Project Name - Play Store App Review Analysis

Project Type - EDA

Contribution - Team

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Project Summary -

*Hi everybody *!

In this notebook, I'm gonna analyze Google Play Store datas. While I was analyzing the data, I used Python. This study is my first data analyzing study.

Google Play Store apps and reviews Mobile apps are everywhere. They are easy to create and can be lucrative. Because of these two factors, more and more apps are being developed. In this notebook, we will do a comprehensive analysis of the Android app market by comparing over ten thousand apps in Google Play across different categories. We'll look for insights in the data to devise strategies to drive growth and retention.

Let's take a look at the data, which consists of two files:

> **playstore data.csv**: contains all the details of the applications on Google Play. There are 13 features that describe a given app.
> **user_reviews.csv**: contains 100 reviews for each app, most helpful first. The text in each review has been pre-processed and attributed with three new features: Sentiment (Positive, Negative or Neutral), Sentiment Polarity and Sentiment Subjectivity.

Before jumping into the data's provided, let me first explain you about the EDA analysis.

GitHub Link -

https://github.com/soumyaranjan23

Problem Statement

1. What are the top categories on Play Store?
2. Are majority of the apps Paid or Free?
3. How importance is the rating of the application?
4. Which categories from the audience should the app be based on?
5. Which category has the most no. of installations?
6. How does the count of apps varies by Genres?
7. How does the last update has an effect on the rating?
8. How are ratings affected when the app is a paid one?
9. How are reviews and ratings co-related?
10. Lets us discuss the sentiment subjectivity.
11. Is subjectivity and polarity proportional to each other?
12. What is the percentage of review sentiments?
13. How is sentiment polarity varying for paid and free apps?
14. How Content Rating affect over the App?
15. Does Last Update date has an effects on rating?
16. Distribution of App update over the Year.
17. Distribution of Paid and Free app updated over the Month.

Define Your Business Objective?

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.

General Guidelines : -

1. Well-structured, formatted, and commented code is required.
2. Exception Handling, Production Grade Code & Deployment Ready Code will be a plus. Those students will be awarded some additional credits.

   The additional credits will have advantages over other students during Star Student selection.

   ```
   [ Note: - Deployment Ready Code is defined as, the whole .ipynb notebook should be executable in one go
             without a single error logged. ]
   ```

3. Each and every logic should have proper comments.
4. You may add as many number of charts you want. Make Sure for each and every chart the following format should be answered.

```
# Chart visualization code
```

- Why did you pick the specific chart?
- What is/are the insight(s) found from the chart?
- Will the gained insights help creating a positive business impact? Are there any insights that lead to negative growth? Justify with specific reason.

5. You have to create at least 20 logical & meaningful charts having important insights.

[Hints : - Do the Vizualization in a structured way while following "UBM" Rule.

U - Univariate Analysis,

B - Bivariate Analysis (Numerical - Categorical, Numerical - Numerical, Categorical - Categorical)

M - Multivariate Analysis]

Let's Begin !

1. Know Your Data

Import Libraries

```
# Import Libraries
#import library
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import numpy as np # linear algebra
import matplotlib.pyplot as plt
import seaborn as sns  # visualization tool
from datetime import datetime
# plotly
import plotly
plotly.offline.init_notebook_mode(connected=True)
import plotly.graph_objs as go
import warnings
#sns.set(font_scale=1.5)
warnings.filterwarnings("ignore")
```

Dataset Loading

```
# Load Dataset
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
file_path = '/content/drive/MyDrive/AlmaBetter/Capstone Projects/Play Store app review analysis/Play Store Data/Play Store Data.csv'
ps_df=pd.read_csv(file_path)
```

Dataset First View

```
# Dataset First Look
play_store=pd.concat([ps_df.head(),ps_df.tail()])
play_store
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	January 7, 2018	1.0.0
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	Art & Design;Pretend Play	January 15, 2018	2.0.0

U

Dataset Rows & Columns count

Cool

```
# Dataset Rows & Columns count
print(ps_df.columns)
rows=ps_df.shape[0]
columns=ps_df.shape[1]
print(f"the number of rows is {rows} and number of columns is {columns}")
```

```
Index(['App', 'Category', 'Rating', 'Reviews', 'Size', 'Installs', 'Type',
       'Price', 'Content Rating', 'Genres', 'Last Updated', 'Current Ver',
       'Android Ver'],
      dtype='object')
the number of rows is 10841 and number of columns is 13
```

Sya9a FAMILY 4.5 38 53M 5,000+ Free 0 Everyone Education July 25, 1.48

Dataset Information

```
# Dataset Info
ps_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
```

Duplicate Values

```
# Dataset Duplicate Value Count
boolean = ps_df['App'].duplicated().any()
boolean
```

```
True
```

```
ps_df['App'].value_counts()
```

```
ROBLOX                                             9
CBS Sports App - Scores, News, Stats & Watch Live  8
ESPN                                               7
Duolingo: Learn Languages Free                     7
Candy Crush Saga                                   7
                                                  ..
Meet U - Get Friends for Snapchat, Kik & Instagram 1
U-Report                                           1
U of I Community Credit Union                      1
```

```
Waiting For U Launcher Theme                        1
iHoroscope - 2018 Daily Horoscope & Astrology       1
Name: App, Length: 9660, dtype: int64
```

Missing Values/Null Values

```
# Missing Values/Null Values Count
def playstoreinfo():
  temp=pd.DataFrame(index=ps_df.columns)
  temp["datatype"]=ps_df.dtypes
  temp["not null values"]=ps_df.count()
  temp["null values"]=ps_df.isnull().sum()
  temp["% of the null values"]=ps_df.isnull().mean()
  temp["unique count"]=ps_df.nunique()
  return temp
playstoreinfo()
```

	datatype	not null values	null values	% of the null values	unique count
App	object	10841	0	0.000000	9660
Category	object	10841	0	0.000000	34
Rating	float64	9367	1474	0.135965	40
Reviews	object	10841	0	0.000000	6002
Size	object	10841	0	0.000000	462
Installs	object	10841	0	0.000000	22
Type	object	10840	1	0.000092	3
Price	object	10841	0	0.000000	93
Content Rating	object	10840	1	0.000092	6
Genres	object	10841	0	0.000000	120
Last Updated	object	10841	0	0.000000	1378
Current Ver	object	10833	8	0.000738	2832
Android Ver	object	10838	3	0.000277	33

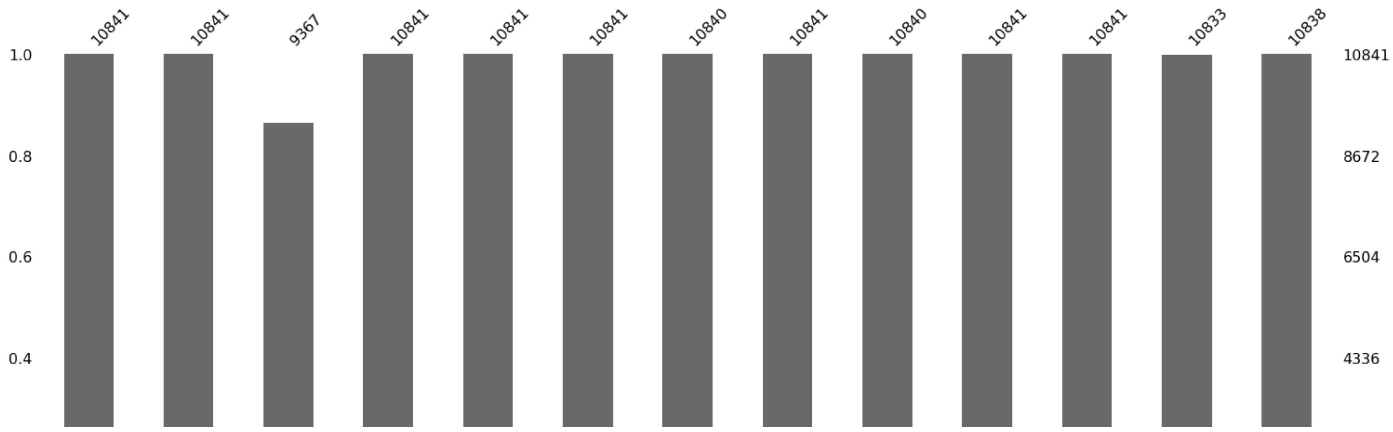
Findings

```
The number of null values are:
```

Rating has 1474 null values which contributes 13.60% of the data. Type has 1 null value which contributes 0.01% of the data. Content_rating has 1 null value which contributes 0.01% of the data.Current_Ver has 8 null values which contributes 0.07% of the data.Android_ver has 3 null values which contribute 0.03% of the data.

```
# Visualizing the missing values
import missingno as msno
msno.bar(ps_df)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9634e518b0>
```



What did you know about your dataset?

Exploratory data analysis (EDA) is used by data scientists to analyze and investigate data sets for patterns, and anomalies (outliers), and form hypotheses based on our understanding of the dataset and summarize their main characteristics, often employing data visualization methods. It is an important step in any Data Analysis or Data Science project. It helps determine how best to manipulate data sources to get the answers you need.

EDA involves generating summary statistics for numerical data in the dataset and creating various graphical representations to understand the data better and make it more attractive and appealing.

The following are the various steps involved in the EDA process:

1. **Problem Statement** - We shall brainstorm and understand the given data set. We shall study the attributes present in it and try to do a philosophical analysis about their meaning and importance for this problem.
2. **Hypothesis** - Upon studying the attributes present in the data base, we shall develop some basic hypothesis on which we can work and play with the data to look for the varied results which we can get out of it.
3. **Univariate Analysis** - It is the simplest form of analyzing the data. In this we would initially pick up a single attribute and study it in and out. It doesn't deal with any sort of co-relation and it's major purpose is to describe. It takes data, summarizes that data and finds patterns in the data.
4. **Bivariate Analysis** - This analysis is related to cause and the relationship between the two attributes. We will try to understand the dependency of attributes on each other.
5. **Multivariate Analysis** - This is done when more than two variables have to be analyzed simultaneously.
6. **Data Cleaning** - We shall clean the dataset and handle the missing data, outliers and categorical variables.
7. Testing Hypothesis - We shall check if our data meets the assumptions required by most of the multivariate techniques.Answer Here

2. Understanding Your Variables

```
# Dataset Columns
print(ps_df.columns)
columns=ps_df.shape[1]
print(f"The number of columns is {columns}.")
```

```
Index(['App', 'Category', 'Rating', 'Reviews', 'Size', 'Installs', 'Type',
       'Price', 'Content Rating', 'Genres', 'Last Updated', 'Current Ver',
       'Android Ver'],
      dtype='object')
The number of columns is 13.
```

```
# Dataset Describe
ps_df.describe()
```

	Rating
count	9367.000000
mean	4.193338
std	0.537431
min	1.000000
50%	4.300000

Variables Description

play_store dataframe has 10841 rows and 13 columns. The 13 columns are identified as below:

1. **App** - It tells us about the name of the application with a short description (optional).
2. **Category** - It gives the category to the app.
3. **Rating** - It contains the average rating the respective app received from its users.
4. **Reviews** - It tells us about the total number of users who have given a review for the application.
5. **Size** - It tells us about the size being occupied the application on the mobile phone.
6. **Installs** - It tells us about the total number of installs/downloads for an application.
7. **Type** - IIt states whether an app is free to use or paid.
8. **Price** - It gives the price payable to install the app. For free type apps, the price is zero.
9. **Content Rating** - It states whether or not an app is suitable for all age groups or not.
10. **Genres** - It tells us about the various other categories to which an application can belong.
11. **Last Updated** - It tells us about the when the application was updated.
12. **Current Ver** - It tells us about the current version of the application.
13. **Android Ver** - It tells us about the android version which can support the application on its platform.

Check Unique Values for each variable.

```
# Check Unique Values for each variable.
ps_df.nunique(axis=0)
```

```
App               9660
Category            34
Rating              40
Reviews           6002
Size               462
Installs            22
Type                 3
Price               93
Content Rating       6
Genres             120
Last Updated      1378
Current Ver       2832
Android Ver         33
dtype: int64
```

3. *Data Wrangling*

Data Wrangling Code

```
# Write your code to make your dataset analysis ready.
def playstoreinfo():
  temp=pd.DataFrame(index=ps_df.columns)
  temp["datatype"]=ps_df.dtypes
  temp["not null values"]=ps_df.count()
  temp["null values"]=ps_df.isnull().sum()
  temp["% of the null values"]=ps_df.isnull().mean()
  temp["unique count"]=ps_df.nunique()
  return temp
playstoreinfo()
```

	datatype	not null values	null values	% of the null values	unique count
App	object	10841	0	0.000000	9660
Category	object	10841	0	0.000000	34
Rating	float64	9367	1474	0.135965	40
Reviews	object	10841	0	0.000000	6002
Size	object	10841	0	0.000000	462
Installs	object	10841	0	0.000000	22
Type	object	10840	1	0.000092	3
Price	object	10841	0	0.000000	93
Content Rating	object	10840	1	0.000092	6
Genres	object	10841	0	0.000000	120
Last Updated	object	10841	0	0.000000	1378
Current Ver	object	10833	8	0.000738	2832

What all manipulations have you done and insights you found?

Cleaning of the data

The three features that we will be working with most frequently henceforth are Installs, Size, and Price. A careful glance of the dataset reveals that some of these columns mandate data cleaning in order to be consumed by code we'll write later. Specifically, the presence of special characters (, $ +) and letters (M k) in the Installs, Size, and Price columns make their conversion to a numerical data type difficult. Let's clean by removing these and converting each column to a numeric type.

Removing the Nan value and Duplicate present in the data set.

1. Android Ver: there are total of 3 NaN values in this column.

```
# The rows containing NaN values in the Android Ver column
ps_df[ps_df["Android Ver"].isnull()]
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Androi Ve
4453	[substratum] Vacuum: P	PERSONALIZATION	4.4	230	11M	1,000+	Paid	$1.49	Everyone	Personalization	July 20, 2018	4.4	Nal
4490	Pi Dark [substratum]	PERSONALIZATION	4.5	189	2.1M	10,000+	Free	0	Everyone	Personalization	March 27, 2018	1.1	Nal
	Life Made WI-Fi										February 11,		4.0 and

```
# Finding the different values the 'Android Ver' column takes
ps_df["Android Ver"].value_counts()
```

```
4.1 and up            2451
4.0.3 and up          1501
4.0 and up            1375
Varies with device    1362
4.4 and up             980
2.3 and up             652
5.0 and up             601
4.2 and up             394
2.3.3 and up           281
2.2 and up             244
4.3 and up             243
3.0 and up             241
2.1 and up             134
1.6 and up             116
6.0 and up              60
7.0 and up              42
3.2 and up              36
2.0 and up              32
5.1 and up              24
1.5 and up              20
```

```
4.4W and up             12
3.1 and up              10
2.0.1 and up             7
8.0 and up               6
7.1 and up               3
4.0.3 - 7.1.1            2
5.0 - 8.0                2
1.0 and up               2
7.0 - 7.1.1              1
4.1 - 7.1.1              1
5.0 - 6.0                1
2.2 - 7.1.1              1
5.0 - 7.1.1              1
Name: Android Ver, dtype: int64
```

Since the NaN values in the Android Ver column cannot be replaced by any particular value and since there are only 3 rows which comtain NaN values in this column, which accounts to less than 0.03% of the total rows in the given dataset, it can be dropped.

```
# dropping rows corresponding to the NaN values in the 'Android Ver' column.
ps_df=ps_df[ps_df['Android Ver'].notna()]
# shape of the updated dataframe
ps_df.shape
```

```
(10838, 13)
```

We were successfully able to handle the NaN values in the Android Ver column.

2. Current Ver: There are a total of 8 NaN values in this column.

```
# The rows containing NaN values in the Current Ver column
ps_df[ps_df["Current Ver"].isnull()]
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andr
15	Learn To Draw Kawaii Characters	ART_AND_DESIGN	3.2	55	2.7M	5,000+	Free	0	Everyone	Art & Design	June 6, 2018	NaN	4.2
1553	Market Update Helper	LIBRARIES_AND_DEMO	4.1	20145	11k	1,000,000+	Free	0	Everyone	Libraries & Demo	February 12, 2013	NaN	1.5
6322	Virtual DJ Sound Mixer	TOOLS	4.2	4010	8.7M	500,000+	Free	0	Everyone	Tools	May 10, 2017	NaN	4.0
6803	BT Master	FAMILY	NaN	0	222k	100+	Free	0	Everyone	Education	November 6, 2016	NaN	1.6

```
# Finding the different values the 'Current Ver' column takes
ps_df['Current Ver'].value_counts()
```

```
Varies with device    1459
1.0                    809
1.1                    263
1.2                    178
2.0                    151
                      ...
5.44.1                   1
7.16.8                   1
04.08.00                 1
2.10.06                  1
2.0.148.0                1
Name: Current Ver, Length: 2831, dtype: int64
```

Since there are only 8 rows which contain NaN values in the Current Ver column, and it accounts to just around 0.07% of the total rows in the given dataset, and there is no particular value with which we can replace it,these rows can be dropped.

```
# Dropping rows corresponding to the values which contain NaN in the column 'Current Ver'
ps_df=ps_df[ps_df["Current Ver"].notna()]
```

```
# Shape of the updated dataframe
ps_df.shape
```

```
(10830, 13)
```

3. Type: There is only one NaN value in this column.

```
# The row containing NaN values in the Type column
ps_df[ps_df["Type"].isnull()]
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
	Command &				Varies				Everyone		June 28	Varies with	Varies with

```
# Finding the different values the 'Type' column takes
ps_df["Type"].value_counts()
```

```
Free    10032
Paid      797
Name: Type, dtype: int64
```

The `Type` column contains only two entries, namely, `Free` and `Paid`. Also, if the app is of `type-paid`, the price of that app will be printed in the corresponding `price` column else it will show as '0'. In this case the price for the respective app is printed as '0'. which means the app is of `type-free`. Hence we can replace this NaN value with free.

```
# Replacing the NaN value in 'Type' column corresponding tp row index 9148 with 'Free'
ps_df.loc[9148,"Type"]='Free'
```

```
ps_df[ps_df["Type"].isnull()]
```

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

4. Rating: This column contains 1470 Nan values.

```
# The rows containing NaN values in the Rating column
ps_df[ps_df['Rating'].isnull()]
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Cu
23	Mcqueen Coloring pages	ART_AND_DESIGN	NaN	61	7.0M	100,000+	Free	0	Everyone	Art & Design;Action & Adventure	March 7, 2018	
113	Wrinkles and rejuvenation	BEAUTY	NaN	182	5.7M	100,000+	Free	0	Everyone 10+	Beauty	September 20, 2017	
123	Manicure - nail design	BEAUTY	NaN	119	3.7M	50,000+	Free	0	Everyone	Beauty	July 23, 2018	
126	Skin Care and Natural Beauty	BEAUTY	NaN	654	7.4M	100,000+	Free	0	Teen	Beauty	July 17, 2018	
129	Secrets of beauty, youth and health	BEAUTY	NaN	77	2.9M	10,000+	Free	0	Mature 17+	Beauty	August 8, 2017	
...	...	...	...	...	...	...	...	...	...	...	...	...
10824	Cardio-FR	MEDICAL	NaN	67	82M	10,000+	Free	0	Everyone	Medical	July 31, 2018	
10825	Naruto & Boruto FR	SOCIAL	NaN	7	7.7M	100+	Free	0	Teen	Social	February 2, 2018	
10831	payermonstationnement.fr	MAPS_AND_NAVIGATION	NaN	38	9.8M	5,000+	Free	0	Everyone	Maps & Navigation	June 13, 2018	2.0
10835	FR Forms	BUSINESS	NaN	0	9.6M	10+	Free	0	Everyone	Business	September 29, 2016	

Also, we know that the rating of any app in the play store will be in between 1 and 5. Lets check whether there are any ratings out of tjis range.

```
ps_df[(ps_df['Rating'] <1) | (ps_df['Rating']>5)]
```

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

- The `Rating` column contains 1470 NaN values which acounts to approximately 13.5% of the rows in the entire dataset. It is not practical to drop these rows because by doing so, we will loose a large amount of data, which may impact the final quality of the analysis.
- The NaN values in this case can be imputed by the aggregate (mean or median) of the remaining values in the Rating column.

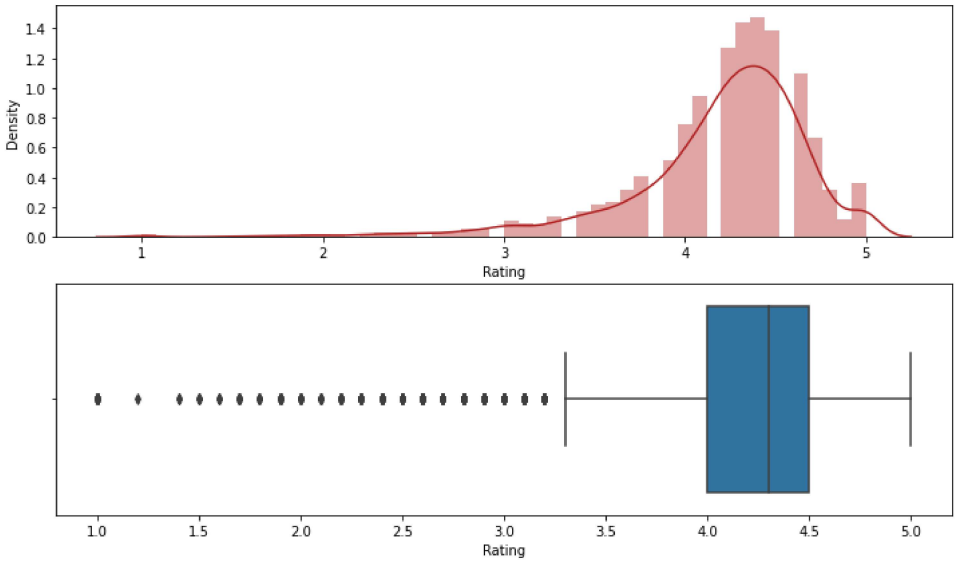
```
# Finding mean and median in the Rating column excluding the NaN values.
mean_rating = round(ps_df[~ps_df['Rating'].isnull()]['Rating'].mean(),4)
median_rating = ps_df[~ps_df['Rating'].isnull()]['Rating'].median()
[mean_rating , median_rating]
```

```
[4.1918, 4.3]
```

Visualization of distribution of rating using displot and detecting the outliers through boxplot.

```
fig, ax = plt.subplots(2,1, figsize=(12,7))
sns.distplot(ps_df['Rating'],color='firebrick',ax=ax[0])
sns.boxplot(x='Rating',data=ps_df, ax=ax[1])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9631fb7070>
```



- The mean of the average ratings(excluding the NaN values) comes to be 4.2.
- The median of the entries(excluding the NaN values) in the 'Rating' column to be 4.3. from this we can say that 50% of the apps have an average rating of above 4.3, and the rest below 4.3.
- From the distplot visualizations, it is clear that the ratings are left skewed.
- We know that if the variable is skewed, the mean is biased by the values at the far end of the distribution. Therefore, the median is a better representation of the majority of the values in the variable.
- Hence we will impute the NaN values in the Rating column with its median.

```
#Replacing the NaN values in the 'Rating' column with its median value
ps_df['Rating'].fillna(value=median_rating,inplace=True)
```

Handling duplicates values and Manipulating dtataset:

1. Handling the duplicates in the **App** column

```
# Handling the error values in the play store data
ps_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	January 7, 2018	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	Art & Design;Pretend Play	January 15, 2018	2.0.0	4.0.3 and up
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	August 1, 2018	1.2.4	4.0.3 and up

```
ps_df['App'].value_counts()
```

```
ROBLOX                                              9
CBS Sports App - Scores, News, Stats & Watch Live   8
Candy Crush Saga                                    7
8 Ball Pool                                         7
ESPN                                                7
                                                   ..
Meet U - Get Friends for Snapchat, Kik & Instagram  1
U-Report                                            1
U of I Community Credit Union                       1
Waiting For U Launcher Theme                        1
iHoroscope - 2018 Daily Horoscope & Astrology       1
Name: App, Length: 9649, dtype: int64
```

```
# Inspecting the duplicate values.
ps_df[ps_df['App']=='ROBLOX']
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
1653	ROBLOX	GAME	4.5	4447388	67M	100,000,000+	Free	0	Everyone 10+	Adventure;Action & Adventure	July 31, 2018	2.347.225742	4.1 and up
1701	ROBLOX	GAME	4.5	4447346	67M	100,000,000+	Free	0	Everyone 10+	Adventure;Action & Adventure	July 31, 2018	2.347.225742	4.1 and up
1748	ROBLOX	GAME	4.5	4448791	67M	100,000,000+	Free	0	Everyone 10+	Adventure;Action & Adventure	July 31, 2018	2.347.225742	4.1 and up
1841	ROBLOX	GAME	4.5	4449882	67M	100,000,000+	Free	0	Everyone 10+	Adventure;Action & Adventure	July 31, 2018	2.347.225742	4.1 and up
1870	ROBLOX	GAME	4.5	4449910	67M	100,000,000+	Free	0	Everyone 10+	Adventure;Action & Adventure	July 31, 2018	2.347.225742	4.1 and up
2016	ROBLOX	FAMILY	4.5	4449910	67M	100,000,000+	Free	0	Everyone	Adventure;Action &	July 31,	2.347.225742	4.1 and

```
ps_df[ps_df.duplicated()]
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andro
229	Quick PDF Scanner + OCR FREE	BUSINESS	4.2	80805	Varies with device	5,000,000+	Free	0	Everyone	Business	February 26, 2018	Varies with device	4.(and
236	Box	BUSINESS	4.2	159872	Varies with device	10,000,000+	Free	0	Everyone	Business	July 31, 2018	Varies with device	Var w dev
239	Google My Business	BUSINESS	4.4	70991	Varies with device	5,000,000+	Free	0	Everyone	Business	July 24, 2018	2.19.0.204537701	4.4 a
	ZOOM										July 20,		4.0 a

```
# dropping duplicates from the 'App' column.
ps_df.drop_duplicates(subset = 'App', inplace = True)
ps_df.shape
```

```
(9649, 13)
```

	...	...	...	...	...	...	...	...	...	...	...	...	...

```
# Checking whether the duplicates in the 'App' column are taken care of or not
ps_df[ps_df['App']=='ROBLOX']
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
1653	ROBLOX Day Planner	GAME	4.5	4447388	67M	100,000,000+	Free	0	Everyone	Adventure;Action &	July 31,	2.347.225742	4.1 and

We have successfully handled all the duplicates values in the App column.The resultant number of rows after dropping the duplicate rows in the app column out to be 9660.

2. Changing the datatype of the Last Updated column from string to datetime.

```
# Pandas to datetime() function applied to the values in the last updated column helps to convert string date time into Python Date time obje
ps_df["Last Updated"] = pd.to_datetime(ps_df['Last Updated'])
ps_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0	Everyone	Art & Design	2018-01-07	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up
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	2018-08-01	1.2.4	4.0.3 and up

3. Changing the datatype of thePrice column from string to float.

```
ps_df['Price'].value_counts()
```

```
0          8896
$0.99       143
$2.99       124
$1.99        73
$4.99        70
          ...
$18.99        1
$389.99       1
$19.90        1
$1.75         1
```

```
$1.04         1
Name: Price, Length: 92, dtype: int64
```

To convert this column from string to float, we must first drop the $ symbol from the all the values. Then we can assign float datatype to those values.

Applying the `drop_dollar` function to convert the values in thePrice column from string datatype to float datatype.

```
# Creating a function drop-dollar which drops the $ symbol if it is present and returns the output which is of float datatype.
def convert_dollar(val):
  '''
  This function drops the $ symbol if present and returns value with float datatype.
  '''
  if'$' in val:
    return float(val[1:])
  else:
    return float(val)
```

```
# The drop_dollar function applied to the price column
ps_df['Price']=ps_df['Price'].apply(lambda x: convert_dollar(x))
ps_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10,000+	Free	0.0	Everyone	Art & Design	2018-01-07	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500,000+	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7M	5,000,000+	Free	0.0	Everyone	Art & Design	2018-08-01	1.2.4	4.0.3 and up

```
ps_df[ps_df['Price']!=0].head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
234	TurboScan: scan documents and receipts in PDF	BUSINESS	4.7	11442	6.8M	100,000+	Paid	4.99	Everyone	Business	2018-03-25	1.5.2	4.0 and up
235	Tiny Scanner Pro: PDF Doc Scan	BUSINESS	4.8	10295	39M	100,000+	Paid	4.99	Everyone	Business	2017-04-11	3.4.6	3.0 and up
427	Puffin Browser Pro	COMMUNICATION	4.0	18247	Varies with device	100,000+	Paid	3.99	Everyone	Communication	2018-07-05	7.5.3.20547	4.1 and up
	Moco+ -				Varies				Mature		2018-		4.1 and

We have successfully converted the datatype of values in the Price column from string to float.

4. Converting the values in theInstallscolumn from string datatype to integer datatype.

```
# Checking the contents of the 'Installs' column
ps_df['Installs'].value_counts()
```

```
1,000,000+        1416
100,000+          1112
```

```
10,000+           1029
10,000,000+        937
1,000+             886
100+               709
5,000,000+         607
500,000+           504
50,000+            468
5,000+             467
10+                384
500+               328
50+                204
50,000,000+        202
100,000,000+       188
5+                  82
1+                  67
500,000,000+        24
1,000,000,000+      20
0+                  14
0                    1
Name: Installs, dtype: int64
```

To convert all the values in the **Installs** column from string datatype to integer datatype, we must first drop the '+' symbol from all the entries if present and then we can change its datatype.

Applying the `convert_plus` function to convert the values in the `Installs` column from string datatype to float datatype.

```
# Creating a function convert_plus which drops the '+' symbol if it is present and returns the output which is of integer datatype.
def convert_plus(val):
  '''
  This function drops the + symbol if present and returns value with int datatype.
  '''
  if'+' and ',' in val:
    new = int(val[:-1].replace(',',''))
    return new
  elif '+' in val:
    new1 = int(val[:-1])
    return new1
  else:
    return int(val)


# The drop_plus function applied to the main dataframe

ps_df['Installs'] = ps_df['Installs'].apply(lambda x: convert_plus(x))
ps_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19M	10000	Free	0.0	Everyone	Art & Design	2018-01-07	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14M	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7M	5000000	Free	0.0	Everyone	Art & Design	2018-08-01	1.2.4	4.0.3 and up
3	Sketch - Draw	ART_AND_DESIGN	4.5	215644	25M	50000000	Free	0.0	Teen	Art & Design	2018-06-	Varies	4.2 and

The resultant values in the **Installs** column are of the integer datatype, and it represents the least number of times a particular app has been installed.

- **Installs** = 0 indicates that that particular app has not been installed by anyone yet.
- Installs = 1 indicates that the particular app has been installed by atleast one user.
- **Installs** = 1000000 indicates that the particular app has been installed by atleast one million users. So on and so forth.
- We have successfully converted the datatype of values in the Installs column from string to int.

5. Converting the values in theSizecolumn to a same unit of measure(MB).

```
ps_df['Size'].value_counts()
```

```
Varies with device    1227
12M                    181
11M                    181
13M                    177
14M                    176
                      ...
721k                     1
430k                     1
429k                     1
200k                     1
619k                     1
Name: Size, Length: 457, dtype: int64
```

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.

```
# Defining a function to convert all the entries in KB to MB and then converting them to float datatype.
def convert_kb_to_mb(val):
  '''
  This function converts all the valid entries in KB to MB and returns the result in float datatype.
  '''
  try:
    if 'M' in val:
      return float(val[:-1])
    elif 'K' in val:
      return round(float(val[:-1])/1024, 4)
    else:
      return val
  except:
    return val
```

Applying the kb_to_mb function to convert the values in the Size column to a single unit of measure (MB) and the datatype from string to float.

```
# The kb_to_mb function applied to the size column
ps_df['Size'] = ps_df['Size'].apply(lambda x: convert_kb_to_mb(x))
ps_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19.0	10000	Free	0.0	Everyone	Art & Design	2018-01-07	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7	5000000	Free	0.0	Everyone	Art & Design	2018-08-01	1.2.4	4.0.3 and up
3	Sketch - Draw	ART_AND_DESIGN	4.5	215644	25.0	50000000	Free	0.0	Teen	Art & Design	2018-06-	Varies	4.2 and

6. Converting the datatype of values in theReviewscolumn from string to int.

```
# Converting the datatype of the values in the reviews column from string to int
ps_df['Reviews'] = ps_df['Reviews'].astype(int)
ps_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.1	159	19.0	10000	Free	0.0	Everyone	Art & Design	2018-01-07	1.0.0	4.0.3 and up
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.7	87510	8.7	5000000	Free	0.0	Everyone	Art & Design	2018-08-01	1.2.4	4.0.3 and up

```
ps_df.describe()
```

	Rating	Reviews	Installs	Price
count	9649.000000	9.649000e+03	9.649000e+03	9649.000000
mean	4.192476	2.168145e+05	7.785404e+06	1.100079
std	0.496528	1.832255e+06	5.378557e+07	16.860857
min	1.000000	0.000000e+00	0.000000e+00	0.000000
25%	4.000000	2.500000e+01	1.000000e+03	0.000000
50%	4.300000	9.690000e+02	1.000000e+05	0.000000
75%	4.500000	2.944500e+04	1.000000e+06	0.000000
max	5.000000	7.815831e+07	1.000000e+09	400.000000

We have successfully converted the datatype of the values in the Reviews column from string to int.

Now that we have handled the errors and NaN values in the playstoredata.csv file, lets do the same for the userreviews.csv file

Exploring User_review dataframe

```
file_path = '/content/drive/MyDrive/AlmaBetter/Capstone Projects/Play Store app review analysis/User Reviews.csv'
ur_df=pd.read_csv(file_path)


# Checking the top 10 rows of the data
ur_df.head()
```

	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

```
ur_df.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
```

```
# Checking shape and column in dataframe
print(ur_df.columns)
rows=ur_df.shape[0]
columns=ur_df.shape[1]
print(f"The number of rows is{rows} and number of columns is {columns}")
```

```
Index(['App', 'Translated_Review', 'Sentiment', 'Sentiment_Polarity',
       'Sentiment_Subjectivity'],
      dtype='object')
The number of rows is64295 and number of columns is 5
```

Let us first define what information the columns contain based on our inspection.

user_reviews dataframe has 64295 rows and 5 columns. The 5 columns are identified as follows:

- **App**: Contains the name of the app with a short description (optional).
- **Translated_Review**: It contains the English translation of the review dropped by the user of the app.
- **Sentiment**: It gives the attitude/emotion of the writer. It can be 'Positive', 'Negative', or 'Neutral'.
- **Sentiment_Polarity**: It gives the polarity of the review. Its range is [-1,1], where 1 means 'Positive statement' and -1 means a 'Negative statement'
- **Sentiment_Subjectivity**: This value gives how close a reviewers opinion is to the opinion of the general public. Its range is [0,1]. Higher the subjectivity, closer is the reviewers opinion to the opinion of the general public, and lower subjectivity indicates the review is more of a factual information.

```
def Urinfo():
  temp1=pd.DataFrame(index=ur_df.columns)
  temp1["datatype"]=ur_df.dtypes
  temp1["not null values"]=ur_df.count()
  temp1["null value"]=ur_df.isnull().sum()
  temp1["% of the null value"] = ur_df.isnull().mean().round(4)*100
  temp1["unique count"]=ur_df.nunique()
  return temp1
Urinfo()
```

	datatype	not null values	null value	% of the null value	unique count
App	object	64295	0	0.00	1074
Translated_Review	object	37427	26868	41.79	27994
Sentiment	object	37432	26863	41.78	3
Sentiment_Polarity	float64	37432	26863	41.78	5410
Sentiment_Subjectivity	float64	37432	26863	41.78	4474

Findings

The number of null values are:

- **Translated_Review** has 26868 null values which contributes **41.79%** of the data.
- **Sentiment** has 26863 null values which contributes **41.78%** of the data.
- **Sentiment_Polarity** has 26863 null values which contributes **41.78%** of the data.
- **Sentiment_Subjectivity** has 26863 null values which contributes **41.78%** of the data.

Handling the error and NaN values in the User reviews

```
# Finding the total no of NaN values in each column
ur_df.isnull().sum()
```

```
App                        0
Translated_Review      26868
Sentiment              26863
Sentiment_Polarity     26863
```

```
Sentiment_Subjectivity    26863
dtype: int64
```

There are a lot of NaN values. We need ro analyse these values and see how we can handle them.

```
# checking the NaN values in the translated review column
ur_df[ur_df['Translated_Review'].isnull()]
```

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
2	10 Best Foods for You	NaN	NaN	NaN	NaN
7	10 Best Foods for You	NaN	NaN	NaN	NaN
15	10 Best Foods for You	NaN	NaN	NaN	NaN
102	10 Best Foods for You	NaN	NaN	NaN	NaN
107	10 Best Foods for You	NaN	NaN	NaN	NaN
...	...	...	...	...	...
64290	Houzz Interior Design Ideas	NaN	NaN	NaN	NaN
64291	Houzz Interior Design Ideas	NaN	NaN	NaN	NaN
64292	Houzz Interior Design Ideas	NaN	NaN	NaN	NaN
64293	Houzz Interior Design Ideas	NaN	NaN	NaN	NaN
64294	Houzz Interior Design Ideas	NaN	NaN	NaN	NaN

26868 rows × 5 columns

There are a total of 26868 rows containing NaN values in the Translated_Review column.

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.

Lets check if there are any exceptions.

```
# The rows corresponding to the NaN values in the translated_review column, where the rest of the columns are non null.
ur_df[ur_df['Translated_Review'].isnull() & ur_df['Sentiment'].notna()]
```

	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.

```
# Deleting the rows containing NaN values
ur_df = ur_df.dropna()
```

```
# The shape of the updated df
ur_df.shape
```

```
(37427, 5)
```

There are a total of 37427 rows in the updated df.

Hence we have taken care of all the NaN values in the df.

Lets inspect the updated df.

```
# Inspecting the sentiment column
ur_df['Sentiment'].value_counts()
```

```
Positive    23998
Negative     8271
Neutral      5158
Name: Sentiment, dtype: int64
```

The values in the `Sentiment_Polarity and Sentiment_Subjectivity` looks correct.

On the given datasets, we successfully developed a data pipeline. We can now examine this data flow and create user-friendly visuals. It is easy to compare different measures using the visualizations, and thus to draw implications from them.

4. Data Vizualization, Storytelling & Experimenting with charts : Understand the relationships between variables

We have sucessfully cleaned the dirty data. Now we can perform some data visualization and come up with insights on the given datasets.

Chart - 1

```
# Chart - 1 visualization code
```

1. Heat map

```
merged_df = pd.merge(ps_df,ur_df, on='App', how="inner")
```

```
def merged_dfinfo():
  temp = pd.DataFrame(index=merged_df.columns)
  temp['data_type'] = merged_df.dtypes
  temp["count of non null values"] = merged_df.count()
  temp['NaN values'] = merged_df.isnull().sum()
  temp['% Nan values'] = merged_df.isnull().mean()
  temp['unique_count'] = merged_df.nunique()
  return temp
merged_dfinfo()
```

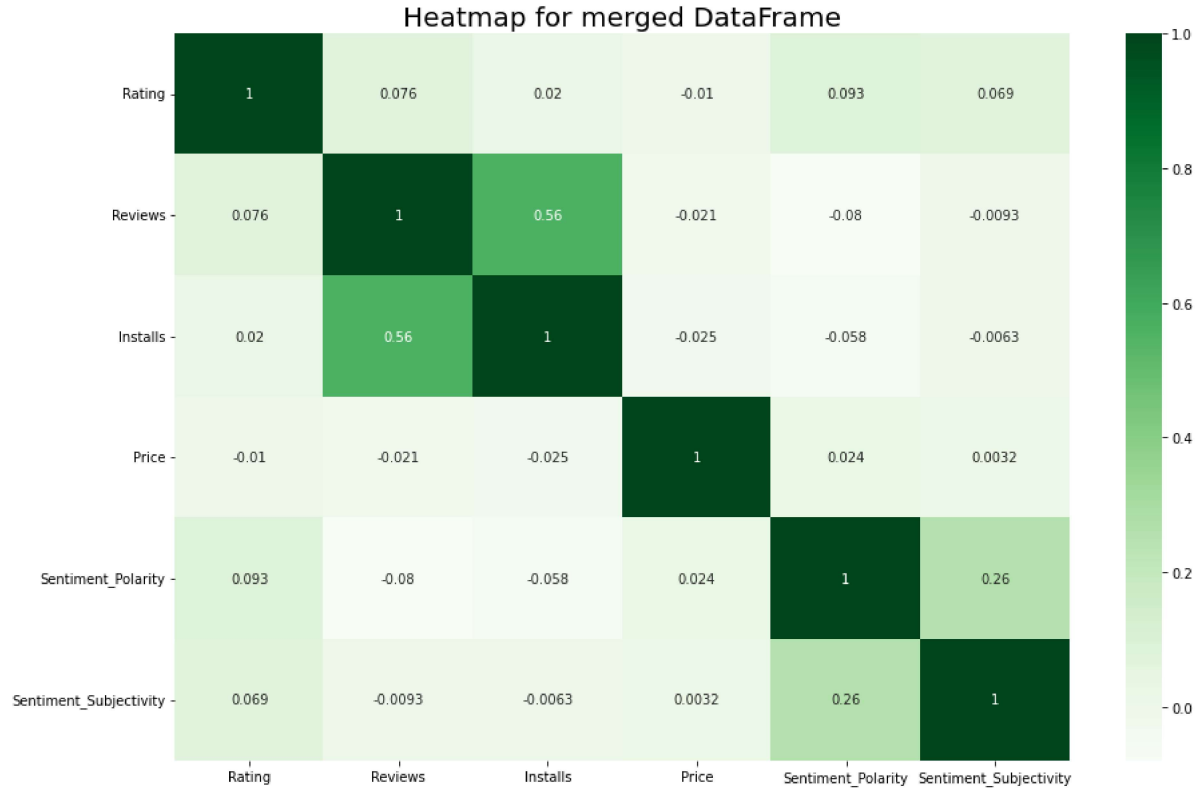
	data_type	count of non null values	NaN values	% Nan values	unique_count
App	object	35929	0	0.0	816

```
merged_df.corr()
```

	Rating	Reviews	Installs	Price	Sentiment_Polarity	Sentiment_Subjectivity
Rating	1.000000	0.075736	0.020145	-0.010055	0.092903	0.068758
Reviews	0.075736	1.000000	0.564256	-0.020591	-0.080021	-0.009315
Installs	0.020145	0.564256	1.000000	-0.025213	-0.057842	-0.006307
Price	-0.010055	-0.020591	-0.025213	1.000000	0.024148	0.003182
Sentiment_Polarity	0.092903	-0.080021	-0.057842	0.024148	1.000000	0.259668
Sentiment_Subjectivity	0.068758	-0.009315	-0.006307	0.003182	0.259668	1.000000
Genres	object		35929	0	0.0	67

```
# Heatmap
# Heat Map for the merged data frame
plt.figure(figsize = (15,10))
sns.heatmap(merged_df.corr(), annot=True, cmap='Greens')
plt.title('Heatmap for merged DataFrame', size=20)
```

```
Text(0.5, 1.0, 'Heatmap for merged DataFrame')
```



▼ 1. Why did you pick the specific chart?

A heat map is a data visualization technique that shows magnitude of a phenomenon as color in two dimensions.

▶ 2. What is/are the insight(s) found from the chart?

1 cell hidden

▼ 3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

There is a strong positive correlation between the Reviews and Installs column. This is pretty much obvious. Higher the number of installs, higher is the user base, and higher are the total number of reviews dropped by the users.

Chart - 2

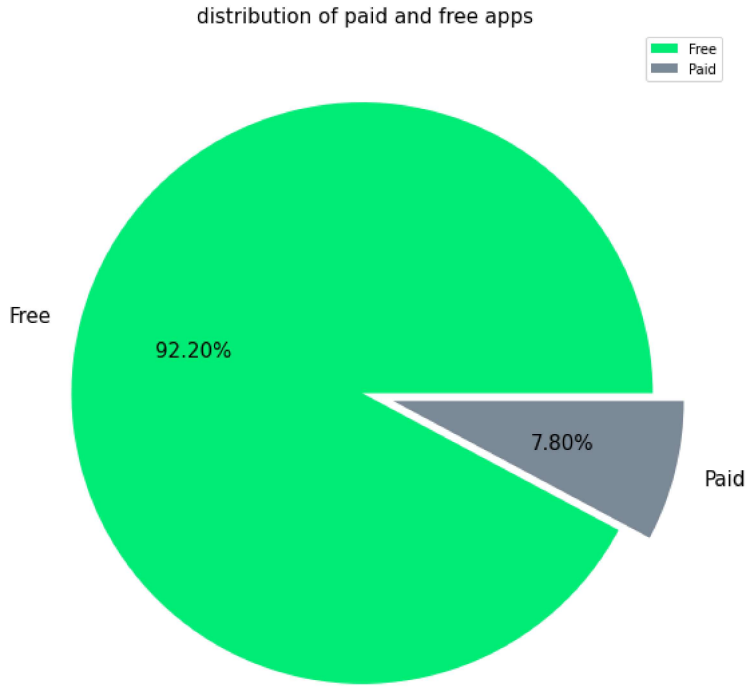
```
# Chart - 2 visualization code
```

2. The Ratio of number of paid apps and free apps

```
data = ps_df['Type'].value_counts()
labels = ['Free','Paid']

# create pie chart
plt.figure(figsize=(10,10))
colors = ["#00EE76","#7B8895"]
explode=(0.01,0.1)
plt.pie(data, labels = labels, colors = colors, autopct='%.2f%%',explode=explode,textprops={'fontsize':15})
plt.title('distribution of paid and free apps',size=15,loc='center')
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f9631823eb0>
```



1. Why did you pick the specific chart?

Pie chart is a way of summarizing a set of nominal data or displaying the different values of a given variable.

2. What is/are the insight(s) found from the chart?

From the above graph we can see that 92% of apps in google play store are free and 8%are paid.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

As we saw from the above graph majority of people uses the free apps and less number people uses the paid app. So this is obvious more number of paid apps means less number of people.

```
ps_df['Content Rating'].unique()
```

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

Chart - 3

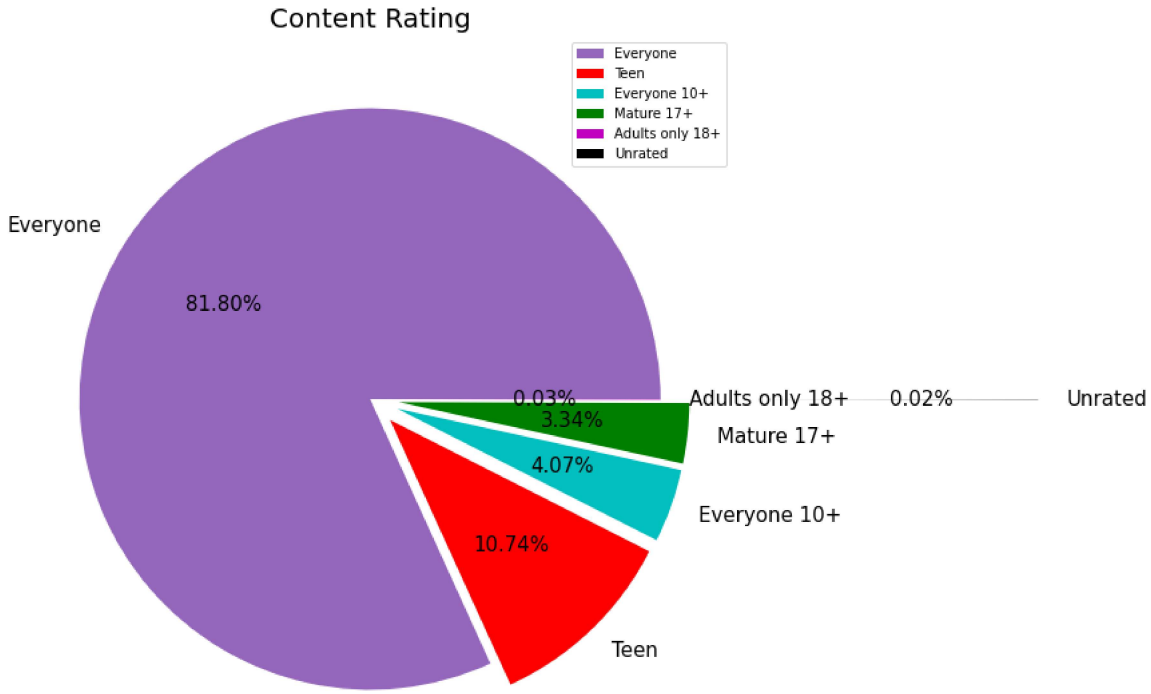
```
# Chart - 3 visualization code
```

3. Category of Apps from the content Rating column are found more on playstore

```
# content rating of the apps
data = ps_df['Content Rating'].value_counts()
labels = ['Everyone','Teen','Everyone 10+','Mature 17+','Adults only 18+','Unrated']

# create pie chart
plt.figure(figsize=(10,10))
explode=(0,0.1,0.1,0.1,0.0,1.3)
colors = ['C4','r','c','g','m','k']
plt.pie(data, labels = labels, colors = colors, autopct='%.2f%%',explode=explode,textprops={'fontsize':15})
plt.title('Content Rating', size=20,loc='center')
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f96317a6be0>
```



1. Why did you pick the specific chart?

Pie chart is a way of summarizing a set of nominal data or displaying the different values of a given variable.

2. What is/are the insight(s) found from the chart?

A majority of the apps (82%) in the play store are can be used by everyone.The remaining apps have various age restrictions to use it.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

As we saw from the above graph majority of apps can be used by everyone. so there is no such reasons that will lead to negative growth.

Chart - 4

```
# Chart - 4 visualization code
```

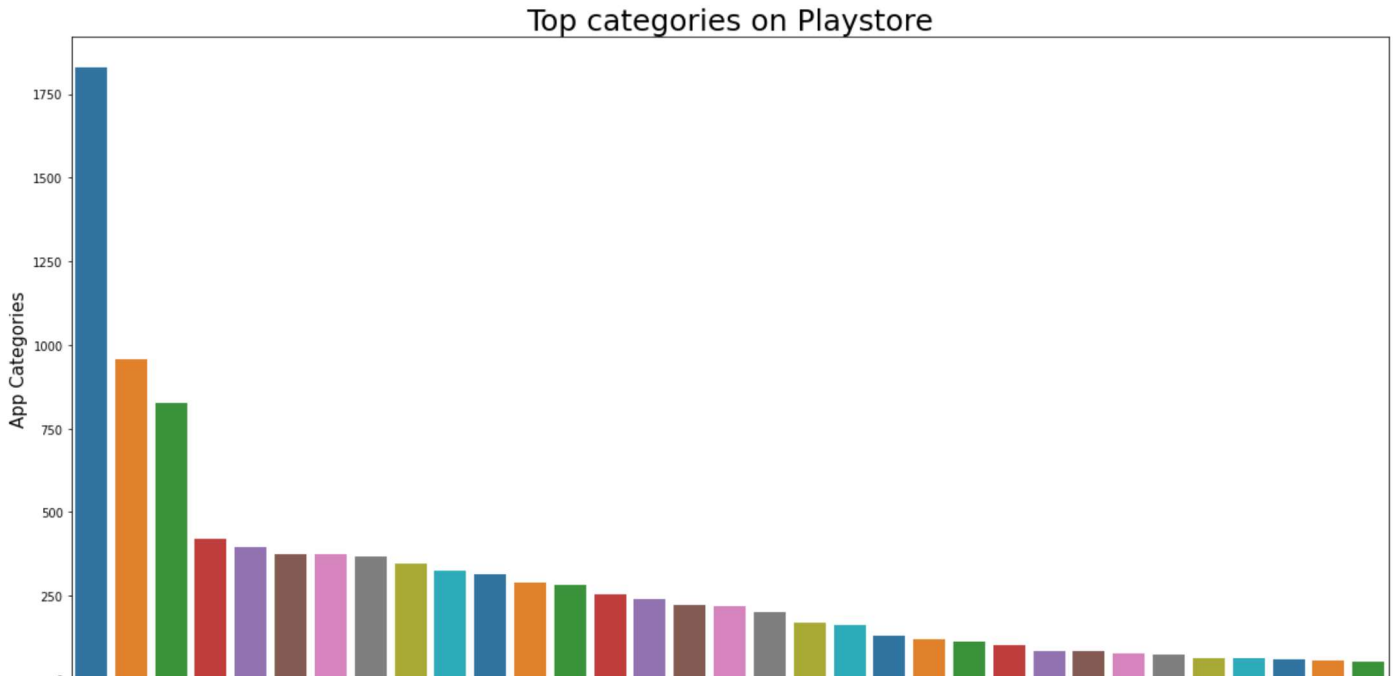
4. Top categories on Google Playstore

```
ps_df.groupby("Category")["App"].count().sort_values(ascending=False)
```

```
Category
FAMILY                 1829
GAME                    959
TOOLS                   825
BUSINESS                420
MEDICAL                 395
PERSONALIZATION         374
PRODUCTIVITY            374
LIFESTYLE               369
FINANCE                 345
SPORTS                  325
COMMUNICATION           315
HEALTH_AND_FITNESS      288
PHOTOGRAPHY             281
NEWS_AND_MAGAZINES      254
SOCIAL                  239
BOOKS_AND_REFERENCE     221
TRAVEL_AND_LOCAL        219
SHOPPING                202
DATING                  171
VIDEO_PLAYERS           163
MAPS_AND_NAVIGATION     131
EDUCATION               119
FOOD_AND_DRINK          112
ENTERTAINMENT           102
AUTO_AND_VEHICLES        85
LIBRARIES_AND_DEMO       83
WEATHER                  79
HOUSE_AND_HOME           74
EVENTS                   64
ART_AND_DESIGN           63
PARENTING                60
COMICS                   56
BEAUTY                   53
Name: App, dtype: int64
```

```
x = ps_df['Category'].value_counts()
y = ps_df['Category'].value_counts().index
x_list = []
y_list = []
for i in range(len(x)):
  x_list.append(x[i])
  y_list.append(y[i])
```

```
# Number of apps belongingto each category in the playstore
plt.figure(figsize=(20,10))
plt.xlabel('Number of Apps', size=15)
plt.ylabel('App Categories', size=15)
graph = sns.barplot(y = x_list, x = y_list, palette="tab10")
graph.set_title("Top categories on Playstore", fontsize = 25)
graph.set_xticklabels(graph.get_xticklabels(), rotation=45, horizontalalignment='right',);
```



1. Why did you pick the specific chart?

Bar plot presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent.

2. What is/are the insight(s) found from the chart?

So there are all total 33 categories in the dataset From the above output we can come to a conclusion that in playstore most of the apps are under `FAMILY & GAME` category and least are of `EVENTS & BEAUTY` Category.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

As we saw from the above graph that most of the apps are in family and game categories.so most people use these categories only. so there may be a slight negative growth in case of events and beauty categories, which is negligible.

```
# Percentage of apps belonging to each category in the playstore
plt.figure(figsize=(18,18))
plt.pie(ps_df.Category.value_counts(), labels=ps_df.Category.value_counts().index, autopct='%1.2f%%')
my_circle = plt.Circle( (0,0), 0.50, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.title('% of apps share in each Category', fontsize = 25)
plt.show()
```

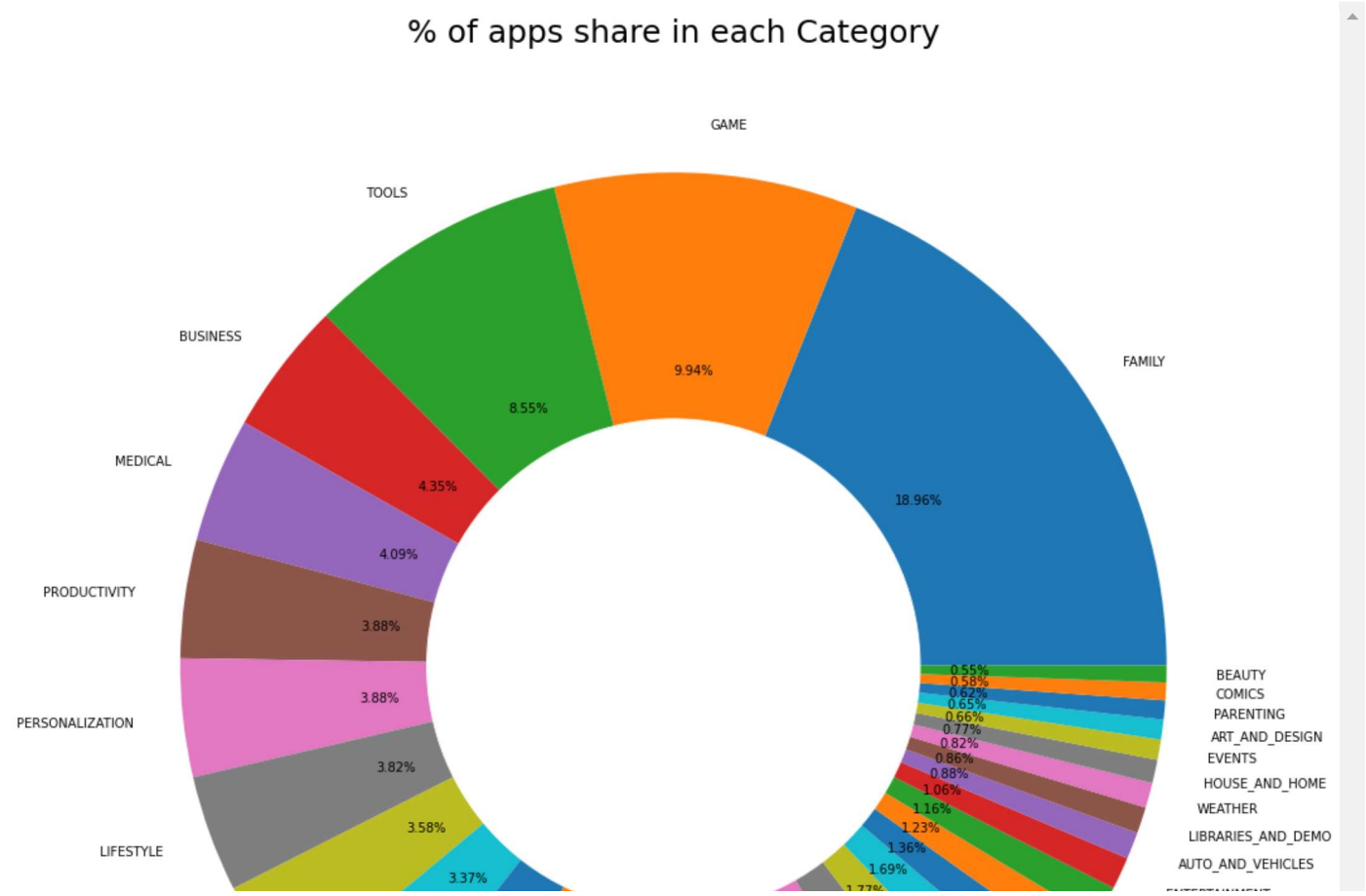


Chart - 5

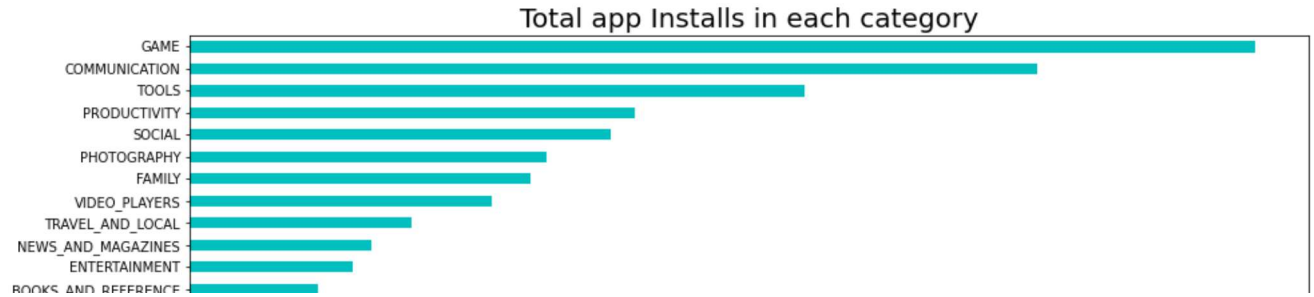

```
# Chart - 5 visualization code
```

5. App's having most number of installs

```
 # total app installs in each category of the play store

a = ps_df.groupby(['Category'])['Installs'].sum().sort_values()
a.plot.barh(figsize=(15,10),color = 'c',)
plt.ylabel('Total app Installs', fontsize = 15)
plt.xlabel('App Categories', fontsize = 15)
plt.xticks()
plt.title('Total app Installs in each category', fontsize = 20)
```

```
Text(0.5, 1.0, 'Total app Installs in each category')
```



1. Why did you pick the specific chart?

Plot bar presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent.

2. What is/are the insight(s) found from the chart?

This tells us the category of apps that has the maximum number of installs. The `Game, Communication and Tools` categories has the highest number of installs compared to other categories of apps.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

Yes, the gained insights help creating a positive business impact.

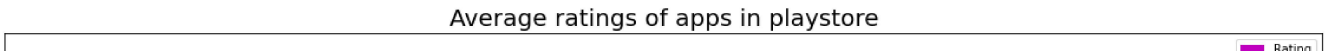
Chart - 6

```
# Chart - 6 visualization code
```

6. Average rating of the apps

```
# Average app rating
ps_df['Rating'].value_counts().plot.bar(figsize=(20,8), color = 'm' )
plt.xlabel('Average rating', fontsize = 15)
plt.ylabel('Number of apps', fontsize = 15)
plt.title('Average ratings of apps in playstore', fontsize = 20)
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f962fc95dc0>
```



presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent:

- 4-5: Top rated
- 3-4: Above average
- 2-3: Average
- 1-2: Below average

Lets create a new column `Rating group` in the main dataframe and apply these filters.

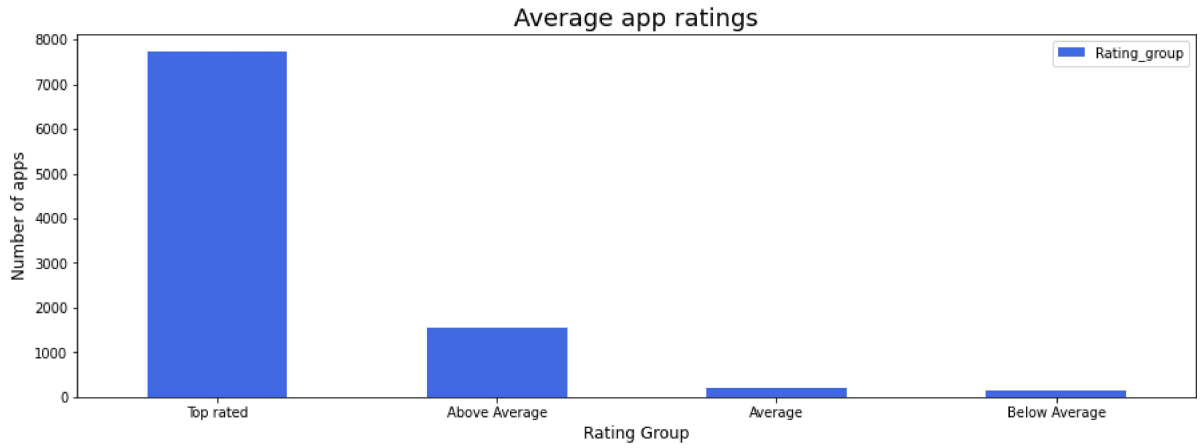
```
# Defining a function grouped)rating to group the ratings as mentioned above
def Rating_app(val):
  '''
  This function help to categories the rating from 1to 5
  as Top_rated,Above_average & below Average
  '''
  if val>=4:
    return 'Top rated'
  elif val>3 and val<4:
    return'Above Average'
  elif val>2 and val<3:
    return 'Average'
  else:
    return 'Below Average'
```

Lets apply the `grouped_rating` function on the Rating column and save the output in new column named as Rating group in the main df.

```
# Applying grouped rating function
ps_df['Rating_group']=ps_df['Rating'].apply(lambda x: Rating_app(x))
```

```
# Average app ratings
ps_df['Rating_group'].value_counts().plot.bar(figsize=(15,5), color = 'royalblue')
plt.xlabel('Rating Group', fontsize = 12)
plt.ylabel('Number of apps', fontsize = 12)
plt.title('Average app ratings', fontsize = 18)
plt.xticks(rotation=0)
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f96316307c0>
```



▼ 1. Why did you pick the specific chart?

Bar plot presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent.

▼ 2. What is/are the insight(s) found from the chart?

There are almost 7000 plus apps having highest ratings and so on.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

As we saw in the above graph that most of the apps having higher ratings so there is no lead to negative growth.

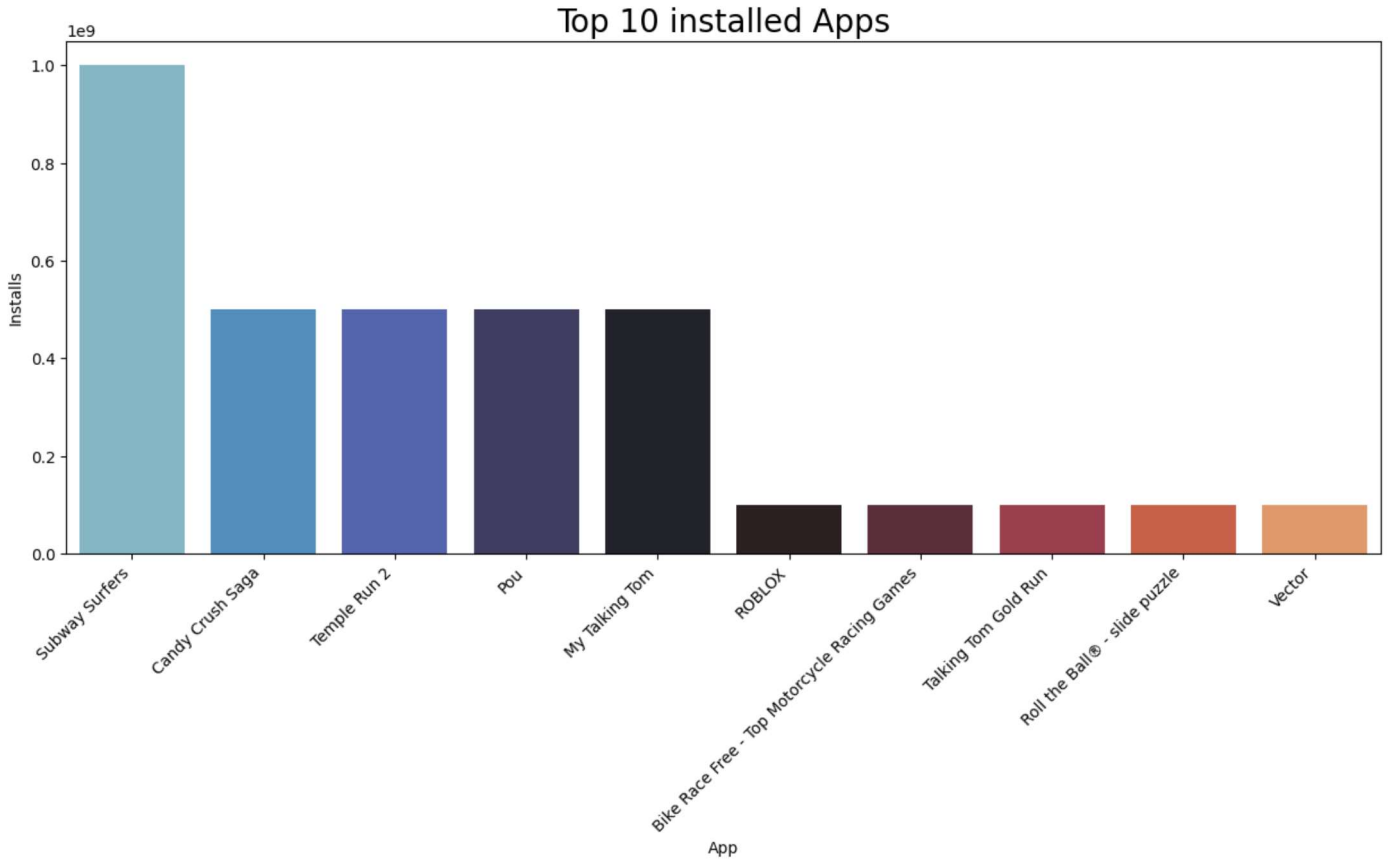
Chart - 7

```
# Chart - 7 visualization code
```

7. Top 10 installed apps in any category

```
def findtop10incategory(str):
  str = str.upper()
  top10 = ps_df[ps_df['Category'] == str]
  top10apps = top10.sort_values(by='Installs', ascending=False).head(10)
  plt.figure(figsize=(15,6), dpi=100)
  plt.title('Top 10 installed Apps', size = 20)
  graph = sns.barplot(x = top10apps.App, y = top10apps.Installs, palette="icefire")
  graph.set_xticklabels(graph.get_xticklabels(), rotation=45, horizontalalignment='right')

findtop10incategory('GAME')
```



1. Why did you pick the specific chart?

Bar plot presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent..

2. What is/are the insight(s) found from the chart?

From the above graph we can see that in the Game category **`Subway Surfers,Candy Crush Saga, Temple Run 2`** has the highest installs. In the same way we by passing different category names to the function, we can get the top 10 installed apps.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

As we saw in the above graph Subway surfer can affect all other games in case of installation.

Chart - 8

```
# Chart - 8 visualization code
```

8. Top apps that are of free type.

```
# Creating a df for only free apps
free_df = ps_df[ps_df['Type'] == 'Free']
```

```
# Creating a df for top free apps
top_free_df = free_df[free_df['Installs'] == free_df['Installs'].max()]
top10free_apps=top_free_df.nlargest(10, 'Installs', keep='first')
top10free_apps.head(10)
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	An
152	Google Play Books	BOOKS_AND_REFERENCE	3.9	1433233	Varies with device	1000000000	Free	0.0	Teen	Books & Reference	2018-08-03	Varies with device	
335	Messenger – Text and Video Chat for Free	COMMUNICATION	4.0	56642847	Varies with device	1000000000	Free	0.0	Everyone	Communication	2018-08-01	Varies with device	
336	WhatsApp Messenger	COMMUNICATION	4.4	69119316	Varies with device	1000000000	Free	0.0	Everyone	Communication	2018-08-03	Varies with device	
338	Google Chrome: Fast & Secure	COMMUNICATION	4.3	9642995	Varies with device	1000000000	Free	0.0	Everyone	Communication	2018-08-01	Varies with device	
340	Gmail	COMMUNICATION	4.3	4604324	Varies with device	1000000000	Free	0.0	Everyone	Communication	2018-08-02	Varies with device	
341	Hangouts	COMMUNICATION	4.0	3419249	Varies with device	1000000000	Free	0.0	Everyone	Communication	2018-07-21	Varies with device	
391	Skype - free IM & video calls	COMMUNICATION	4.1	10484169	Varies with device	1000000000	Free	0.0	Everyone	Communication	2018-08-03	Varies with device	
	Google				Varies							Varies	

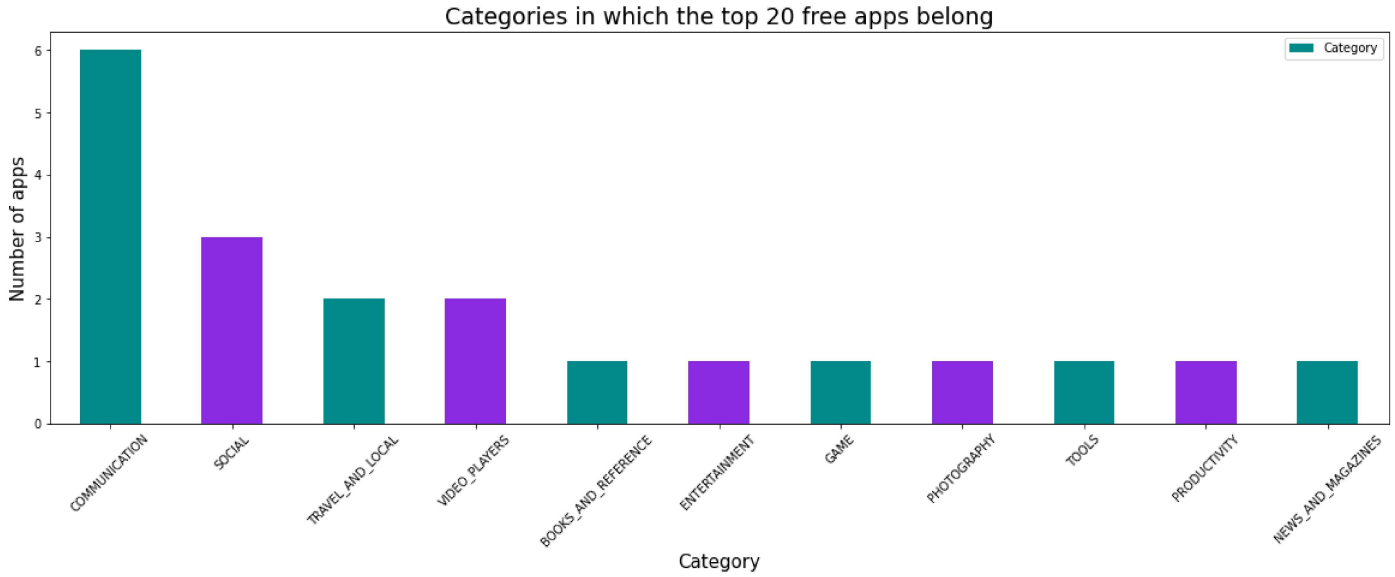
```
# Top free apps
top_free_df['App']
```

```
152                           Google Play Books
335     Messenger – Text and Video Chat for Free
336                           WhatsApp Messenger
```

```
338                Google Chrome: Fast & Secure
340                                       Gmail
341                                     Hangouts
391               Skype - free IM & video calls
865                           Google Play Games
1654                             Subway Surfers
2544                                   Facebook
2545                                  Instagram
2554                                    Google+
2808                              Google Photos
3117                  Maps - Navigate & Explore
3127                         Google Street View
3234                                     Google
3454                               Google Drive
3665                                    YouTube
3687                  Google Play Movies & TV
3736                               Google News
Name: App, dtype: object
```

```
# Categories in which the top 20 free apps belong to
top_free_df['Category'].value_counts().plot.bar(figsize=(20,6), color=('darkcyan','blueviolet'))
plt.xlabel('Category',size=15)
plt.ylabel('Number of apps', size=15)
plt.title('Categories in which the top 20 free apps belong', size=19)
plt.xticks(rotation=45)
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f962fa6e280>
```



▾ 1. Why did you pick the specific chart?

Plot bar presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent

▾ 2. What is/are the insight(s) found from the chart?

Free apps that are related to communication has more downloads than others.

▾ 3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

Communication apps has more positive business impact than others.

▾ Chart - 9

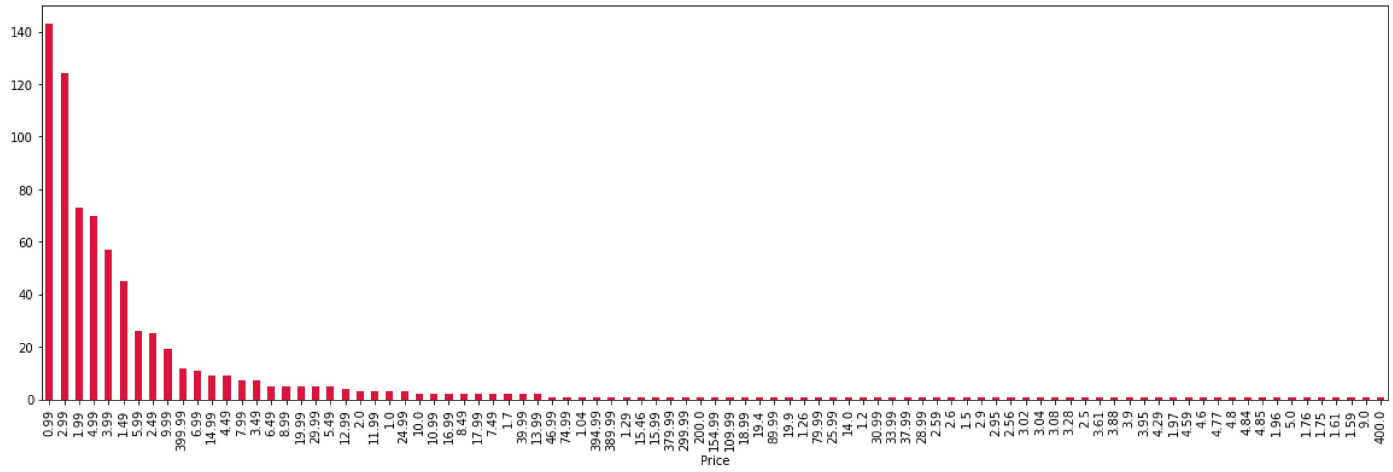
```
# Chart - 9 visualization code
```

9. Top apps that are of paid type

```
# Creating a df containing only paid apps
paid_df=ps_df[ps_df['Type']=='Paid']
```

```
# Number of apps that can be installed at a particular price
paid_df.groupby('Price')['App'].count().sort_values(ascending=False).plot.bar(figsize = (20,6), color = 'crimson')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f962f9f0a90>
```



- 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:

Revenue generated through installs = (Number of installs)x(Price to install the app)

Lets define a new column Revenue in paid_df which gives the revenue generated by the app through installs alone.

```
# Creating a new column 'Revenue' in paid_df
paid_df['Revenue'] = paid_df['Installs']*paid_df['Price']
paid_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver	Ra
234	TurboScan: scan documents and receipts in PDF	BUSINESS	4.7	11442	6.8	100000	Paid	4.99	Everyone	Business	2018-03-25	1.5.2	4.0 and up	
235	Tiny Scanner Pro: PDF Doc Scan	BUSINESS	4.8	10295	39.0	100000	Paid	4.99	Everyone	Business	2017-04-11	3.4.6	3.0 and up	
427	Puffin Browser Pro	COMMUNICATION	4.0	18247	Varies with device	100000	Paid	3.99	Everyone	Communication	2018-07-05	7.5.3.20547	4.1 and up	

```
# Top app in the paid category
paid_df[paid_df['Revenue'] == paid_df['Revenue'].max()]
```

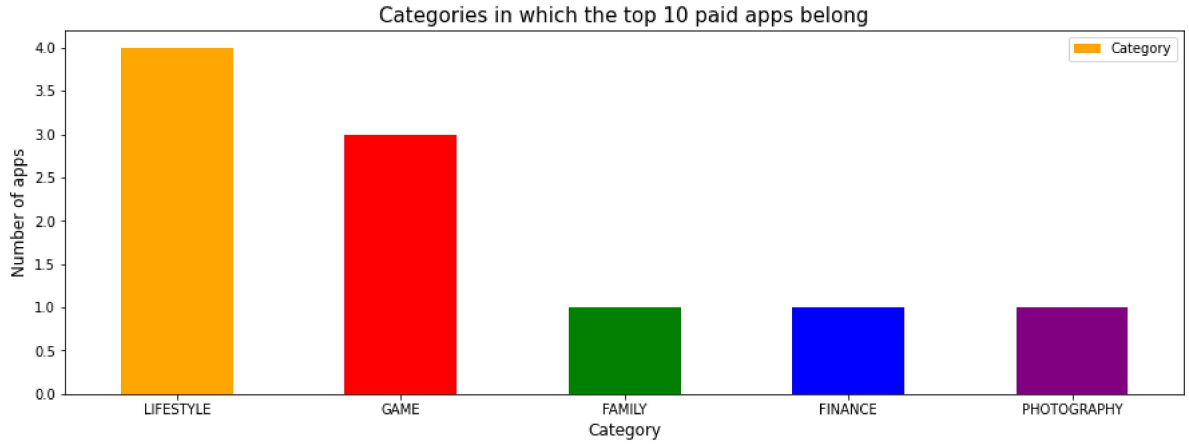
	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver	Rating_group
2241	Minecraft	FAMILY	4.5	2376564	Varies with device	10000000	Paid	6.99	Everyone 10+	Arcade;Action & Adventure	2018-07-24	1.5.2.1	Varies with device	Top rated

```
# Top 10 paid apps in the play store
top10paid_apps=paid_df.nlargest(10, 'Revenue', keep='first')
top10paid_apps['App']
```

```
2241                      Minecraft
5351                      I am rich
5356               I Am Rich Premium
4034                   Hitman Sniper
7417    Grand Theft Auto: San Andreas
2883             Facetune - For Free
5578          Sleep as Android Unlock
8804              DraStic DS Emulator
4367         I'm Rich - Trump Edition
4362                      💎 I'm rich
Name: App, dtype: object
```

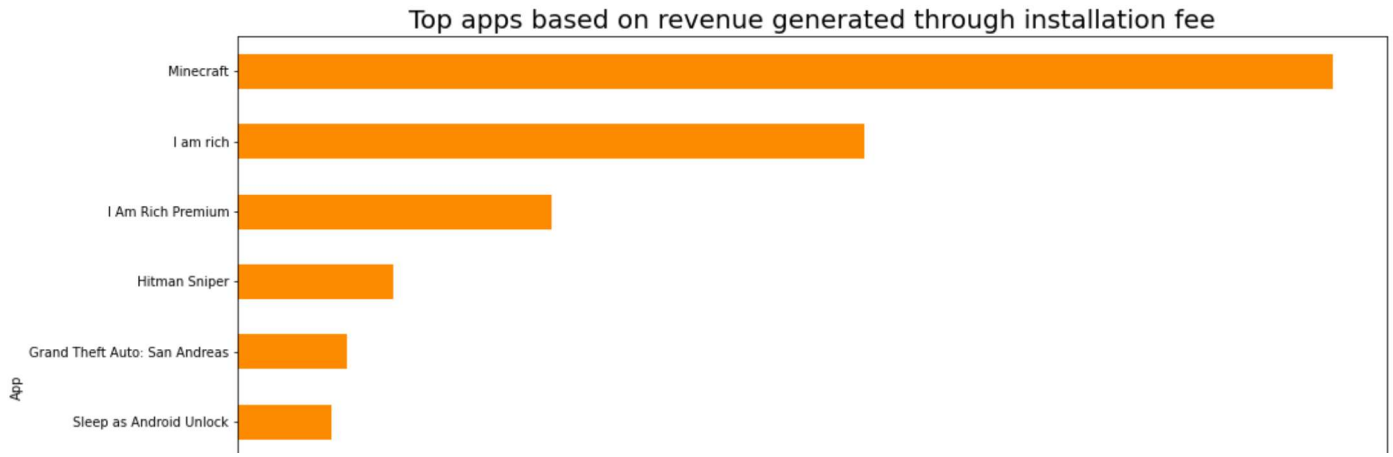
```
# Categories in which the top 10 paid apps belong to
top10paid_apps['Category'].value_counts().plot.bar(figsize=(15,5), color=["orange", "red","green","blue","purple"])
plt.xlabel('Category',size=12)
plt.ylabel('Number of apps',size=12)
plt.title('Categories in which the top 10 paid apps belong',size=15)
plt.xticks(rotation=0)
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f962f79fdc0>
```




```
# Top paid apps according to the revenue generated through installs alone
top10paid_apps.groupby('App')['Revenue'].mean().sort_values(ascending=True).plot.barh(figsize=(16,10),color='darkorange')
plt.xlabel('Revenue Generated (USD)', size=15)
plt.title('Top apps based on revenue generated through installation fee', size=20)
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f962f765310>
```




```
# Paid apps with the highest number of installs
paid_df[paid_df['Revenue'] == paid_df['Revenue'].max()]
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver	Rating_group
2241	Minecraft	FAMILY	4.5	2376564	Varies with device	10000000	Paid	6.99	Everyone 10+	Arcade;Action & Adventure	2018-07-24	1.5.2.1	Varies with device	Top rated

0 1 2 3 4 5 6 7

- 1. Why did you pick the specific chart?

  Plot bar presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent.

- 2. What is/are the insight(s) found from the chart?

  Minecraft is the app whose revenue is much higher than all other apps in the playstore.

- 3. Will the gained insights help creating a positive business impact?

  Are there any insights that lead to negative growth? Justify with specific reason.

  The above graph tells that higher the revenue higher the possitive business impact.

- Chart - 10

```
# chart - 10 visualization code
```

Data Visualization on User Reviews:

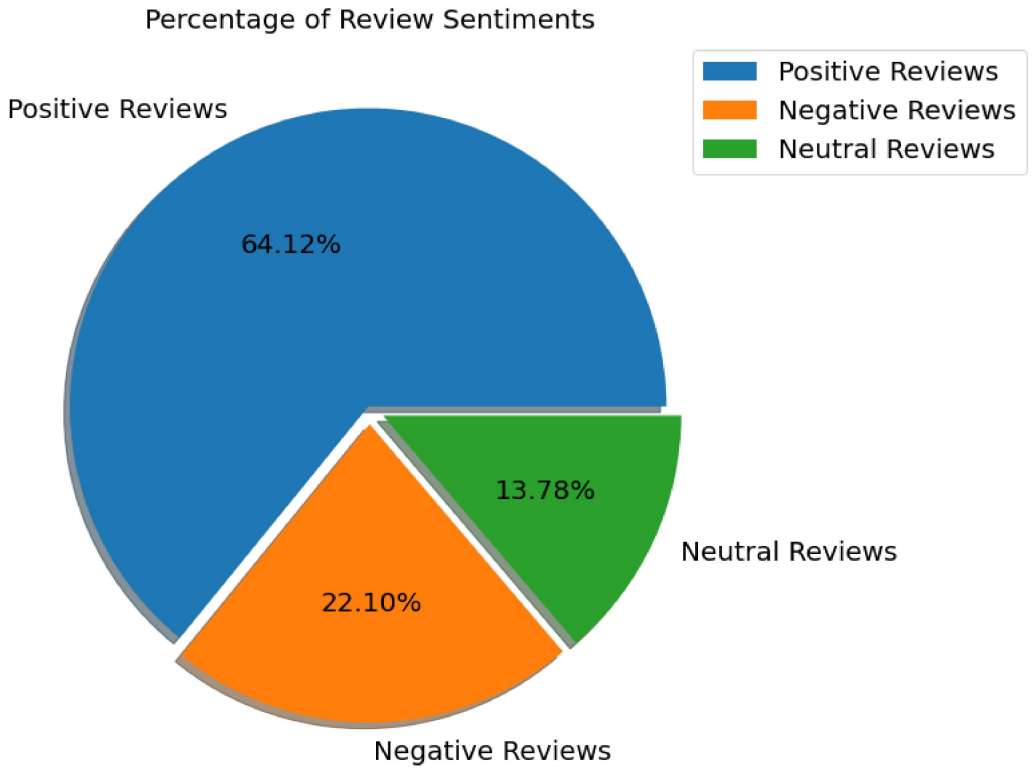
- 1. Percentage of Review Sentiments

```
# Basic inspection
ur_df.columns
```

```
Index(['App', 'Translated_Review', 'Sentiment', 'Sentiment_Polarity',
       'Sentiment_Subjectivity'],
      dtype='object')
```

```
import matplotlib
counts = list(ur_df['Sentiment'].value_counts())
labels = 'Positive Reviews', 'Negative Reviews','Neutral Reviews'
```

```
matplotlib.rcParams['font.size'] = 20
matplotlib.rcParams['figure.figsize'] = (10,15)
plt.pie(counts, labels=labels, explode=[0.01,0.05,0.05], shadow=True, autopct="%.2f%%")
plt.title('Percentage of Review Sentiments', fontsize=20)
plt.axis('off')
plt.legend(bbox_to_anchor=(0.9,0,0.5,1))
plt.show()
```



1. Why did you pick the specific chart?

Pie chart is a way of summarizing a set of nominal data or displaying the different values of a given variable.

2. What is/are the insight(s) found from the chart?

We found that

1. Positive reviews are 64.30%
2. Negative reviews are 22.80%
3. Neutral reviews are 12.90%

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

Apps which got positive reviews will lead to positve business impact. and the apps which got Negative reviews and Neutral reviews will lead to negative growth.

Chart - 11

```
# Chart - 11 visualization code
```

2. Apps with the highest number of positive reviews

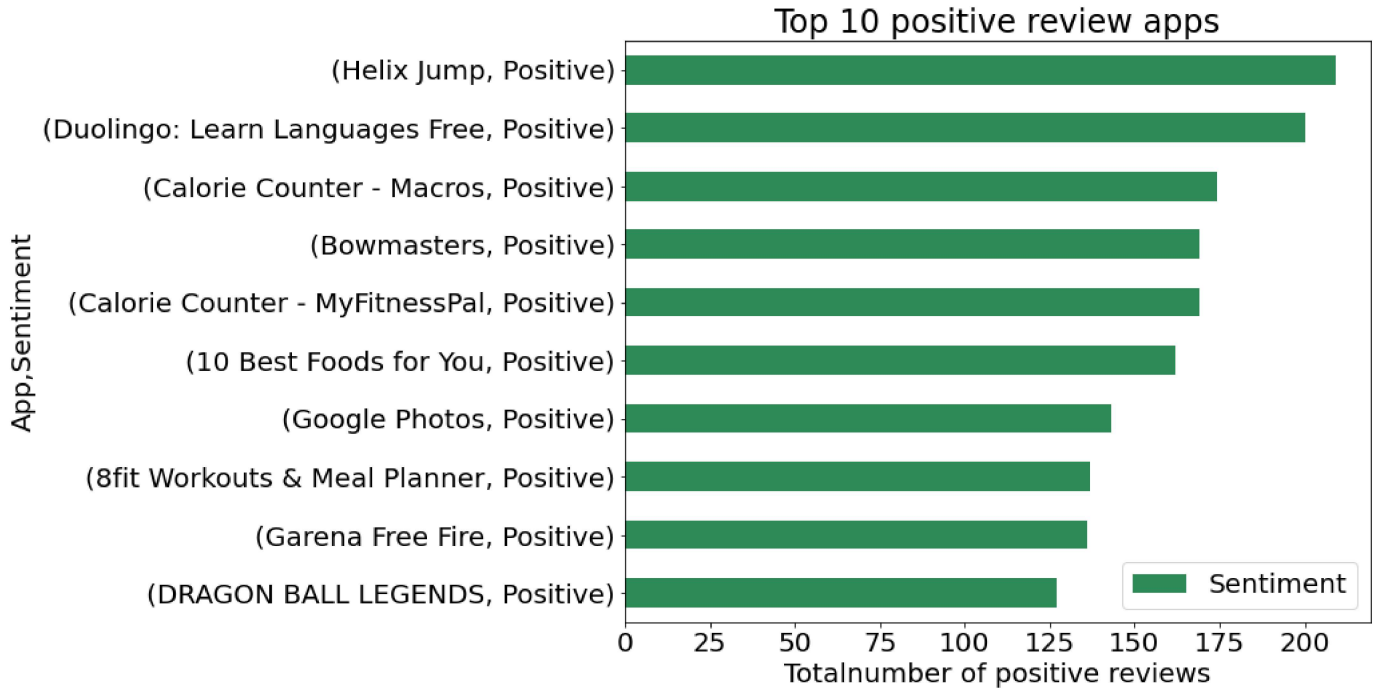
```
# positive reviews
positive_ur_df=ur_df[ur_df['Sentiment']=='Positive']
positive_ur_df
```

	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	1.000000	0.533333
1	10 Best Foods for You	This help eating healthy exercise regular basis	Positive	0.250000	0.288462
3	10 Best Foods for You	Works great especially going grocery store	Positive	0.400000	0.875000
4	10 Best Foods for You	Best idea us	Positive	1.000000	0.300000
5	10 Best Foods for You	Best way	Positive	1.000000	0.300000
...	...	...	...	...	...
64217	Housing-Real Estate & Property	I able set range 1cr, scroll space 0-1cr range...	Positive	0.233333	0.550000
64221	Housing-Real Estate & Property	Everything old stuff neither clear sold proper...	Positive	0.021591	0.259470
64222	Housing-Real Estate & Property	Most ads older many agents ..not much owner po...	Positive	0.173333	0.486667
64223	Housing-Real Estate & Property	If photos posted portal load, fit purpose. I'm...	Positive	0.225000	0.447222
64227	Housing-Real Estate & Property	I property business got link SMS happy perform...	Positive	0.800000	1.000000

23998 rows × 5 columns

```
positive_ur_df.groupby('App')['Sentiment'].value_counts().nlargest(10).plot.barh(figsize=(10,8),color='seagreen').invert_yaxis()
plt.title("Top 10 positive review apps")
plt.xlabel('Totalnumber of positive reviews')
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f962f656dc0>
```



▾ 1. Why did you pick the specific chart?

Plot bar presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent.

▾ 2. What is/are the insight(s) found from the chart?

As we saw in the above graph Helix Jump has the highest number of positive reviews while Dragon ball legend has lesser number of positive reviews in the top 10 list.

▾ 3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

Higher number of positive reviews will lead to a positive business impact.

Chart - 12

```
# Chart - 12 visualization code
```

3. Apps with the highest number of negative reviews.

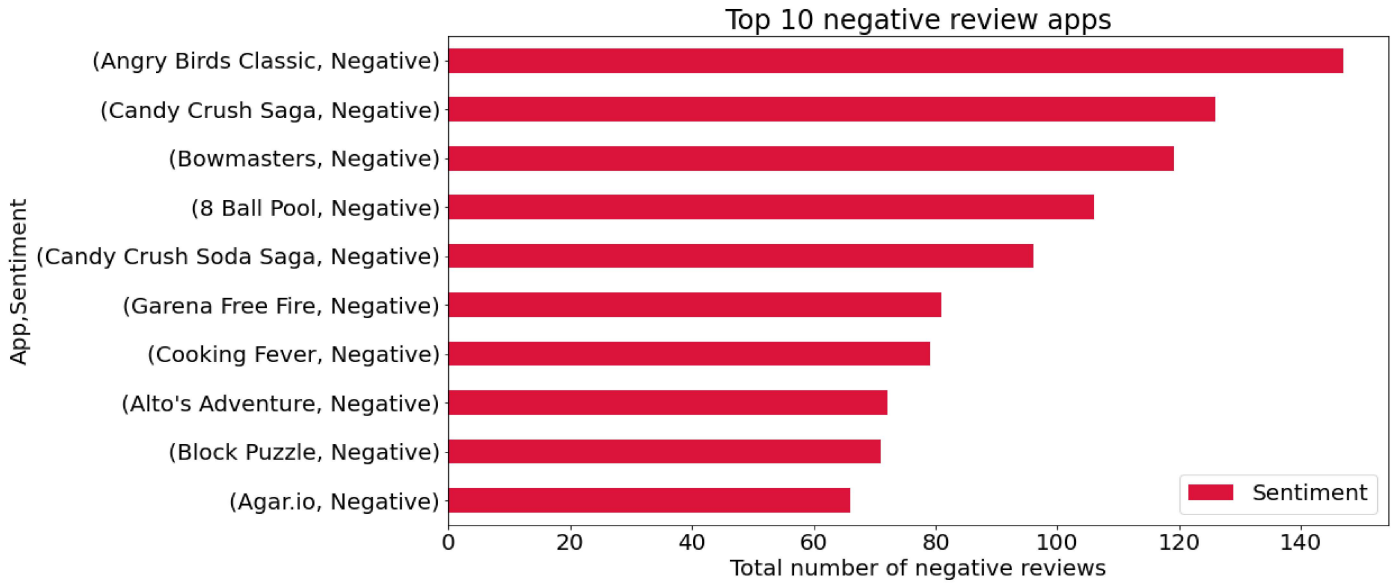
```
negative_ur_df=ur_df[ur_df['Sentiment']=='Negative']
negative_ur_df
```

	App	Translated_Review	Sentiment	Sentiment_Polarity	Sentiment_Subjectivity
32	10 Best Foods for You	No recipe book Unable recipe book.	Negative	-0.500000	0.500000
43	10 Best Foods for You	Waste time It needs internet time n ask calls ...	Negative	-0.200000	0.000000
68	10 Best Foods for You	Faltu plz waste ur time	Negative	-0.200000	0.000000
85	10 Best Foods for You	Crap Doesn't work	Negative	-0.800000	0.800000
95	10 Best Foods for You	Boring. I thought actually just texts that's i...	Negative	-0.325000	0.475000
...	...	...	...	...	...
64215	Housing-Real Estate & Property	Horrible app. I wanted list property get aroun...	Negative	-0.528571	0.717262
64216	Housing-Real Estate & Property	Worst app. We get nothing Time waste . They up...	Negative	-0.400000	0.250000
64220	Housing-Real Estate & Property	No response support team. After I login, unabl...	Negative	-0.377778	0.533333
64226	Housing-Real Estate & Property	Dumb app, I wanted post property rent give opt...	Negative	-0.287500	0.250000
64230	Housing-Real Estate & Property	Useless app, I searched flats kondapur, Hydera...	Negative	-0.316667	0.400000

8271 rows × 5 columns

```
negative_ur_df.groupby('App')['Sentiment'].value_counts().nlargest(10).plot.barh(figsize=(15,8),color='crimson').invert_yaxis()
plt.title("Top 10 negative review apps")
plt.xlabel('Total number of negative reviews')
plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f962f62fd90>
```



1. Why did you pick the specific chart?

Plot bar presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent.

2. What is/are the insight(s) found from the chart?

Angry birds clasic has the highest number of Negative reviews while Agar.io has the lesser number of negative reviews in the Top 10 list.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

Higher the number of negative reviews will lead to negative growth.

Chart - 13

```
# Chart - 13 visualization code
```

4. Histogram of Subjectivity

```
merged_df.Sentiment_Subjectivity.value_counts()
```

```
0.000000    4134
1.000000    1653
0.500000    1579
0.600000    1133
0.750000    1095
            ...
0.508052       1
0.454167       1
0.417316       1
0.765000       1
0.545714       1
Name: Sentiment_Subjectivity, Length: 4382, dtype: int64
```

```
plt.figure(figsize=(18,9))
plt.xlabel("Subjectivity")
plt.title("Distribution of Subjectivity")
plt.hist(merged_df[merged_df['Sentiment_Subjectivity'].notnull()]['Sentiment_Subjectivity'])
plt.show()
```

1. Why did you pick the specific chart?

A histogram is graph showing frequency distribution. It is a graph showing the number of observations within each given interval.

2. What is/are the insight(s) found from the chart?

We found that: 0 - objective(fact), 1 - subjective(opinion) it can be seen that maximum number of number sentiment subjectivity lies between 0.4 to 0.7 from this we can conclude that maximum number of users give reviews to the application according to their experience.

3. Will the gained insights help creating a positive business impact?

Are there any insights that lead to negative growth? Justify with specific reason.

Yes, the gained insights will help in creating a positive business impact.

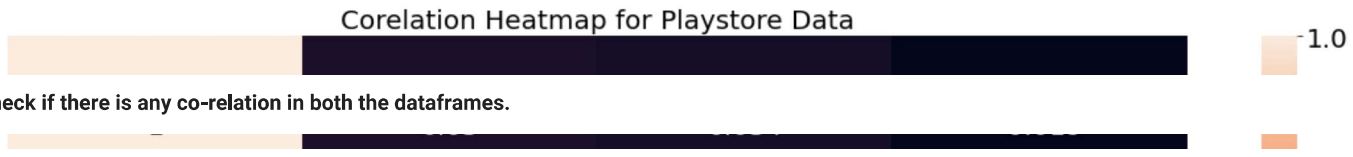
Chart - 14 - Correlation Heatmap


```
# Correlation Heatmap visualization code
ps_df.corr()
```

	Rating	Reviews	Installs	Price
Rating	1.000000	0.050212	0.034306	-0.018674
Reviews	0.050212	1.000000	0.625158	-0.007603
Installs	0.034306	0.625158	1.000000	-0.009412
Price	-0.018674	-0.007603	-0.009412	1.000000

```
# Heat map for play_store
plt.figure(figsize = (20,10))
sns.heatmap(ps_df.corr(), annot= True)
plt.title('Corelation Heatmap for Playstore Data', size=20)
```

```
Text(0.5, 1.0, 'Corelation Heatmap for Playstore Data')
```



Let us check if there is any co-relation in both the dataframes.

```
merged_df = pd.merge(ps_df, ur_df, on='App', how = "inner")
```

```
def merged_dfinfo():
  temp = pd.DataFrame(index=merged_df.columns)
  temp['data_type'] = merged_df.dtypes
  temp["count of non null values"] = merged_df.count()
  temp['NaN values'] = merged_df.isnull().sum()
  temp['% NaN values'] =merged_df.isnull().mean()
  temp['unique_count'] = merged_df.nunique()
  return temp
merged_dfinfo()
```

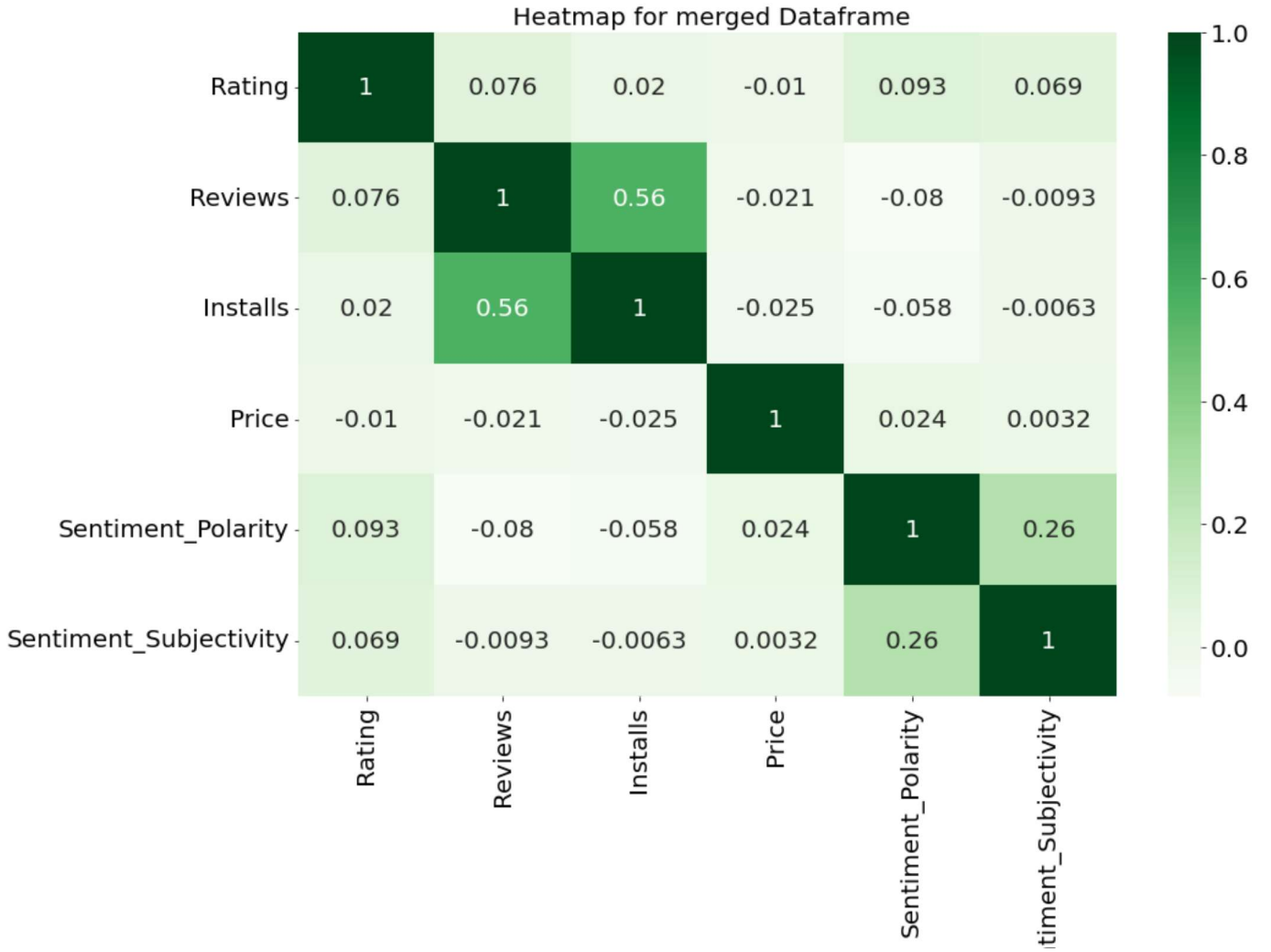
	data_type	count of non null values	NaN values	% NaN values	unique_count
App	object	35929	0	0.0	816
Category	object	35929	0	0.0	33
Rating	float64	35929	0	0.0	22
Reviews	int64	35929	0	0.0	807
Size	object	35929	0	0.0	167
Installs	int64	35929	0	0.0	12
Type	object	35929	0	0.0	2
Price	float64	35929	0	0.0	9
Content Rating	object	35929	0	0.0	5
Genres	object	35929	0	0.0	67
Last Updated	datetime64[ns]	35929	0	0.0	247
Current Ver	object	35929	0	0.0	498
Android Ver	object	35929	0	0.0	22
Rating_group	object	35929	0	0.0	4
Translated_Review	object	35929	0	0.0	26682
Sentiment	object	35929	0	0.0	3
Sentiment_Polarity	float64	35929	0	0.0	5295
Sentiment_Subjectivity	float64	35929	0	0.0	4382

```
merged_df.corr()
```

	Rating	Reviews	Installs	Price	Sentiment_Polarity	Sentiment_Subjectivity
Rating	1.000000	0.075736	0.020145	-0.010055	0.092903	0.068758
Reviews	0.075736	1.000000	0.564256	-0.020591	-0.080021	-0.009315
Installs	0.020145	0.564256	1.000000	-0.025213	-0.057842	-0.006307
Price	-0.010055	-0.020591	-0.025213	1.000000	0.024148	0.003182
Sentiment_Polarity	0.092903	-0.080021	-0.057842	0.024148	1.000000	0.259668
Sentiment_Subjectivity	0.068758	-0.009315	-0.006307	0.003182	0.259668	1.000000

```
# Correlation heatmap
# Heat Map for the merged data frame
plt.figure(figsize = (15,10))
sns.heatmap(merged_df.corr(), annot= True, cmap='Greens')
plt.title(' Heatmap for merged Dataframe', size=20)
```

```
Text(0.5, 1.0, ' Heatmap for merged Dataframe')
```




```
merged_df = merged_df.dropna(subset=['Sentiment', 'Translated_Review'])
```

```
merged_df.head()
```

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver	Rating_grc
0	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up	Abc Avera
1	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up	Abc Avera
2	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up	Abc Avera
3	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up	Abc Avera
4	Coloring book moana	ART_AND_DESIGN	3.9	967	14.0	500000	Free	0.0	Everyone	Art & Design;Pretend Play	2018-01-15	2.0.0	4.0.3 and up	Abc Avera

▾ 1. Why did you pick the specific chart?

Because it visualizes the strength of relationship between numerical variables.

▾ 2. What is/are the insight(s) found from the chart?

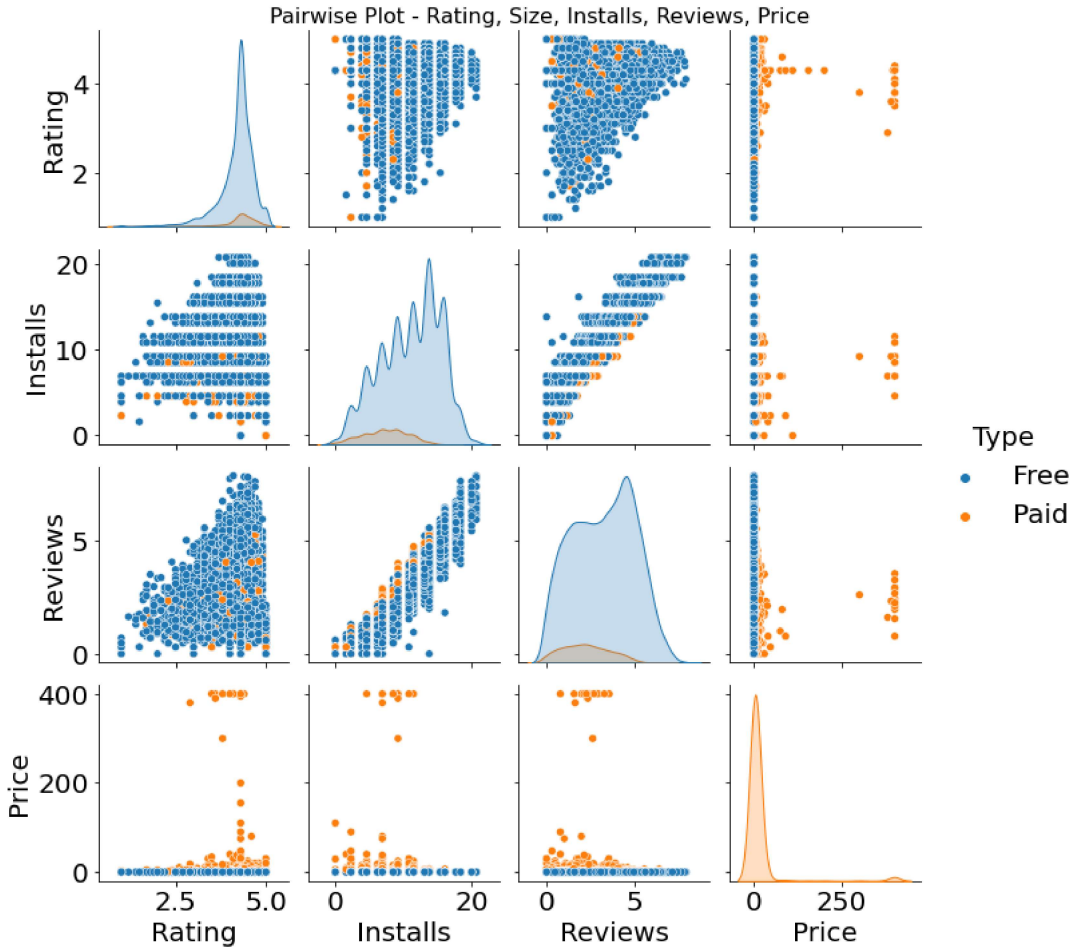
- The `Price` is slightly negatively correlated with the `Rating, Reviews, and Installs`. This means that as the prices of the app increases, the average rating, total number of reviews and Installs fall slightly.
- The `Rating` is slightly positively correlated with the `Installs and Reviews column`. This indicates that as the the average user rating increases, the app installs and number of reviews also increase.

▾ Chart - 15 - Pair Plot

```
# Pair Plot visualization code
Rating = ps_df['Rating']
Size = ps_df['Size']
Installs = ps_df['Installs']
Reviews = ps_df['Reviews']
Type = ps_df['Type']
Price = ps_df['Price']

p = sns.pairplot(pd.DataFrame(list(zip(Rating, Size, np.log(Installs), np.log10(Reviews), Price, Type)),
                        columns=['Rating','Size', 'Installs', 'Reviews', 'Price','Type']), hue='Type')
p.fig.suptitle("Pairwise Plot - Rating, Size, Installs, Reviews, Price",x=0.5, y=1.0, fontsize=16)
```

```
Text(0.5, 1.0, 'Pairwise Plot - Rating, Size, Installs, Reviews, Price')
```



▾ 1. Why did you pick the specific chart?

Pair plot is used to understand the best set of features to explain a relationship between two variables or to form the most separated clusters. It also helps to form some simple classification models by drawing some simple lines or make linear separation in our data-set.

▾ 2. What is/are the insight(s) found from the chart?

we found that:

- Most of the App are Free.
- Most of the Paid Apps have Rating around 4
- As the number of installation increases the number of reviews of the particaular app also increases.

5. Solution to Business Objective

What do you suggest the client to achieve Business Objective ?

Explain Briefly.

Business objectives are a written explanation of your goals as a business. Business objectives usually have to do with the most important operating factors of a company's success, such as revenue, operations, productivity and growth. To be most successful, some companies find that a business objective needs to be specific, measurable, attainable and time-based. Large and small businesses alike might find value in developing written business objectives.

In this project of analyzing play store applications, we have worked on several parameters which would help the client to do well in launching their apps on the play store.

In the initial phase, we focused more on the problem statements and data cleaning, in order to ensure that we give them the best results out of our analysis.

Client needs to focus more on:

1. Developing apps related to the least categories as they are not explored much. Like events and beauty.
2. Most of the apps are Free, so focusing on free app is more important.
3. Focusing more on content available for Everyone will increase the chances of getting the highest installs.
4. They need to focus on updating their apps regularly, so that it will attract more users.
5. They need to keep in mind that the sentiments of the user keep varying as they keep using the app, so they should focus more on users needs and features.

Conclusion

After analyzing the data we concluded that:

- Percentage of free apps = ~92%
- Percentage of apps with no age restrictions = ~82%
- Most competitive category: Family
- Category with the highest average app installs: Game
- Percentage of apps that are top rated = ~80%
- Family, Game and Tools are top three categories having 1906, 926 and 829 app count.
- Tools, Entertainment, Education, Buisness and Medical are top Genres.
- 8783 Apps are having size less than 50 MB. 7749 Apps are having rating more than 4.0 including both type of apps.
- 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.
- Category in which the paid apps have the highest average installation fee: Finance
- 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.
- Overall sentiment count of merged dataset in which Positive sentiment count is 64%, Negative 22% and Neutral 13%.

1.**Rating**

Most of the apps have rating in between 4 and 5.

Most numbers of apps are rated at 4.3

Categories of apps have more than 4 average rating.item

2.**Size**

Maximum number of applications present in the dataset are of small size.

3.**Installs**

Majority of the apps come into these three categories, Family, Game, and Tools.

Maximum number of apps present in google play store come under Family, Game and tools but as per the installation and requirement in the market plot, scenario is not the same. Maximum installed apps comes under Game, Communication, Productivity and Social.

Subway Surfers, Facebook, Messenger and Google Drive are the most installed apps.

4.**Type(Free/Paid)**

About 92% apps are free and 8% apps are of paid type.

The category 'Family' has the highest number of paid apps.

Free apps are installed more than paid apps.

The app "I'm Rich — Trump Edition" from the category 'Lifestyle' is the most costly app priced at $400

5.**Content Rating**

Content having Everyone only has most installs, while unrated and Adults only 18+ have less installs.

6.**Reviews**

Number of installs is positively correlated with reviews with correlation 0.64. Sentiment Analysis

7.**Sentiment**

Most of the reviews are of Positive Sentiment, while Negative and Neutral have low number of reviews.

8.**Sentiment Polarity / Sentiment Subjectivity**

Collection of reviews shows a wide range of subjectivity and most of the reviews fall in [-0.50,0.75] polarity scale implying that the extremely negative or positive sentiments are significantly low. Most of the reviews show a mid-range of negative and positive sentiments.

Sentiment subjectivity is not always proportional to sentiment polarity but in maximum number of case, shows a proportional behavior, when variance is too high or low.

Sentiment Polarity is not highly correlated with Sentiment Subjectivity.

Hurrah! You have successfully completed your EDA Capstone Project !!!

✓ 15s completed at 4:25 PM