Art & Design;Action & Adventure',
       'Auto & Vehicles', 'Beauty', 'Books & Reference', 'Business',
       'Comics', 'Comics;Creativity', 'Communication', 'Dating',
       'Education;Education', 'Education', 'Education;Creativity',
       'Education;Music & Video', 'Education;Action & Adventure',
       'Education;Pretend Play', 'Education;Brain Games', 'Entertainment',
       'Entertainment;Music & Video', 'Entertainment;Brain Games',
       'Entertainment;Creativity', 'Events', 'Finance', 'Food & Drink',
       'Health & Fitness', 'House & Home', 'Libraries & Demo',
       'Lifestyle', 'Lifestyle;Pretend Play',
       'Adventure;Action & Adventure', 'Arcade', 'Casual', 'Card',
       'Casual;Pretend Play', 'Action', 'Strategy', 'Puzzle', 'Sports',
       'Music', 'Word', 'Racing', 'Casual;Creativity',
       'Casual;Action & Adventure', 'Simulation', 'Adventure', 'Board',
       'Trivia', 'Role Playing', 'Simulation;Education',
       'Action;Action & Adventure', 'Casual;Brain Games',
       'Simulation;Action & Adventure', 'Educational;Creativity',
       'Puzzle;Brain Games', 'Educational;Education', 'Card;Brain Games',
       'Educational;Brain Games', 'Educational;Pretend Play',
       'Entertainment;Education', 'Casual;Education',
       'Music;Music & Video', 'Racing;Action & Adventure',
       'Arcade;Pretend Play', '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;Education',
       'Parenting;Brain Games', 'Weather', 'Video Players & Editors',
       'Video Players & Editors;Music & Video', 'News & Magazines',
       'Maps & Navigation', 'Health & Fitness;Action & Adventure',
       'Educational', 'Casino', 'Adventure;Brain Games',
       'Trivia;Education', 'Lifestyle;Education',
       'Books & Reference;Creativity', 'Books & Reference;Education',
       'Puzzle;Education', 'Role Playing;Education',
       'Role Playing;Brain Games', 'Strategy;Education',
       'Racing;Pretend Play', 'Communication;Creativity',
       'February 11, 2018', 'Strategy;Creativity'], dtype=object)
```

In [40]:

```
data[data['Last Updated'] == '1.0.19']
```

Out[40]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Androic Ver
10472	Life Made WI-Fi Touchscreen Photo Frame	NA	19.0	3000000.0	1000.0	0.0	0	NaN	NaN	February 11, 2018	1.0.19	4.0 and up	NaN

In [41]:

```
# replacing the value 1.0.19 to February 11, 2018 which is present in Genres column

data['Last Updated'] = data['Last Updated'].str.replace("1.0.19", data['Genres'][10472])
```

```
C:\Users\MANNAH~1\AppData\Local\Temp/ipykernel_15948/3465870206.py:3: FutureWarning: The
default value of regex will change from True to False in a future version.
  data['Last Updated'] = data['Last Updated'].str.replace("1.0.19", data['Genres'][10472]
)
```

In [42]:

```
data[data['Last Updated'] == '1.0.19']
```

Out[42]:

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

In [43]:

```
# now changing the value of genre in which date is present to None
# now changing the value of genre in which date is present to None

data[data['Genres'] == 'February 11, 2018']
```

Out[43]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Androi Ve
10472	Life Made WI-Fi Touchscreen Photo Frame	NA	19.0	3000000.0	1000.0	0.0	0	NaN	NaN	February 11, 2018	February 11, 2018	4.0 and up	Na

In [44]:

```
data['Genres'] = data['Genres'].str.replace("February 11, 2018", "NaN")
```

Dealing with nan values

In [45]:

```
data.isna().any()
```

Out[45]:

```
App                False
Category           False
Rating             False
Reviews            False
Size                True
Installs           False
Type                True
Price               True
Content Rating      True
Genres             False
Last Updated       False
Current Ver         True
Android Ver         True
dtype: bool
```

In [46]:

```
data.dropna(inplace = True)
data.isna().any()
```

Out[46]:

```
App                False
Category           False
Rating             False
Reviews            False
Size               False
Installs           False
Type               False
Price              False
Content Rating     False
Genres             False
Last Updated       False
Current Ver        False
Android Ver        False
dtype: bool
```

Duplicate Values

In [47]:

```
data.duplicated().any()
```

Out[47]:

```
True
```

In [48]:

```
data.drop_duplicates(inplace = True)
```

In [49]:

```
data.shape
```

Out[49]:

```
(8821, 13)
```

Visualization

Top 10 Categories

In [50]:

```
count = data['Category'].value_counts()
count.head(10)
```

Out[50]:

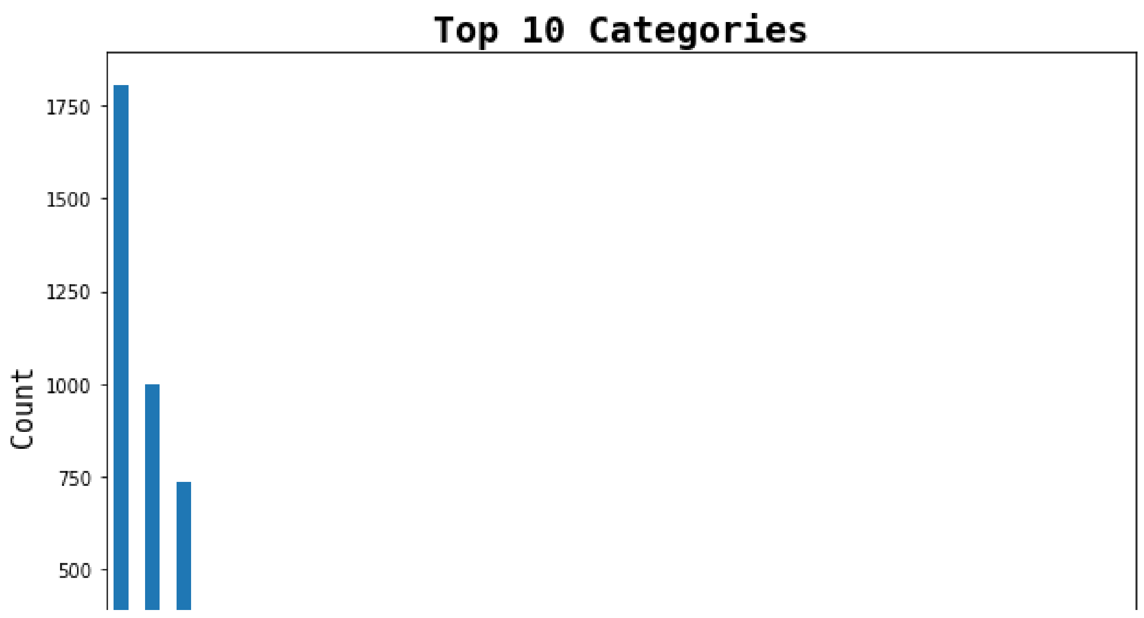
```
FAMILY               1803
GAME                 1000
TOOLS                 737
MEDICAL               380
BUSINESS              379
PERSONALIZATION       352
LIFESTYLE             338
FINANCE               304
PRODUCTIVITY          299
SPORTS                296
Name: Category, dtype: int64
```

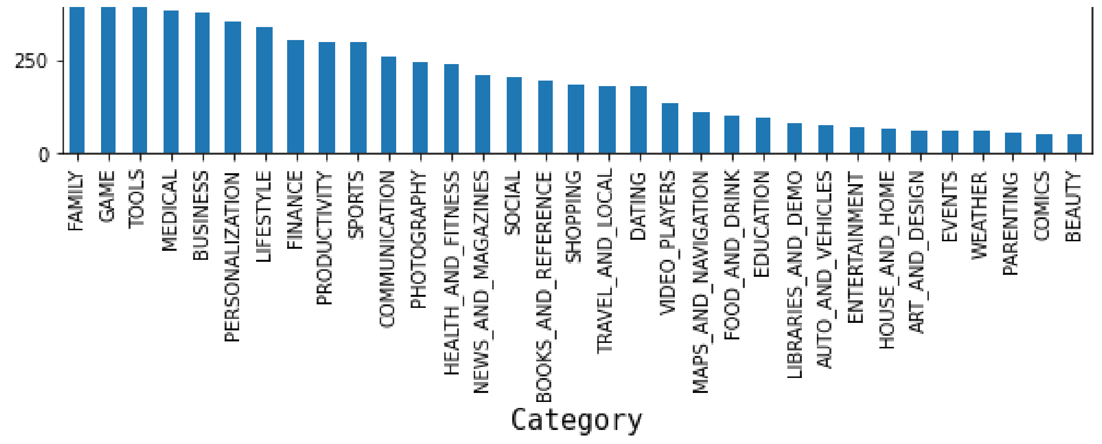
In [51]:

```
plt.figure(figsize=[10,7])
count.plot(kind = 'bar')
plt.title('Top 10 Categories', fontdict={'fontname': 'Monospace', 'fontsize': 20, 'fontw
eight': 'bold'})
plt.xlabel('Category', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Count', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[51]:

```
Text(0, 0.5, 'Count')
```



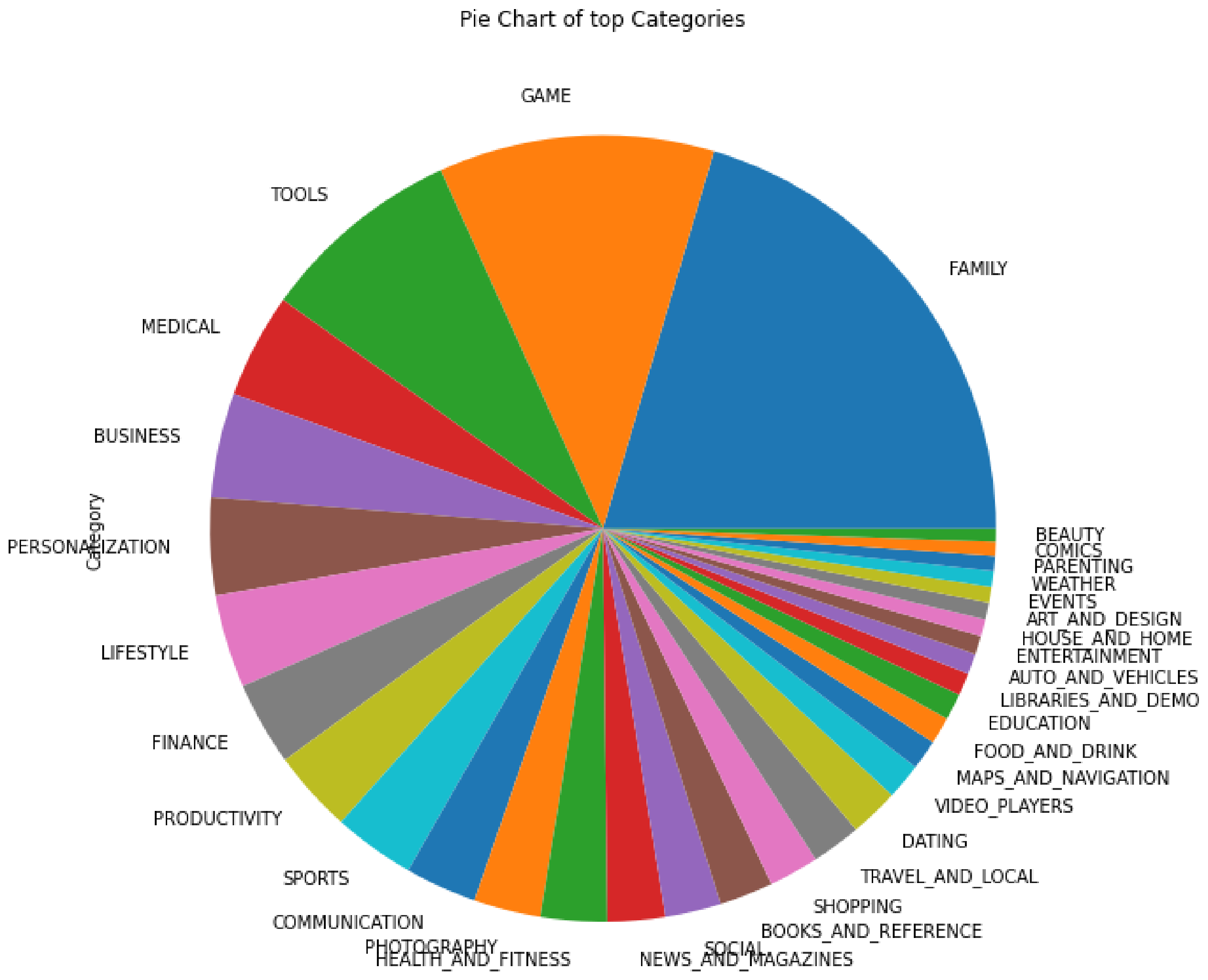


In [52]:

```
plt.figure(figsize=[10,15])
count.plot(kind='pie')
plt.title("Pie Chart of top Categories")
```

Out[52]:

```
Text(0.5, 1.0, 'Pie Chart of top Categories')
```



Category wise Reviews

In [53]:

```
top_10_category = pd.DataFrame(data.groupby('Category')['Reviews'].sum())
top_10_category = top_10_category.sort_values(by = ['Reviews'], ascending = False)
top_10_category = top_10_category.reset_index()
top_10_category.head(10)
```

Out[53]:

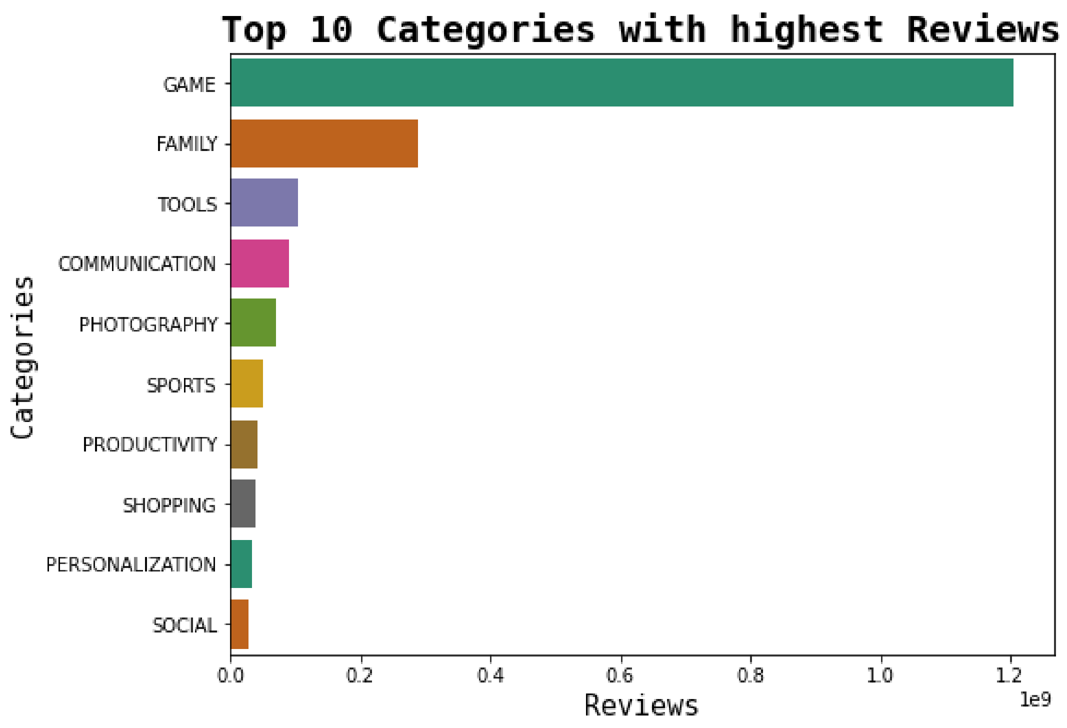
	Category	Reviews
0	GAME	1.206725e+09
1	FAMILY	2.884686e+08
2	TOOLS	1.052768e+08
3	COMMUNICATION	8.907720e+07
4	PHOTOGRAPHY	7.172162e+07
5	SPORTS	5.091184e+07
6	PRODUCTIVITY	4.264305e+07
7	SHOPPING	3.951521e+07
8	PERSONALIZATION	3.485290e+07
9	SOCIAL	2.794313e+07

In [54]:

```
plt.figure(figsize=[8,6])
sb.barplot(data = top_10_category.head(10), x = 'Reviews', y = 'Category', palette = 'Da
rk2')
plt.title('Top 10 Categories with highest Reviews', fontdict={'fontname': 'Monospace', 'f
ontsize': 20, 'fontweight': 'bold'})
plt.xlabel('Reviews', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Categories', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[54]:

```
Text(0, 0.5, 'Categories')
```



Catergory wise Ratings

In [55]:

```
ratings = pd.DataFrame(data.groupby('Category')['Rating'].sum())
ratings = ratings.sort_values(by = ['Rating'], ascending = False)
ratings = ratings.reset_index()
ratings.head(10)
```

Out[55]:

	Category	Rating

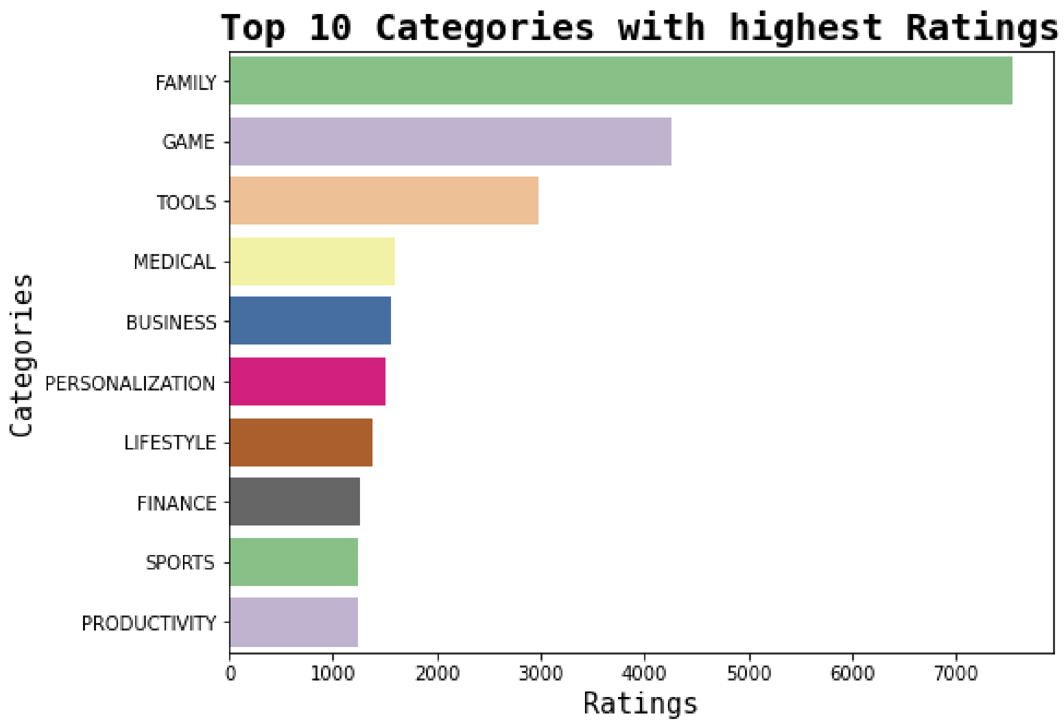
	Category	Rating
0	FAMILY	7554.1[illegible]
1	GAME	4262.726871
2	TOOLS	2974.907185
3	MEDICAL	1589.313846
4	BUSINESS	1568.274101
5	PERSONALIZATION	1512.200374
6	LIFESTYLE	1389.966990
7	FINANCE	1252.626871
8	SPORTS	1244.673652
9	PRODUCTIVITY	1241.847005

In [56]:

```
plt.figure(figsize=[8,6])
sb.barplot(data = ratings.head(10), x = 'Rating', y = 'Category', palette = 'Accent')
plt.title('Top 10 Categories with highest Ratings', fontdict={'fontname': 'Monospace', 'f
ontsize': 20, 'fontweight': 'bold'})
plt.xlabel('Ratings', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Categories', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[56]:

```
Text(0, 0.5, 'Categories')
```



Most Rated Apps

In [57]:

```
most_rated_app = pd.DataFrame(data.groupby('App')['Rating'].sum())
most_rated_app = most_rated_app.sort_values(by = ['Rating'], ascending = False)
most_rated_app = most_rated_app.reset_index()
most_rated_app.head(10)
```

Out[57]:

	App	Rating
0	ROBLOX	40.5
1	8 Ball Pool	31.5

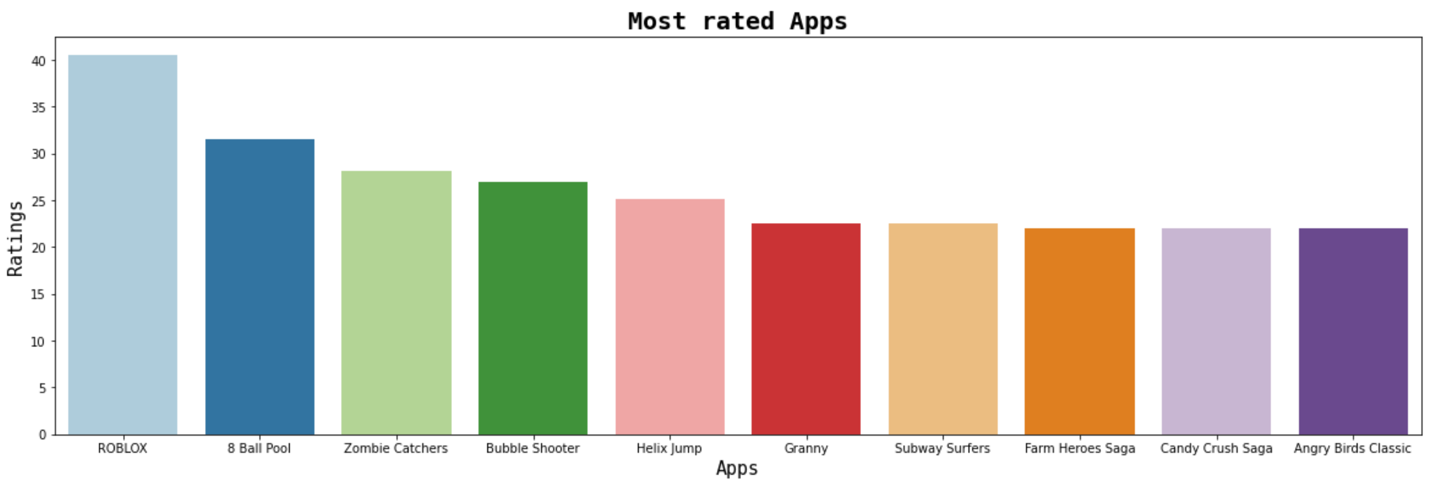
	App	Rating
2	Zombie Catchers	28.2
3	Bubble Shooter	26.9
4	Helix Jump	25.2
5	Granny	22.5
6	Subway Surfers	22.5
7	Farm Heroes Saga	22.0
8	Candy Crush Saga	22.0
9	Angry Birds Classic	22.0

In [58]:

```
plt.figure(figsize=[20,6])
sb.barplot(data = most_rated_app.head(10), x = 'App', y = 'Rating', palette = 'Paired')
plt.title('Most rated Apps', fontdict={'fontname': 'Monospace', 'fontsize': 20, 'fontwei
ght': 'bold'})
plt.xlabel('Apps', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Ratings', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[58]:

```
Text(0, 0.5, 'Ratings')
```



Most reviewed Apps

In [78]:

```
app = pd.DataFrame(data.groupby('App')['Reviews'].sum())
app = app.sort_values(by = ['Reviews'], ascending = False)
app = app.reset_index()
app.head(10)
```

Out[78]:

	App	Reviews
0	Subway Surfers	138606606.0
1	Clash of Clans	134667058.0
2	Candy Crush Saga	112134492.0
3	8 Ball Pool	99386198.0
4	Clash Royale	92530298.0
5	Pou	41939801.0
6	Temple Run 2	40591993.0
7	ROBLOX	40038379.0
8	My Talking Angela	39523473.0

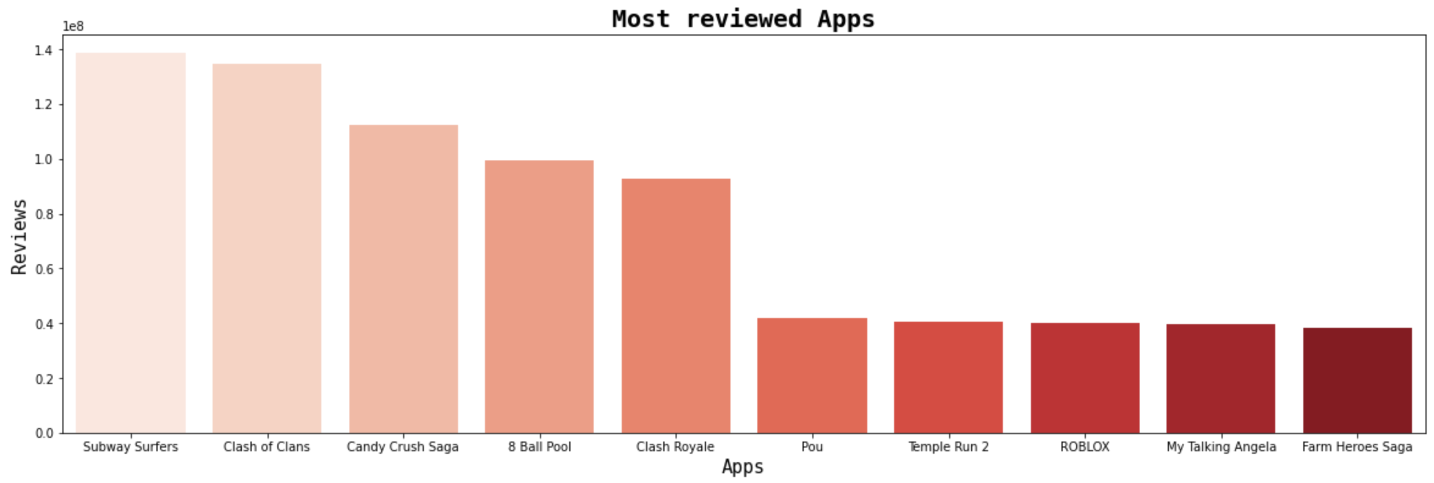
	App	Reviews
9	Farm Heroes Saga	38072669.0

In [81]:

```
plt.figure(figsize=[20,6])
sb.barplot(data = app.head(10), x = 'App', y = 'Reviews', palette = 'Reds')
plt.title('Most reviewed Apps', fontdict={'fontname': 'Monospace', 'fontsize': 20, 'font
weight': 'bold'})
plt.xlabel('Apps', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Reviews', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[81]:

```
Text(0, 0.5, 'Reviews')
```



Most Popular Apps

In [59]:

```
app_count = data['App'].value_counts()
app_count = app_count.sort_values(ascending = False)
app_count.head(10)
```

Out[59]:

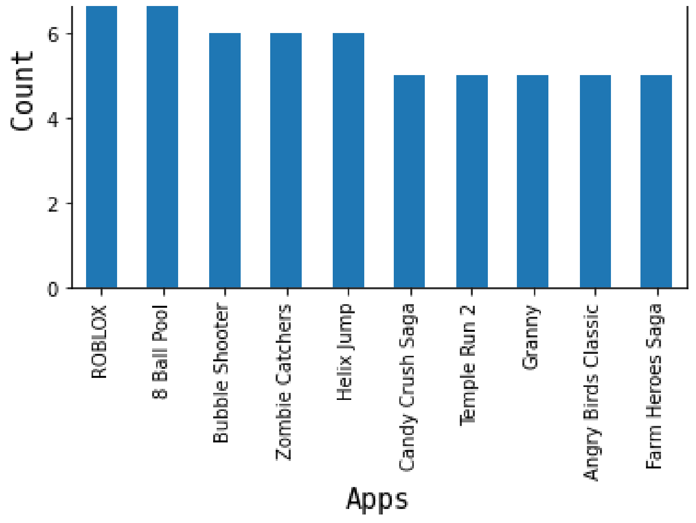
```
ROBLOX                 9
8 Ball Pool            7
Bubble Shooter         6
Zombie Catchers        6
Helix Jump             6
Candy Crush Saga       5
Temple Run 2           5
Granny                 5
Angry Birds Classic    5
Farm Heroes Saga       5
Name: App, dtype: int64
```

In [60]:

```
app_count.head(10).plot(kind = 'bar')
plt.title('Most Polular Apps', fontdict={'fontname': 'Monospace', 'fontsize': 20, 'fontw
eight': 'bold'})
plt.xlabel('Apps', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Count', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[60]:

```
Text(0, 0.5, 'Count')
```



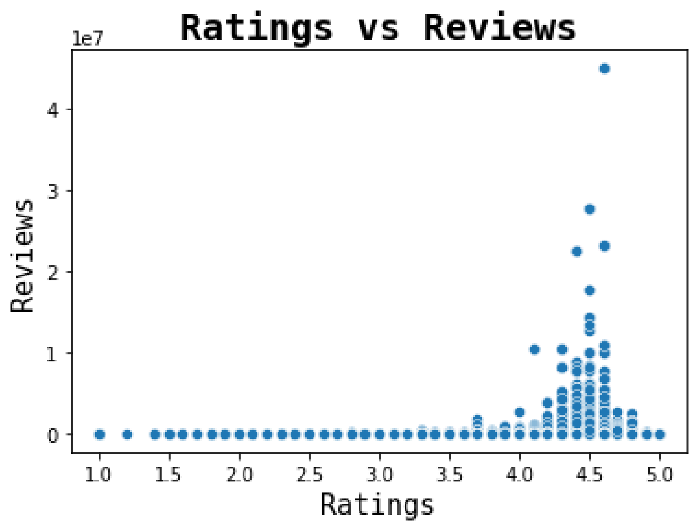
Distribution between rating and reviews

In [83]:

```
sb.scatterplot(data = data, x ='Rating', y = 'Reviews')
plt.title('Ratings vs Reviews', fontdict={'fontname': 'Monospace', 'fontsize': 20, 'fontw
eight': 'bold'})
plt.xlabel('Ratings', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Reviews', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[83]:

```
Text(0, 0.5, 'Reviews')
```



Correlation

In [61]:

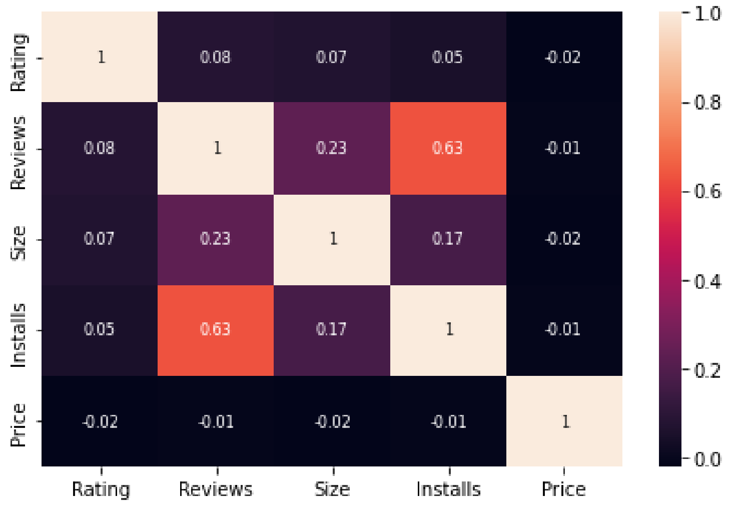
```
data.corr()
```

Out[61]:

	Rating	Reviews	Size	Installs	Price
Rating	1.000000	0.079270	0.073857	0.053150	-0.020093
Reviews	0.079270	1.000000	0.233530	0.633603	-0.009701
Size	0.073857	0.233530	1.000000	0.168328	-0.023576
Installs	0.053150	0.633603	0.168328	1.000000	-0.010290
Price	-0.020093	-0.009701	-0.023576	-0.010290	1.000000

In [62]:

```
sb.heatmap(data=data.corr().round(2), annot=True, annot_kws={"size":8})
plt.tight_layout()
plt.show()
```



Statistical Analysis

In [63]:

```
#RATING

mean = np.mean(data['Rating'])
std = np.std(data['Rating'])
print("Mean ", mean)
print("Standard Deviation", std)
```

```
Mean  4.174884214539512
Standard Deviation 0.5042251985934665
```

In [ ]: