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

from IPython.display import Image
from IPython.display import display
img =
Image(url='https://play.google/howplayworks/static/assets/social/share
_google_play_logo.png')
display(img)
```

```
<IPython.core.display.Image object>
```

```
data_set = pd.read_csv("F:\Data Analyst Roadmap\Inrenship\Google Play
Store EDA (Golden Project 2)\googleplaystore.csv")
```

```
data_set.head()
```

```
                                                 App        Category
Rating  \
0     Photo Editor & Candy Camera & Grid & ScrapBook  ART_AND_DESIGN
4.1
1                                Coloring book moana  ART_AND_DESIGN
3.9
2  U Launcher Lite – FREE Live Cool Themes, Hide ...  ART_AND_DESIGN
4.7
3                             Sketch - Draw & Paint  ART_AND_DESIGN
4.5
4               Pixel Draw - Number Art Coloring Book  ART_AND_DESIGN
4.3

  Reviews  Size     Installs  Type Price Content Rating  \
0     159   19M      10,000+  Free     0       Everyone
1     967   14M     500,000+  Free     0       Everyone
2   87510  8.7M   5,000,000+  Free     0       Everyone
3  215644   25M  50,000,000+  Free     0           Teen
4     967  2.8M     100,000+  Free     0       Everyone

                      Genres      Last Updated         Current Ver  \
0               Art & Design   January 7, 2018               1.0.0
1  Art & Design;Pretend Play  January 15, 2018               2.0.0
2               Art & Design    August 1, 2018               1.2.4
3               Art & Design      June 8, 2018  Varies with device
4    Art & Design;Creativity     June 20, 2018                 1.1

    Android Ver
0  4.0.3 and up
1  4.0.3 and up
2  4.0.3 and up
```

```
3    4.2 and up
4    4.4 and up

data_set.tail()

                                                  App
Category  \
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  \
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
Current Ver  \
10836       Everyone          Education     July 25, 2017
1.48
10837       Everyone          Education      July 6, 2018
1.0
10838       Everyone            Medical  January 20, 2017
1.0
10839     Mature 17+  Books & Reference  January 19, 2015  Varies with
device
10840       Everyone          Lifestyle     July 25, 2018  Varies with
device

              Android Ver
10836          4.1 and up
10837          4.1 and up
10838          2.2 and up
10839  Varies with device
10840  Varies with device

#check for basic information about the dataset
print("Dataset Information:")
data_set.info()
```

```
Dataset Information:
<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
```

```
#summary of dataset

print("Summary statistics:")
data_set.describe()
```

```
Summary statistics:

             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_set.isnull().sum()
```

```
App                  0
Category             0
Rating            1474
Reviews              0
Size                 0
Installs             0
Type                 1
Price                0
Content Rating       1
```

```
Genres                0
Last Updated          0
Current Ver           8
Android Ver           3
dtype: int64
```

```
data_set.isnull().sum() *100 / len(data_set)
```

```
App                 0.000000
Category            0.000000
Rating             13.596532
Reviews             0.000000
Size                0.000000
Installs            0.000000
Type                0.009224
Price               0.000000
Content Rating      0.009224
Genres              0.000000
Last Updated        0.000000
Current Ver         0.073794
Android Ver         0.027673
dtype: float64
```

- Missing Values:

The Rating column has missing values (9367 out of 10841 entries).

The Type, Content Rating, Current Ver, and Android Ver columns also have a few missing values.

- Data Types:

Reviews, Size, Installs, and Price are incorrectly stored as objects (they should likely be numeric after cleaning).

- Outliers:

The maximum value for Rating is 19, which is an unrealistic value as ratings are typically between 1 and 5.

Handle Missing Values

```
#fill missing values in rating with median
data_set['Rating'].fillna(data_set['Rating'].median(), inplace=True)
data_set['Rating'].isnull().sum()
```

```
0
```

```
# set ratings to a maximum of 5
data_set['Rating'] = data_set['Rating'].apply(lambda x: min(x, 5))
```

```
print(data_set['Rating'].describe())
```

```
count    10841.000000
mean         4.206549
std          0.480380
min          1.000000
25%          4.100000
50%          4.300000
75%          4.500000
max          5.000000
Name: Rating, dtype: float64
```

```
# Now fill missing values in Type, 'Content Rating', 'Current Ver',
'Android Ver' with mode  (most frequent value)

data_set['Type'].fillna(data_set['Type'].mode()[0], inplace=True)
data_set['Content Rating'].fillna(data_set['Content Rating'].mode()
[0], inplace=True)
data_set['Current Ver'].fillna(data_set['Current Ver'].mode()[0],
inplace=True)
data_set['Android Ver'].fillna(data_set['Android Ver'].mode()[0],
inplace=True)

data_set.isnull().sum().sum()
```

```
0
```

Now Fix Data Types

```
# convert Reviews to numeric
data_set['Reviews'] = pd.to_numeric(data_set['Reviews'],
errors='coerce')

# Replace 'Free' with NaN
data_set['Installs'] = data_set['Installs'].replace('Free', pd.NA)

#Replace 'Free' with NaN
data_set['Installs'] = data_set['Installs'].replace('Free', pd.NA)

#Remove commas and plus signs from the 'Installs' column
data_set['Installs'] = data_set['Installs'].str.replace('[+,]', '',
regex=True)

#Fill NaN values with 0
data_set['Installs'] = data_set['Installs'].fillna(0)

#convert 'Installs' to float
data_set['Installs'] = data_set['Installs'].astype(float)
```

```
print(data_set['Installs'].head())
```

```
0       10000.0
1      500000.0
2     5000000.0
3    50000000.0
4      100000.0
Name: Installs, dtype: float64
```

```
# Ensure 'Price' is treated as a string, then replace '$' and convert
to numeric
data_set['Price'] =
pd.to_numeric(data_set['Price'].astype(str).str.replace('$', ''),
errors='coerce')

data_set['Price'] = data_set['Price'].fillna(0)

print(data_set['Price'].head())
```

```
0    0.0
1    0.0
2    0.0
3    0.0
4    0.0
Name: Price, dtype: float64
```

```
# Clean 'Size' and convert to numeric
data_set['Size'] = data_set['Size'].replace('Varies with device',
pd.NA)  # Handle special case
data_set['Size'] = data_set['Size'].str.replace('M',
'e+6').str.replace('k', 'e+3')
data_set['Size'] = pd.to_numeric(data_set['Size'], errors='coerce')

print(data_set.info())
print("\nSample of cleaned data:")
print(data_set.head())
```

```
<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          10841 non-null  float64
 3   Reviews         10840 non-null  float64
 4   Size            9145 non-null   float64
 5   Installs        10841 non-null  float64
 6   Type            10841 non-null  object
```

```
 7   Price           10841 non-null  float64
 8   Content Rating  10841 non-null  object
 9   Genres          10841 non-null  object
 10  Last Updated    10841 non-null  object
 11  Current Ver     10841 non-null  object
 12  Android Ver     10841 non-null  object
dtypes: float64(5), object(8)
memory usage: 1.1+ MB
None

Sample of cleaned data:
                                                 App        Category
Rating  \
0     Photo Editor & Candy Camera & Grid & ScrapBook  ART_AND_DESIGN
4.1
1                                 Coloring book moana  ART_AND_DESIGN
3.9
2  U Launcher Lite – FREE Live Cool Themes, Hide ...  ART_AND_DESIGN
4.7
3                                Sketch - Draw & Paint  ART_AND_DESIGN
4.5
4               Pixel Draw - Number Art Coloring Book  ART_AND_DESIGN
4.3

    Reviews        Size    Installs  Type  Price Content Rating  \
0     159.0  19000000.0     10000.0  Free    0.0       Everyone
1     967.0  14000000.0    500000.0  Free    0.0       Everyone
2   87510.0   8700000.0   5000000.0  Free    0.0       Everyone
3  215644.0  25000000.0  50000000.0  Free    0.0           Teen
4     967.0   2800000.0    100000.0  Free    0.0       Everyone

                      Genres      Last Updated         Current Ver  \
0               Art & Design   January 7, 2018               1.0.0
1  Art & Design;Pretend Play  January 15, 2018               2.0.0
2               Art & Design    August 1, 2018               1.2.4
3               Art & Design      June 8, 2018  Varies with device
4    Art & Design;Creativity     June 20, 2018                 1.1

    Android Ver
0  4.0.3 and up
1  4.0.3 and up
2  4.0.3 and up
3    4.2 and up
4    4.4 and up

data_set.head()

                                                 App        Category
Rating  \
0     Photo Editor & Candy Camera & Grid & ScrapBook  ART_AND_DESIGN
```

```
4.1
1                                Coloring book moana  ART_AND_DESIGN
3.9
2  U Launcher Lite – FREE Live Cool Themes, Hide ...  ART_AND_DESIGN
4.7
3                              Sketch - Draw & Paint  ART_AND_DESIGN
4.5
4              Pixel Draw - Number Art Coloring Book  ART_AND_DESIGN
4.3

    Reviews        Size    Installs  Type  Price Content Rating  \
0     159.0  19000000.0     10000.0  Free    0.0       Everyone
1     967.0  14000000.0    500000.0  Free    0.0       Everyone
2   87510.0   8700000.0   5000000.0  Free    0.0       Everyone
3  215644.0  25000000.0  50000000.0  Free    0.0           Teen
4     967.0   2800000.0    100000.0  Free    0.0       Everyone

                      Genres      Last Updated         Current Ver  \
0               Art & Design   January 7, 2018               1.0.0
1  Art & Design;Pretend Play  January 15, 2018               2.0.0
2               Art & Design    August 1, 2018               1.2.4
3               Art & Design      June 8, 2018  Varies with device
4    Art & Design;Creativity     June 20, 2018                 1.1

    Android Ver
0  4.0.3 and up
1  4.0.3 and up
2  4.0.3 and up
3    4.2 and up
4    4.4 and up
```

```
print(data_set.describe())
```

```
              Rating       Reviews          Size      Installs
Price
count  10841.000000  1.084000e+04  9.145000e+03  1.084100e+04
10841.000000
mean       4.206549  4.441529e+05  2.151653e+07  1.546291e+07
1.027273
std        0.480380  2.927761e+06  2.258875e+07  8.502557e+07
15.948971
min        1.000000  0.000000e+00  8.500000e+03  0.000000e+00
0.000000
25%        4.100000  3.800000e+01  4.900000e+06  1.000000e+03
0.000000
50%        4.300000  2.094000e+03  1.300000e+07  1.000000e+05
0.000000
75%        4.500000  5.477550e+04  3.000000e+07  5.000000e+06
0.000000
```

```
max        5.000000  7.815831e+07  1.000000e+08  1.000000e+09
400.000000

categorical_columns =
data_set.select_dtypes(include=['object']).columns
for col in categorical_columns:
    print(f"Unique values in {col}:")
    print(data_set[col].value_counts())
    print("\n")

Unique values in App:
App
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: count, Length: 9660, dtype: int64


Unique values in Category:
Category
FAMILY                 1972
GAME                   1144
TOOLS                   843
MEDICAL                 463
BUSINESS                460
PRODUCTIVITY            424
PERSONALIZATION         392
COMMUNICATION           387
SPORTS                  384
LIFESTYLE               382
FINANCE                 366
HEALTH_AND_FITNESS      341
PHOTOGRAPHY             335
SOCIAL                  295
NEWS_AND_MAGAZINES      283
SHOPPING                260
TRAVEL_AND_LOCAL        258
DATING                  234
BOOKS_AND_REFERENCE     231
VIDEO_PLAYERS           175
EDUCATION               156
ENTERTAINMENT           149
```

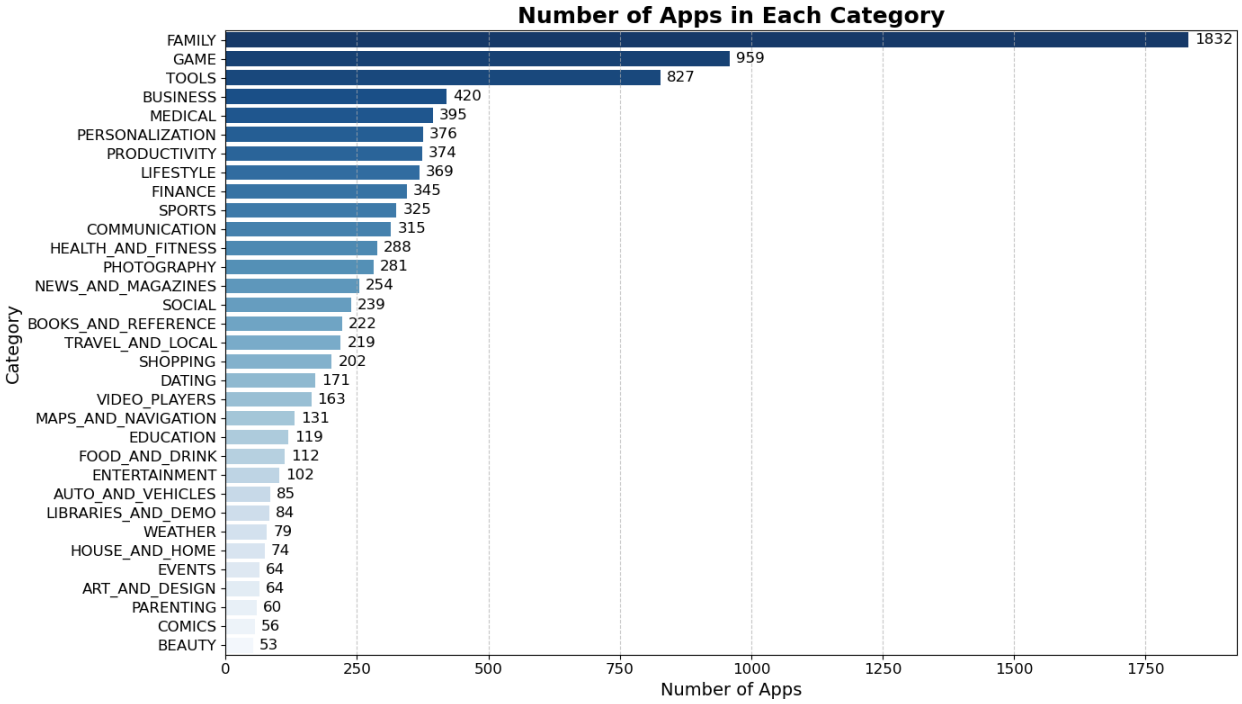
```
MAPS_AND_NAVIGATION     137
FOOD_AND_DRINK          127
HOUSE_AND_HOME           88
LIBRARIES_AND_DEMO       85
AUTO_AND_VEHICLES        85
WEATHER                  82
ART_AND_DESIGN           65
EVENTS                   64
PARENTING                60
COMICS                   60
BEAUTY                   53
1.9                       1
Name: count, dtype: int64


Unique values in Type:
Type
Free    10040
Paid      800
0           1
Name: count, dtype: int64


Unique values in Content Rating:
Content Rating
Everyone           8715
Teen               1208
Mature 17+          499
Everyone 10+        414
Adults only 18+       3
Unrated               2
Name: count, dtype: int64


Unique values in Genres:
Genres
Tools                     842
Entertainment             623
Education                 549
Medical                   463
Business                  460
                         ...
Arcade;Pretend Play         1
Card;Brain Games            1
Lifestyle;Pretend Play      1
Comics;Creativity           1
Strategy;Creativity         1
Name: count, Length: 120, dtype: int64
```

```
Unique values in Last Updated:
Last Updated
August 3, 2018        326
August 2, 2018        304
July 31, 2018         294
August 1, 2018        285
July 30, 2018         211
                     ...
March 20, 2014          1
April 7, 2015           1
September 22, 2014      1
October 3, 2015         1
March 23, 2014          1
Name: count, Length: 1378, dtype: int64


Unique values in Current Ver:
Current Ver
Varies with device    1467
1.0                    809
1.1                    264
1.2                    178
2.0                    151
                      ...
1.0.17.3905              1
15.1.2                   1
4.94.19                  1
1.1.11.11                1
2.0.148.0                1
Name: count, Length: 2832, dtype: int64


Unique values in Android Ver:
Android Ver
4.1 and up            2454
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: count, dtype: int64
```

```
data_set.drop_duplicates(subset=['App'], keep='first', inplace=True)

aggregated_data = data_set.groupby('App').agg({'Rating': 'mean',
'Installs': 'sum'}).reset_index()

# Remove the invalid category "1.9"
data_set = data_set[data_set['Category'] != '1.9']

# Remove the invalid '0' value in the 'Type' column
data_set = data_set[data_set['Type'] != '0']

# Convert 'Last Updated' to datetime format
data_set['Last Updated'] = pd.to_datetime(data_set['Last Updated'])

# Bar plot for app counts in each category
plt.figure(figsize=(14, 8))
category_count = data_set['Category'].value_counts()

bar_plot = sns.barplot(y=category_count.index,
x=category_count.values, palette='Blues_r')

# Add total count for each bar
for bar in bar_plot.patches:
    total = f'{int(bar.get_width())}'
    plt.annotate(total,
                 (bar.get_width(), bar.get_y() + bar.get_height() /
2),  # Position the total counts at the end of each bar
                 ha='left', va='center', fontsize=12, color='black',
xytext=(5, 0), textcoords='offset points')
```

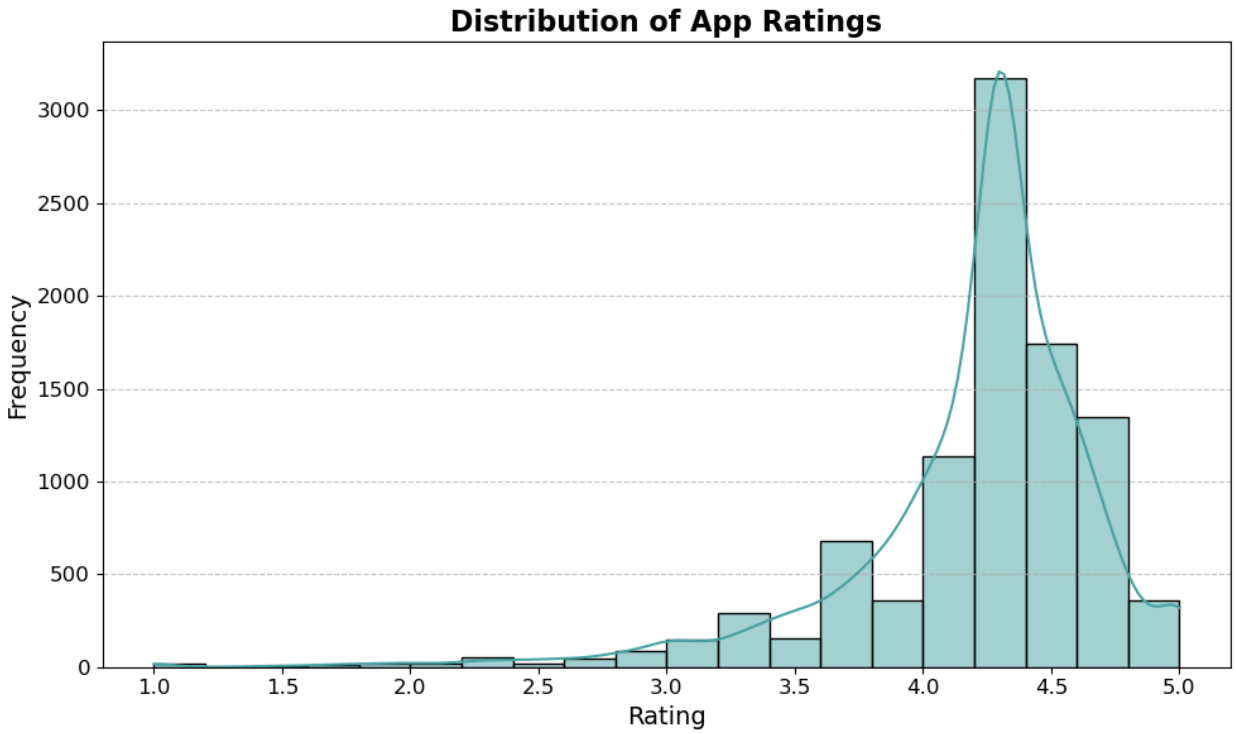
```
plt.title('Number of Apps in Each Category', fontsize=18,
fontweight='bold')
plt.xlabel('Number of Apps', fontsize=14)
plt.ylabel('Category', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='x', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



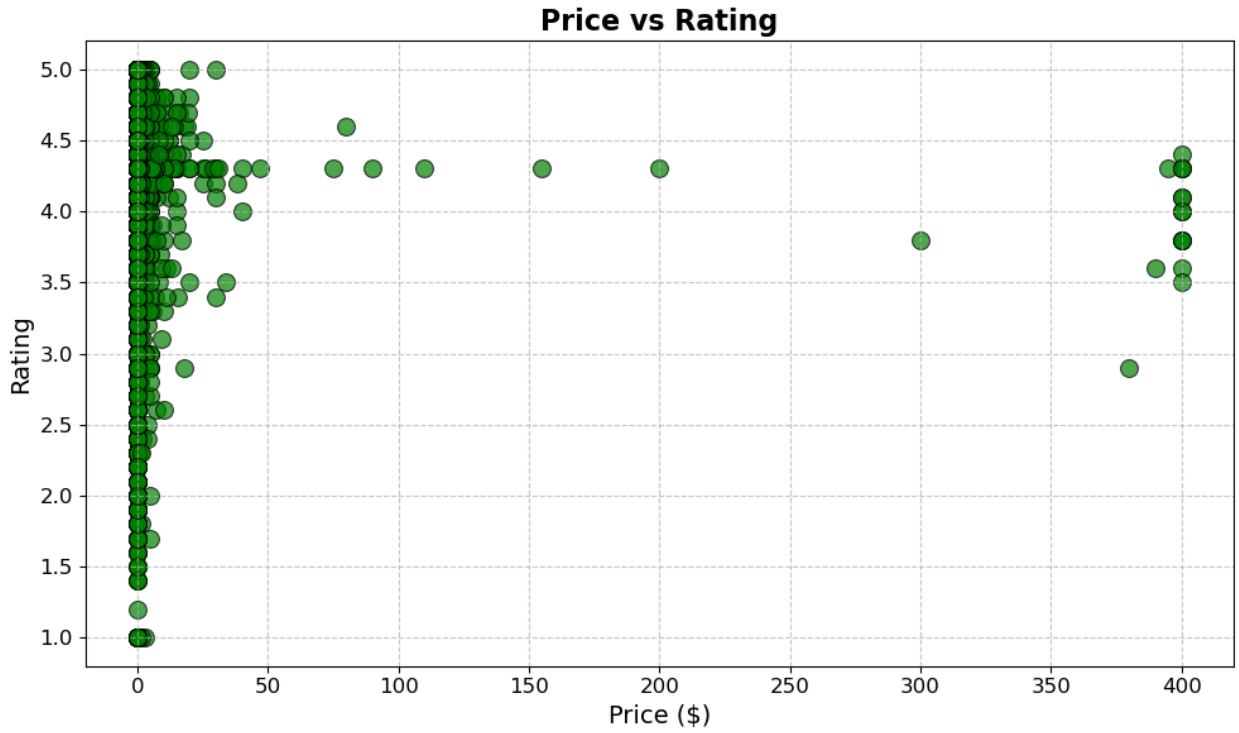
Now Apply Visualizations

```
# Histogram for rating distribution
plt.figure(figsize=(10, 6))
sns.histplot(data_set['Rating'].dropna(), bins=20, kde=True,
color='#49a3a2')
plt.title('Distribution of App Ratings', fontsize=16,
fontweight='bold')
plt.xlabel('Rating', fontsize=14)
plt.ylabel('Frequency', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='y', linestyle='--', alpha=0.7)
```

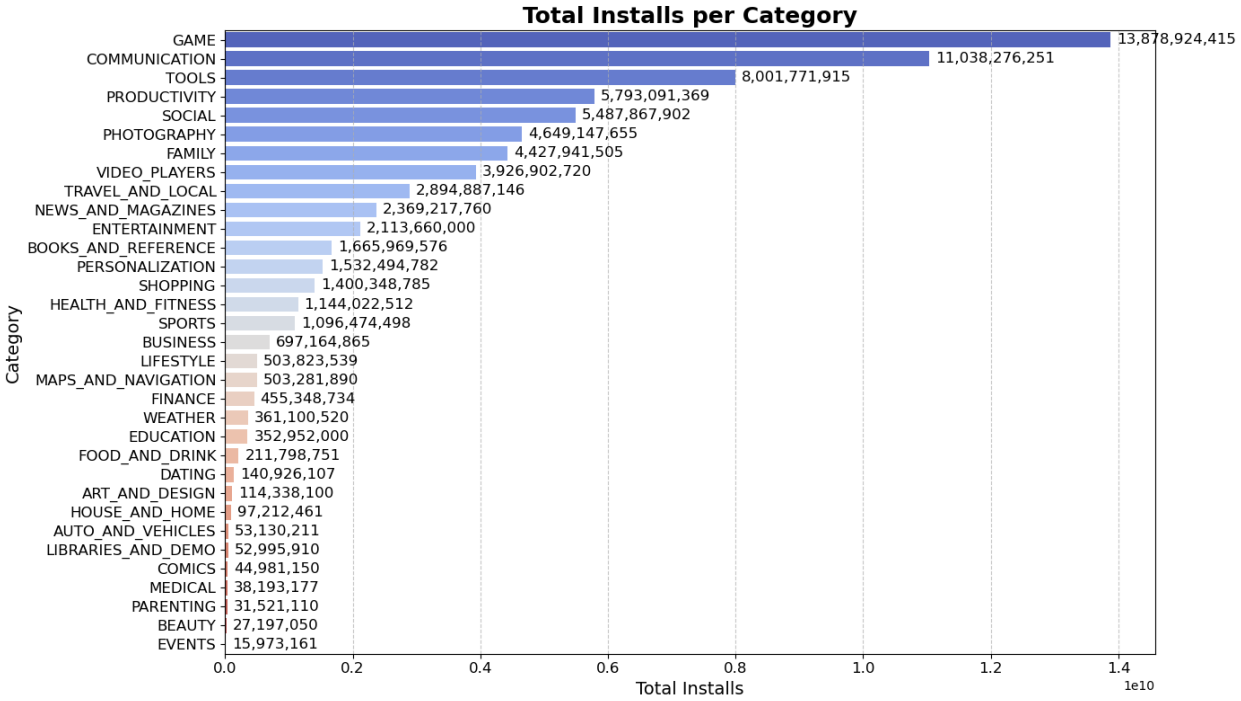
```
plt.tight_layout()
plt.show()
```



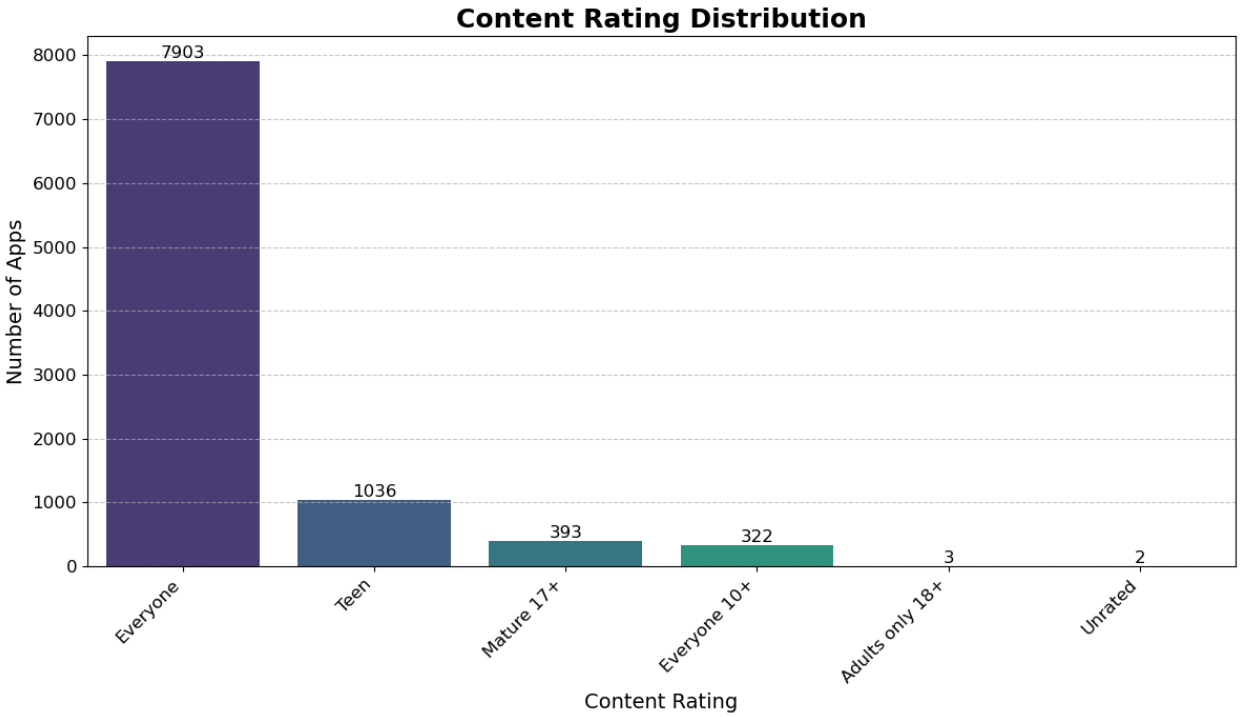

```
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Price', y='Rating', data=data_set, color='green',
s=100, edgecolor='black', alpha=0.7)
plt.title('Price vs Rating', fontsize=16, fontweight='bold')
plt.xlabel('Price ($)', fontsize=14)
plt.ylabel('Rating', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(True, linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```




```
plt.figure(figsize=(14, 8))
category_installs = data_set.groupby('Category')
['Installs'].sum().sort_values(ascending=False)
bar_plot = sns.barplot(x=category_installs.values,
y=category_installs.index, palette='coolwarm')

for bar in bar_plot.patches:
    total = f'{int(bar.get_width()):,}'  # Format with commas for
thousands
    plt.annotate(total,
                 (bar.get_width(), bar.get_y() + bar.get_height() /
2),
                 ha='left', va='center', fontsize=12, color='black',
xytext=(5, 0), textcoords='offset points')

plt.title('Total Installs per Category', fontsize=18,
fontweight='bold')
plt.xlabel('Total Installs', fontsize=14)
plt.ylabel('Category', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='x', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```

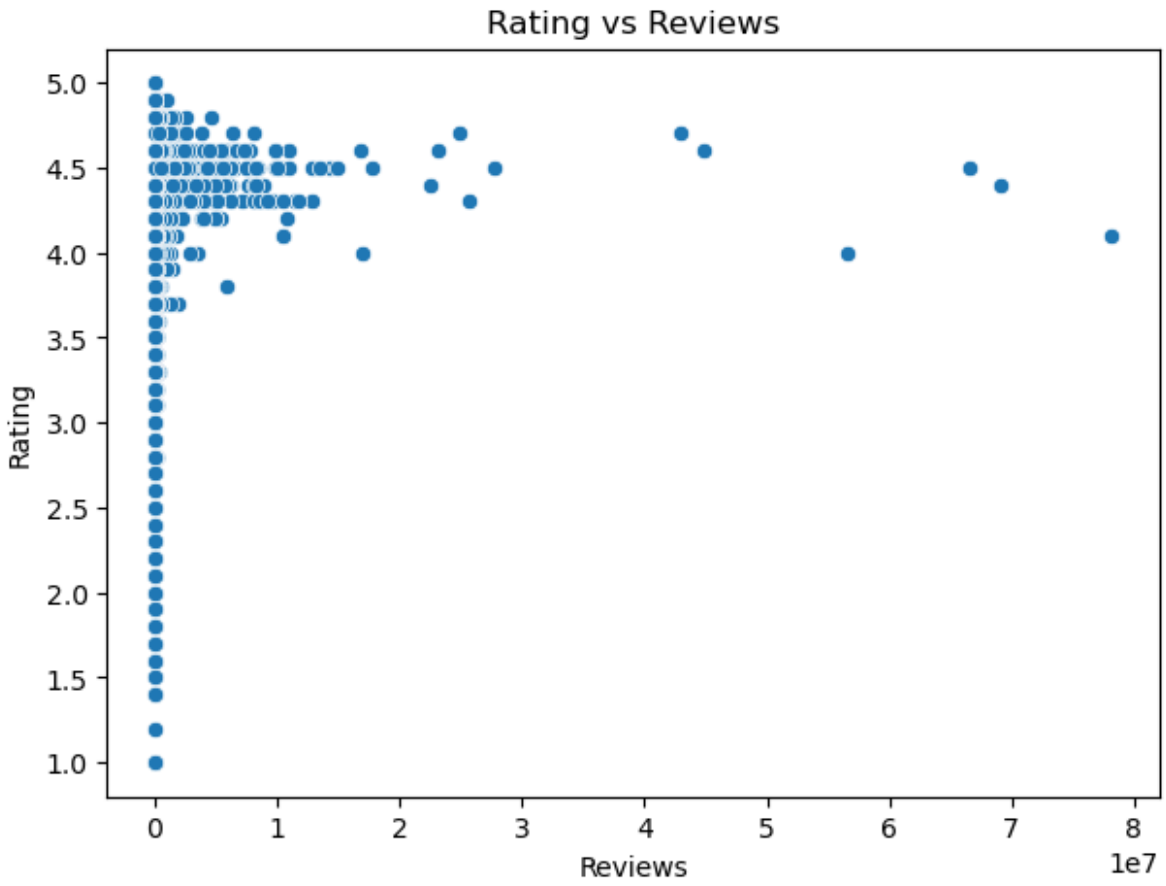


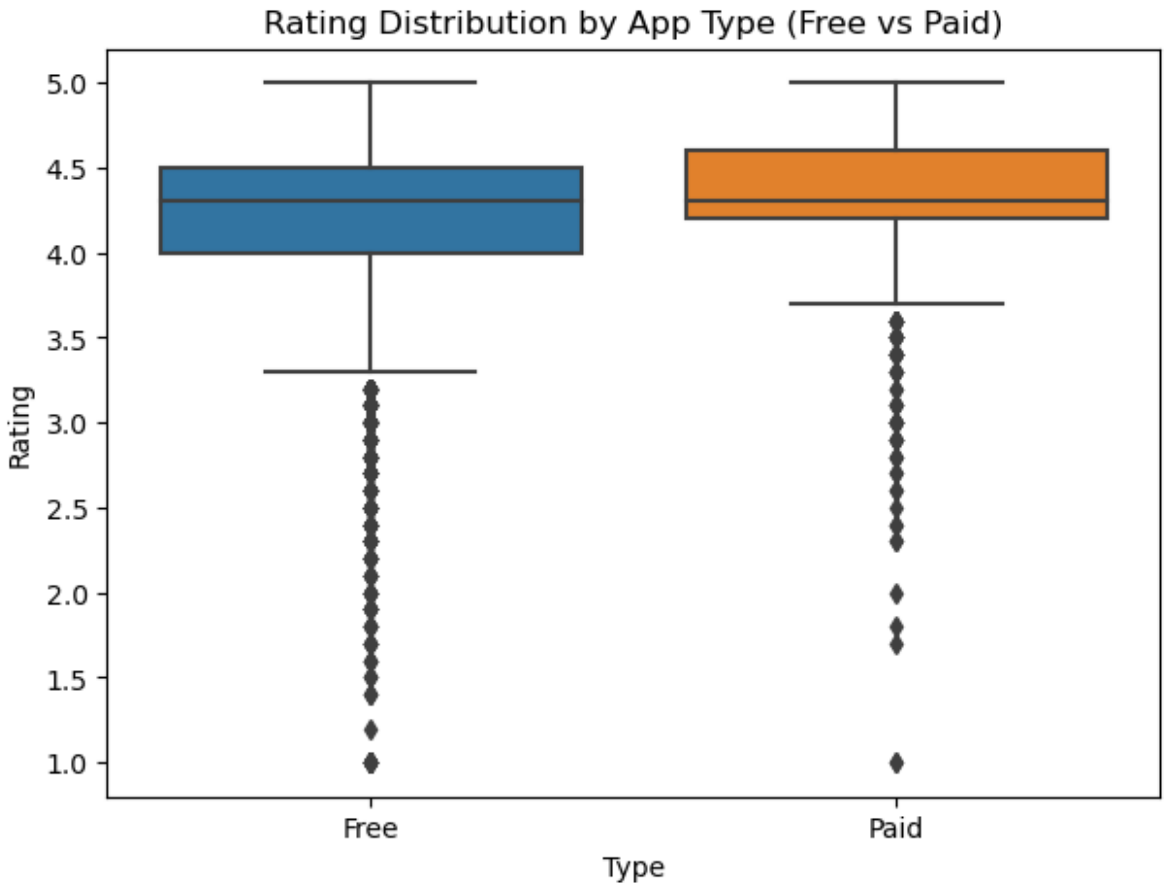

```
plt.figure(figsize=(12, 7))
content_rating_distribution = data_set['Content
Rating'].value_counts()

bar_plot = sns.barplot(x=content_rating_distribution.index,
y=content_rating_distribution.values, palette="viridis")

for bar in bar_plot.patches:
    total = f'{int(bar.get_height())}'  # Display total count on each
bar
    plt.annotate(total,
                 (bar.get_x() + bar.get_width() / 2,
bar.get_height()),
                 ha='center', va='bottom', fontsize=12, color='black')

plt.title('Content Rating Distribution', fontsize=18,
fontweight='bold')
plt.xlabel('Content Rating', fontsize=14)
plt.ylabel('Number of Apps', fontsize=14)
plt.xticks(rotation=45, ha='right', fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



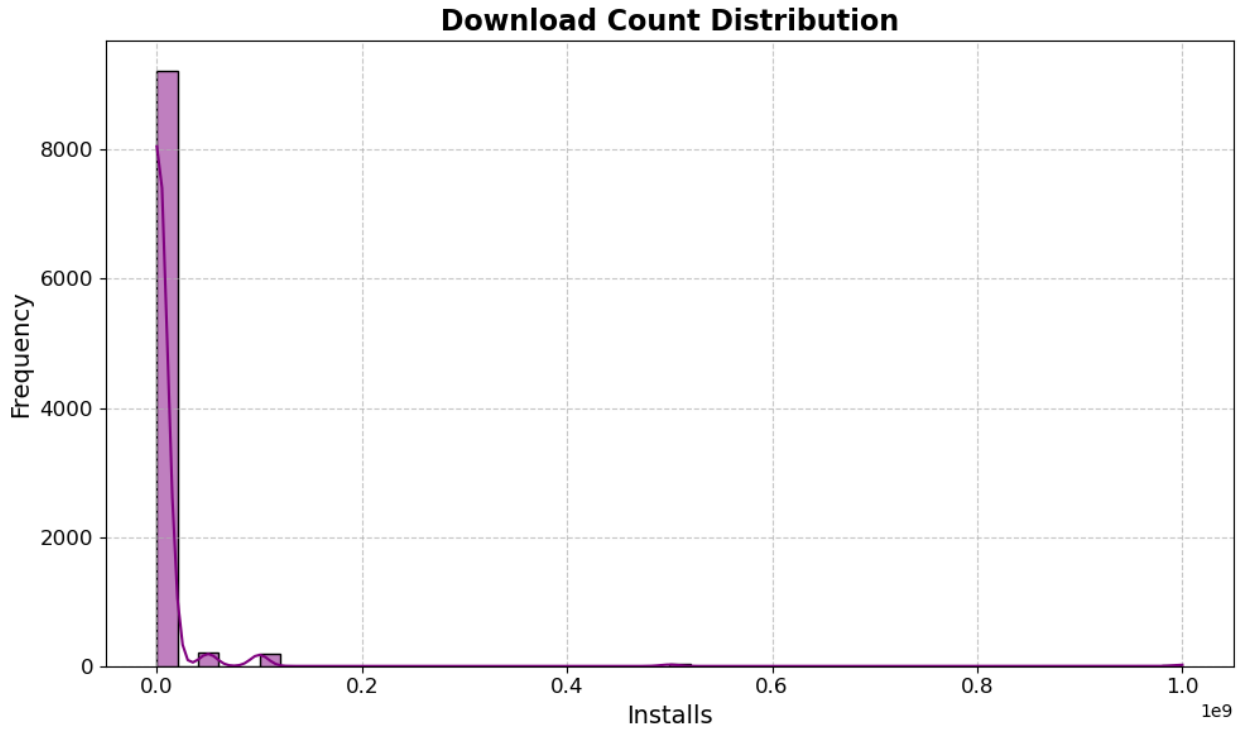

```
# Summary Statistics for Ratings
print("Summary of Ratings:")
print(data_set['Rating'].describe())

# Correlation Analysis
numerical_columns = ['Rating', 'Price', 'Reviews', 'Installs']  #
Adjust with relevant columns
correlation_matrix = data_set[numerical_columns].corr()
print("\nCorrelation Matrix:")
print(correlation_matrix)

#Visualization: Scatter plot of Ratings vs Price
plt.figure(figsize=(7, 5))
sns.scatterplot(data=data_set, x='Price', y='Rating')
plt.title('Rating vs Price')
plt.show()

# Visualization: Scatter plot of Ratings vs Reviews
plt.figure(figsize=(7, 5))
sns.scatterplot(data=data_set, x='Reviews', y='Rating')
plt.title('Rating vs Reviews')
plt.show()

# Visualization: Box plot of Ratings vs Type (Free vs Paid)
plt.figure(figsize=(7, 5))
sns.boxplot(data=data_set, x='Type', y='Rating')
```

```
plt.title('Rating Distribution by App Type (Free vs Paid)')
plt.show()

Summary of Ratings:
count    9659.000000
mean        4.192442
std         0.496397
min         1.000000
25%         4.000000
50%         4.300000
75%         4.500000
max         5.000000
Name: Rating, dtype: float64

Correlation Matrix:
             Rating     Price   Reviews  Installs
Rating     1.000000 -0.018662  0.050207  0.034307
Price     -0.018662  1.000000 -0.007598 -0.009405
Reviews    0.050207 -0.007598  1.000000  0.625165
Installs   0.034307 -0.009405  0.625165  1.000000
```

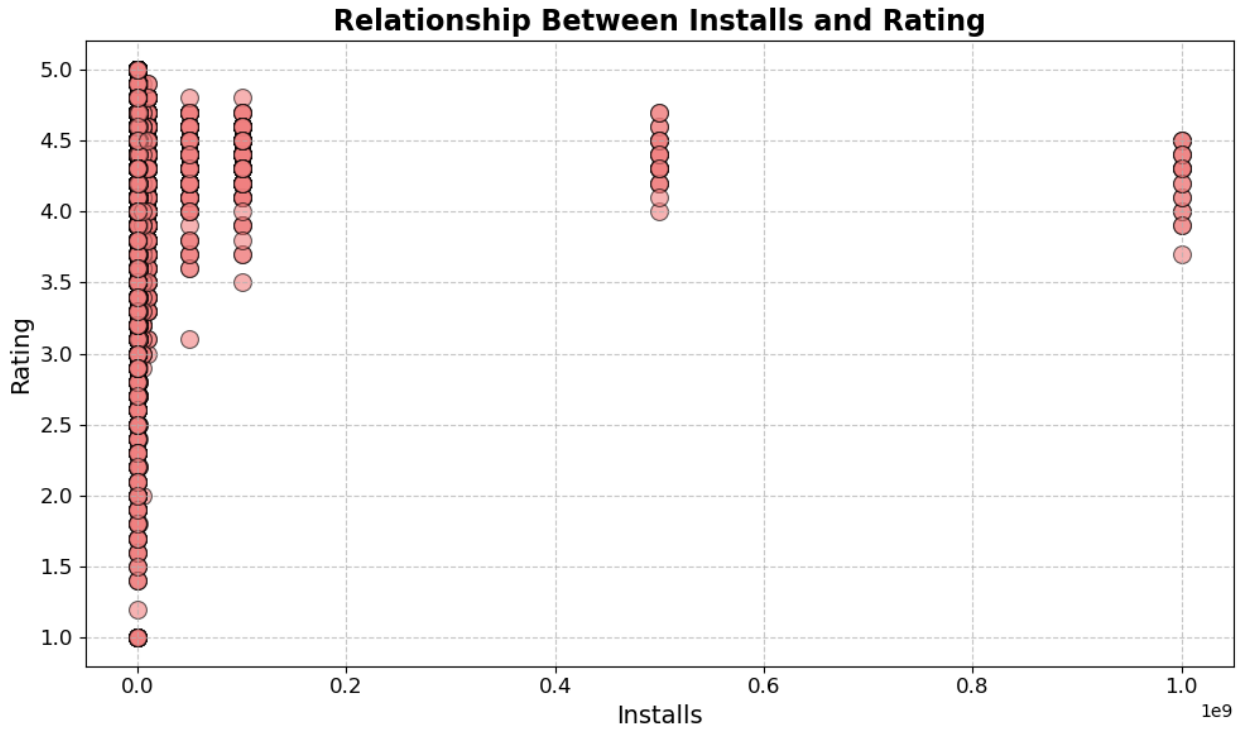

Rating vs Reviews
Rating
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
1
2
3
4
5
6
7
8
Reviews
1e7



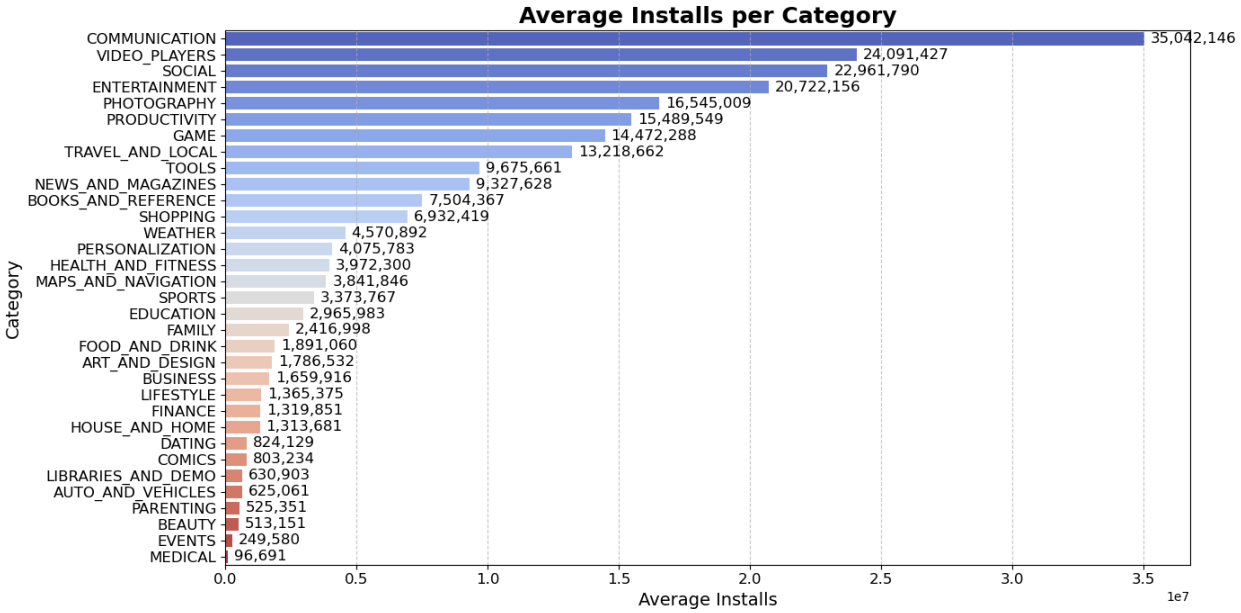

```
# Download Count Distribution
plt.figure(figsize=(10, 6))
sns.histplot(data_set['Installs'], bins=50, kde=True, color='purple')
plt.title('Download Count Distribution', fontsize=16,
fontweight='bold')
plt.xlabel('Installs', fontsize=14)
plt.ylabel('Frequency', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(True, linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



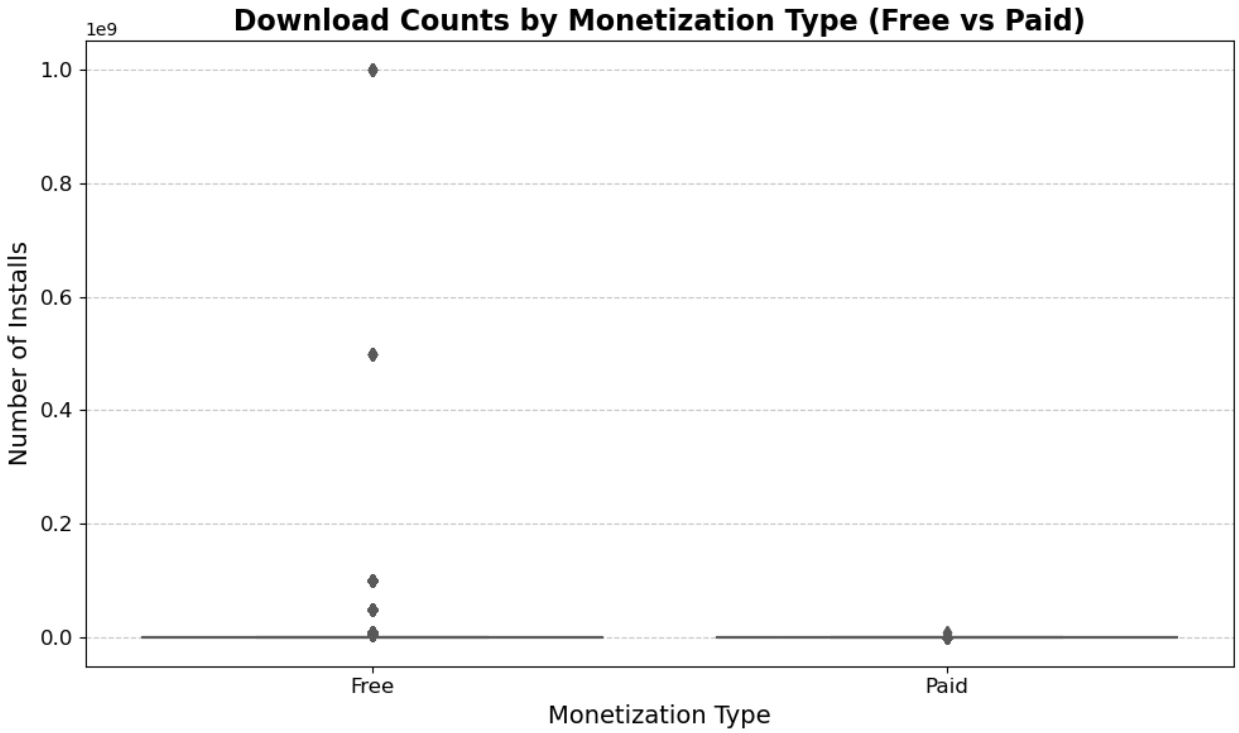

```
#Relationship Between Installs and Rating

plt.figure(figsize=(10, 6))
sns.scatterplot(data=data_set, x='Installs', y='Rating',
color='#F08080', s=100, edgecolor='black', alpha=0.6)
plt.title('Relationship Between Installs and Rating', fontsize=16,
fontweight='bold')
plt.xlabel('Installs', fontsize=14)
plt.ylabel('Rating', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(True, linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```




```
# 3. Category vs. Installs

plt.figure(figsize=(14, 7))
category_installs = data_set.groupby('Category')
['Installs'].mean().sort_values(ascending=False)

bar_plot = sns.barplot(y=category_installs.index,
x=category_installs.values, palette='coolwarm')

for bar in bar_plot.patches:
    total = f'{int(bar.get_width()):,}'  # Display formatted total
installs
    plt.annotate(total,
                 (bar.get_width(), bar.get_y() + bar.get_height() /
2),
                 ha='left', va='center', fontsize=12, color='black',
xytext=(5, 0), textcoords='offset points')

plt.title('Average Installs per Category', fontsize=18,
fontweight='bold')
plt.xlabel('Average Installs', fontsize=14)
plt.ylabel('Category', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='x', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```

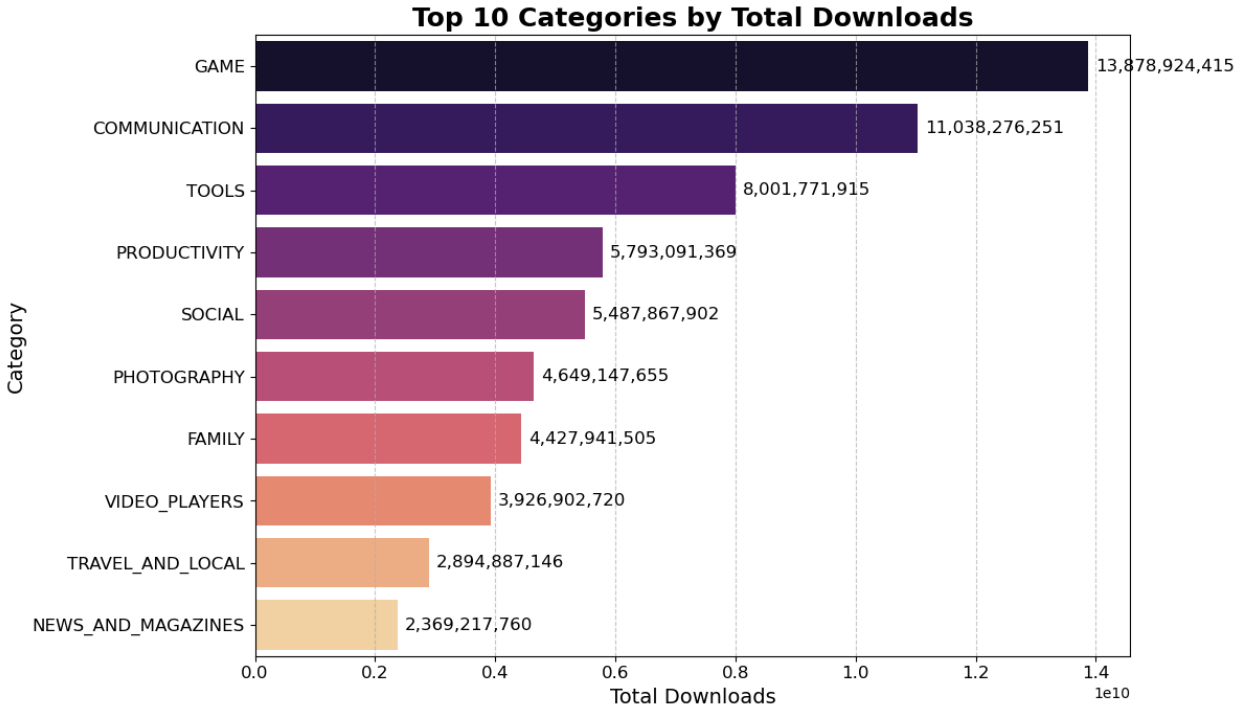



```
#Monetization (Free vs Paid) and Installs
plt.figure(figsize=(10, 6))
sns.boxplot(data=data_set, x='Type', y='Installs', palette='Set2')
plt.title('Download Counts by Monetization Type (Free vs Paid)',
fontsize=16, fontweight='bold')
plt.xlabel('Monetization Type', fontsize=14)
plt.ylabel('Number of Installs', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



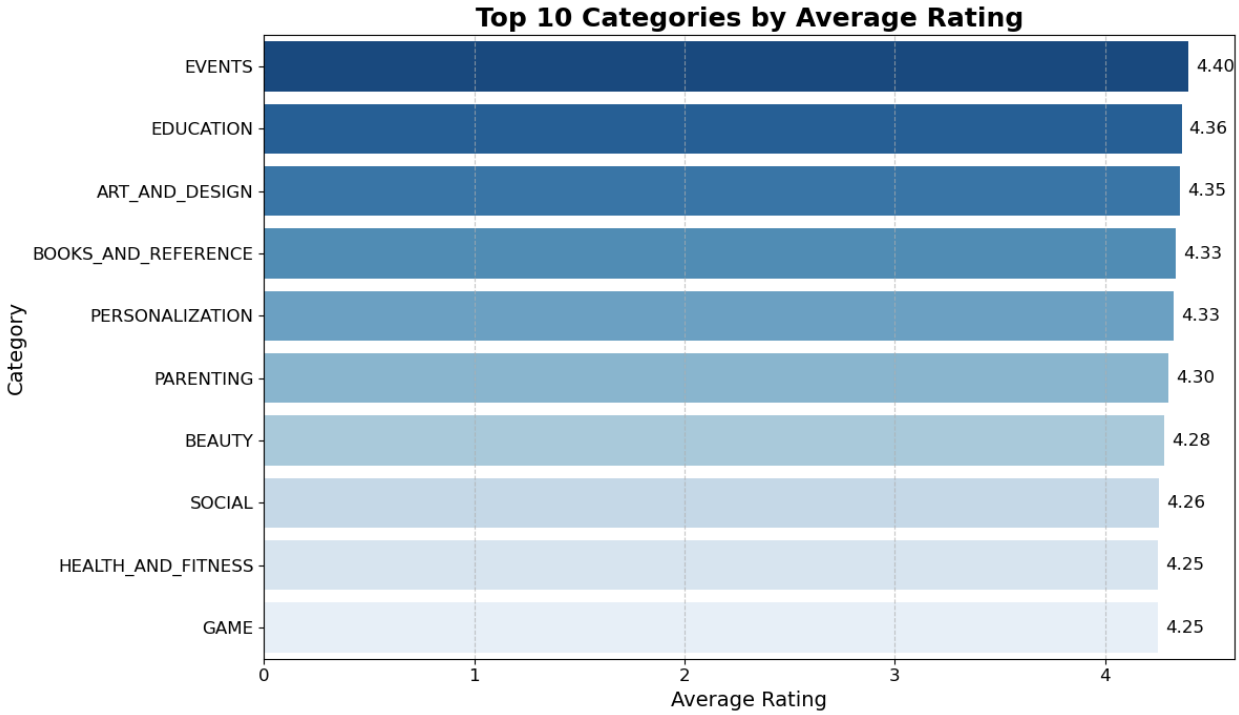

```
# Top Categories by Download Count

top_categories_by_installs = data_set.groupby('Category')
['Installs'].sum().sort_values(ascending=False).head(10) #to check
only top 10 category

plt.figure(figsize=(12, 7))
bar_plot = sns.barplot(x=top_categories_by_installs.values,
y=top_categories_by_installs.index, palette='magma')

for bar in bar_plot.patches:
    total = f'{int(bar.get_width()):,}'  # Display formatted total
downloads
    plt.annotate(total,
                 (bar.get_width(), bar.get_y() + bar.get_height() /
2),
                 ha='left', va='center', fontsize=12, color='black',
xytext=(5, 0), textcoords='offset points')

plt.title('Top 10 Categories by Total Downloads', fontsize=18,
fontweight='bold')
plt.xlabel('Total Downloads', fontsize=14)
plt.ylabel('Category', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='x', linestyle='--', alpha=0.7)
```

```
plt.tight_layout()
plt.show()
```



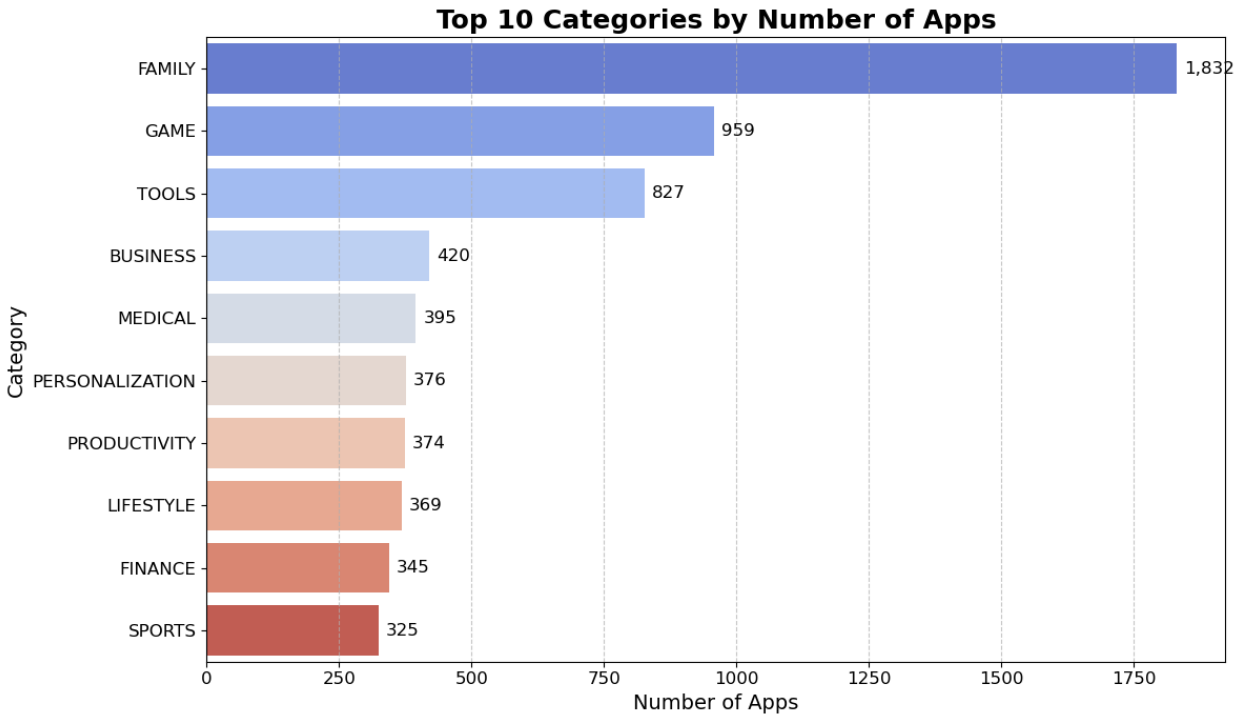

```
#  Top Categories by User Engagement (Rating)
top_categories_by_rating = data_set.groupby('Category')
['Rating'].mean().sort_values(ascending=False).head(10)

plt.figure(figsize=(12, 7))
bar_plot = sns.barplot(x=top_categories_by_rating.values,
y=top_categories_by_rating.index, palette='Blues_r')

for bar in bar_plot.patches:
    avg_rating = f'{bar.get_width():.2f}'  # Display average rating
with two decimal places
    plt.annotate(avg_rating,
                 (bar.get_width(), bar.get_y() + bar.get_height() /
2),
                 ha='left', va='center', fontsize=12, color='black',
xytext=(5, 0), textcoords='offset points')

plt.title('Top 10 Categories by Average Rating', fontsize=18,
fontweight='bold')
plt.xlabel('Average Rating', fontsize=14)
plt.ylabel('Category', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
```

```
plt.grid(axis='x', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```




```
# Top Categories by Number of Apps
top_categories_by_apps = data_set['Category'].value_counts().head(10)

plt.figure(figsize=(12, 7))
bar_plot = sns.barplot(x=top_categories_by_apps.values,
y=top_categories_by_apps.index, palette='coolwarm')

for bar in bar_plot.patches:
    total_apps = f'{int(bar.get_width()):,}'  # Display the total
number of apps
    plt.annotate(total_apps,
                 (bar.get_width(), bar.get_y() + bar.get_height() /
2),
                 ha='left', va='center', fontsize=12, color='black',
xytext=(5, 0), textcoords='offset points')

plt.title('Top 10 Categories by Number of Apps', fontsize=18,
fontweight='bold')
plt.xlabel('Number of Apps', fontsize=14)
plt.ylabel('Category', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.grid(axis='x', linestyle='--', alpha=0.7)
```

```
plt.tight_layout()
plt.show()
```



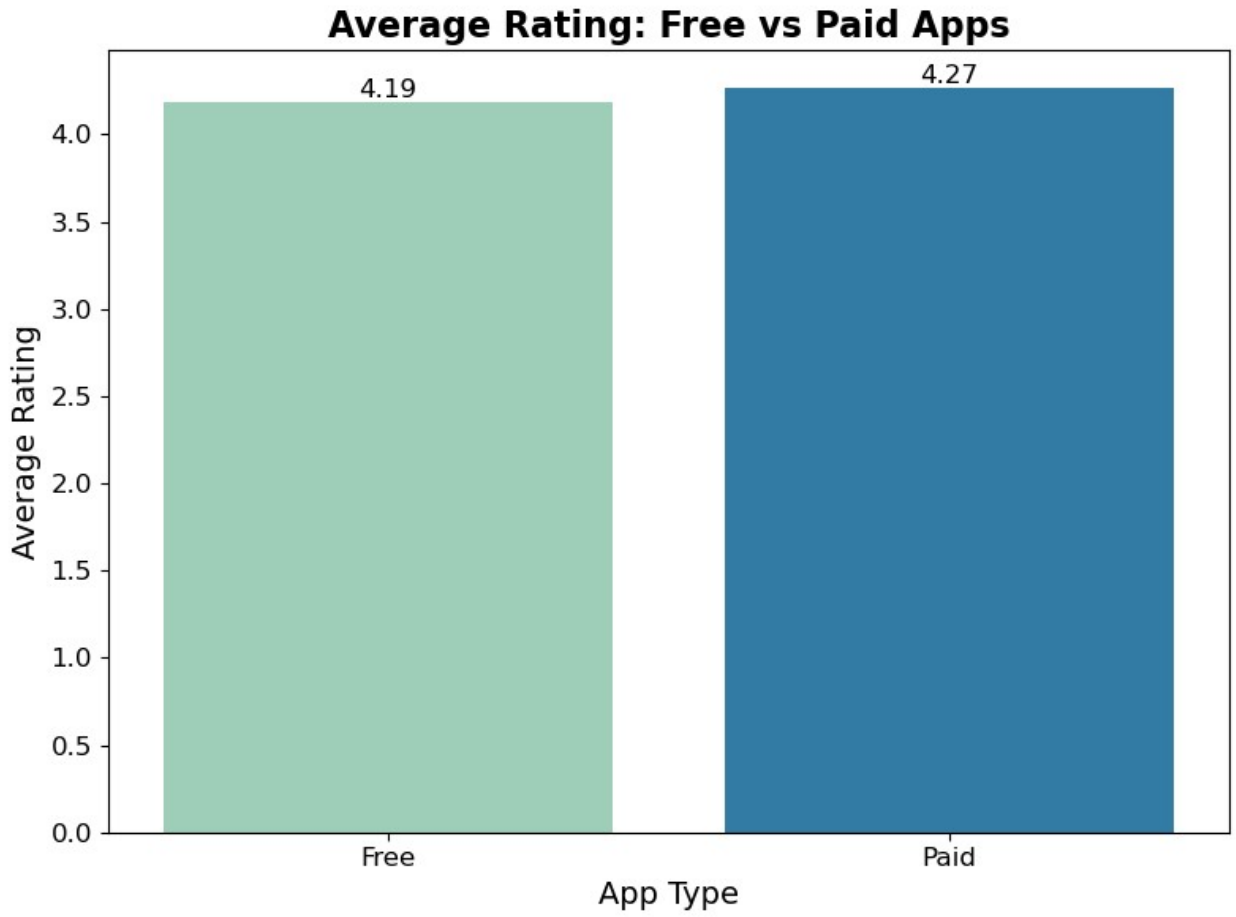
- Top Categories by Download Count: This bar chart shows the categories with the most installs, highlighting the most popular categories.
- Top Categories by Rating: This helps identify the categories where apps tend to have the highest user satisfaction.
- Top Categories by Number of Apps: This shows which categories have the highest number of apps available on the store, providing insight into competition and saturation.

Monetization Strategies

examine how different monetization strategies (Free, Paid, In-app purchases) affect app ratings and download counts.

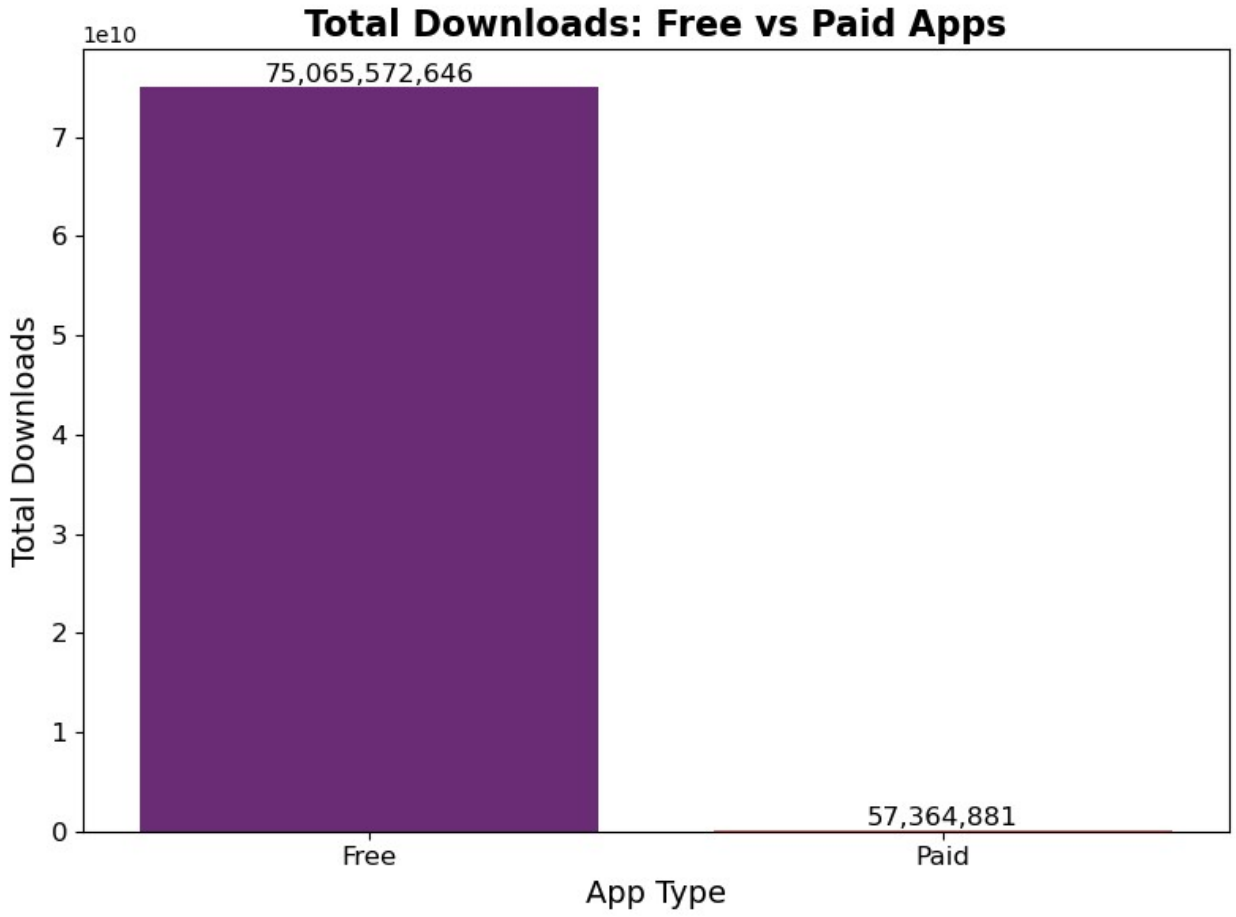
```
# Effect of Free vs Paid apps on Ratings
free_paid_ratings = data_set.groupby('Type')['Rating'].mean()

plt.figure(figsize=(8, 6))
bar_plot = sns.barplot(x=free_paid_ratings.index,
y=free_paid_ratings.values, palette='YlGnBu')

for bar in bar_plot.patches:
    avg_rating = f'{bar.get_height():.2f}'  # Display average rating
with two decimal places
```

```
    plt.annotate(avg_rating,
                 (bar.get_x() + bar.get_width() / 2,
bar.get_height()),
                 ha='center', va='bottom', fontsize=12, color='black')

plt.title('Average Rating: Free vs Paid Apps', fontsize=16,
fontweight='bold')
plt.xlabel('App Type', fontsize=14)
plt.ylabel('Average Rating', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.tight_layout()
plt.show()
```



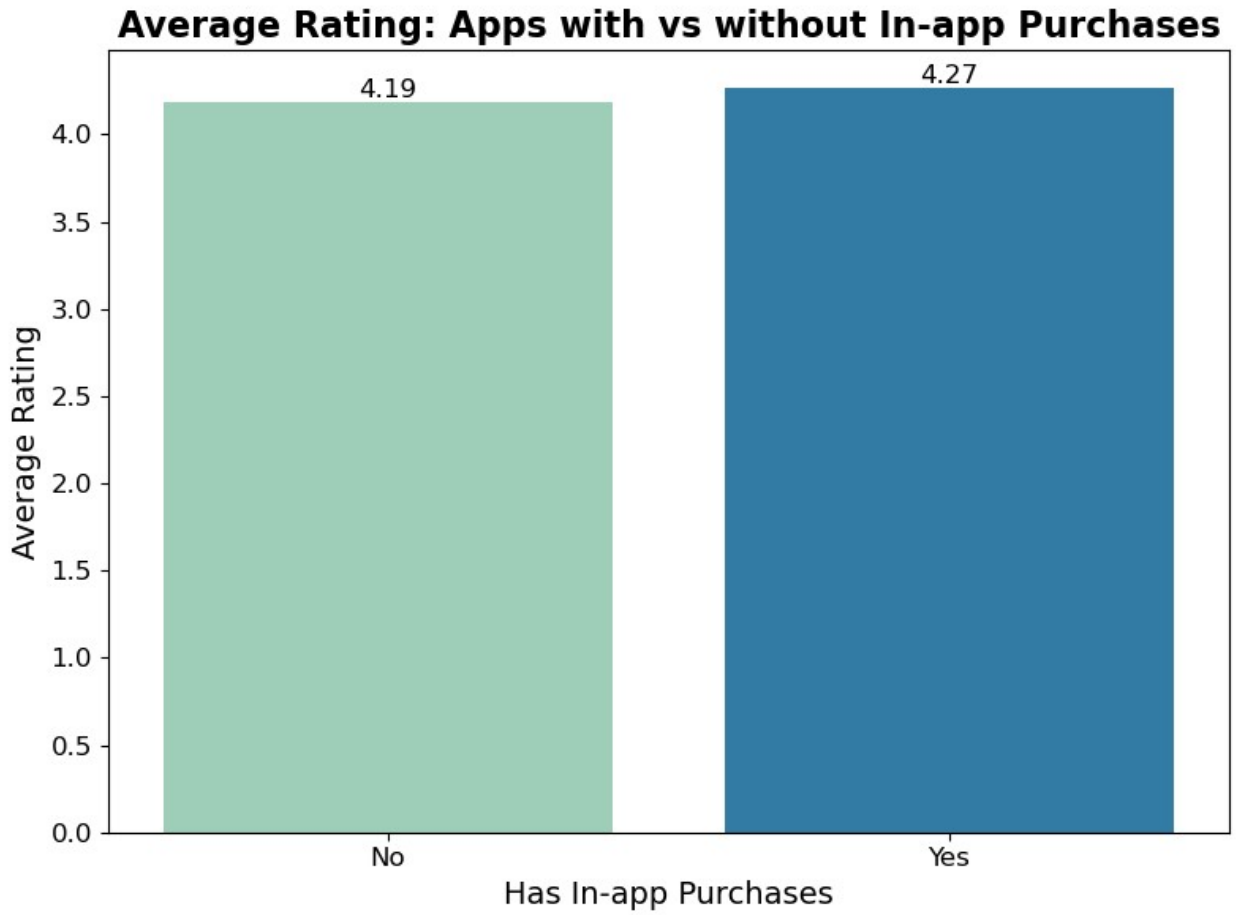

```
# Effect of Free vs Paid apps on Download Counts

free_paid_installs = data_set.groupby('Type')['Installs'].sum()

plt.figure(figsize=(8, 6))
bar_plot = sns.barplot(x=free_paid_installs.index,
y=free_paid_installs.values, palette='magma')
```

```
for bar in bar_plot.patches:
    total_installs = f'{int(bar.get_height()):,}'
    plt.annotate(total_installs,
                 (bar.get_x() + bar.get_width() / 2,
bar.get_height()),
                 ha='center', va='bottom', fontsize=12, color='black')

plt.title('Total Downloads: Free vs Paid Apps', fontsize=16,
fontweight='bold')
plt.xlabel('App Type', fontsize=14)
plt.ylabel('Total Downloads', fontsize=14)
plt.xticks(fontsize=12)
plt.yticks(fontsize=12)
plt.tight_layout()
plt.show()
```




```
# Relationship between In-app Purchases and Ratings

# create a new column in dataset to check if apps have in-app
```

```
purchases
data_set['Has In-app Purchases'] = data_set['Price'] > 0

inapp_ratings = data_set.groupby('Has In-app Purchases')
['Rating'].mean()

plt.figure(figsize=(8, 6))
bar_plot = sns.barplot(x=inapp_ratings.index, y=inapp_ratings.values,
palette='YlGnBu')

for bar in bar_plot.patches:
    avg_rating = f'{bar.get_height():.2f}'
    plt.annotate(avg_rating,
                 (bar.get_x() + bar.get_width() / 2,
bar.get_height()),
                 ha='center', va='bottom', fontsize=12, color='black')

plt.title('Average Rating: Apps with vs without In-app Purchases',
fontsize=16, fontweight='bold')
plt.xlabel('Has In-app Purchases', fontsize=14)
plt.ylabel('Average Rating', fontsize=14)
plt.xticks([0, 1], ['No', 'Yes'], fontsize=12)
plt.yticks(fontsize=12)
plt.tight_layout()
plt.show()
```




```
data_set.head()
```

```
                                                 App        Category
Rating  \
0     Photo Editor & Candy Camera & Grid & ScrapBook  ART_AND_DESIGN
4.1
1                                Coloring book moana  ART_AND_DESIGN
3.9
2  U Launcher Lite – FREE Live Cool Themes, Hide ...  ART_AND_DESIGN
4.7
3                               Sketch - Draw & Paint  ART_AND_DESIGN
4.5
4              Pixel Draw - Number Art Coloring Book  ART_AND_DESIGN
4.3

    Reviews        Size    Installs  Type  Price Content Rating  \
0     159.0  19000000.0     10000.0  Free    0.0       Everyone
1     967.0  14000000.0    500000.0  Free    0.0       Everyone
2   87510.0   8700000.0   5000000.0  Free    0.0       Everyone
3  215644.0  25000000.0  50000000.0  Free    0.0           Teen
4     967.0   2800000.0    100000.0  Free    0.0       Everyone
```

```
                      Genres Last Updated         Current Ver
Android Ver  \
0               Art & Design   2018-01-07               1.0.0  4.0.3
and up
1  Art & Design;Pretend Play   2018-01-15               2.0.0  4.0.3
and up
2               Art & Design   2018-08-01               1.2.4  4.0.3
and up
3               Art & Design   2018-06-08  Varies with device    4.2
and up
4    Art & Design;Creativity   2018-06-20                 1.1    4.4
and up

   Has In-app Purchases
0                 False
1                 False
2                 False
3                 False
4                 False
```

Insights

User Ratings

- Missing Values: The Rating column has significant missing values (9367 out of 10841 entries). There are also missing values in other columns like Type, Content Rating, Current Version, and Android Version.
- Data Issues: The Reviews, Size, Installs, and Price columns are stored as objects, even though they should likely be numeric. Additionally, the Rating column contains unrealistic values (like a maximum value of 19 when ratings typically range between 1 and 5).
- Popular Categories: Categories with the highest number of apps and downloads were examined, as well as those with the highest user satisfaction (i.e., high average ratings). These categories are potential targets for developing successful apps.

Download Counts

- Top Categories by Download: A bar chart is used to highlight the categories with the highest download counts. This indicates which categories are most popular and have the largest user bases.
- Download vs. Rating: The analysis examines how download counts correlate with app ratings, providing insight into how popularity (in terms of installs) aligns with user satisfaction.

Category Success

- No specific insights found in the about category success beyond downloads and ratings.

Monetization Strategies

- Monetization Impact: The examines how different monetization strategies (free, paid, in-app purchases) affect both app ratings and download counts. This analysis is important for understanding how pricing models influence app performance and user engagement.

Recommendations

1. Focus on High-Rating Categories for Better User Engagement

Insight: Categories with high average ratings indicate greater user satisfaction.

Recommendation: Developers should prioritize creating apps in categories where user satisfaction tends to be higher (Productivity, Health & Fitness). Investing in these categories increases the likelihood of positive user reviews and higher retention rates, which can translate to better visibility in app stores and more organic downloads.

2.Improve App Quality to Minimize Outliers in Ratings

Insight: The dataset contains apps with ratings that fall outside the typical 1 to 5 range, suggesting possible data entry errors or poor-quality apps.

Recommendation: Ensuring high app quality (smooth user experience, reliable updates, and strong functionality) will keep ratings within acceptable ranges and avoid extreme negative ratings. This can be achieved by consistently releasing updates, responding to user feedback, and focusing on core app features.

3. Monetization Strategy Must Align with App Category

Insight: Different monetization strategies (free, paid, in-app purchases) have varying impacts on app ratings and download counts.

Recommendation: Developers should align their monetization strategy with the user expectations in each category. For example, gaming apps often thrive on in-app purchases, while utility apps (like calculators or note-taking apps) may perform better when offered for free with ads or a freemium model. Paid apps should focus on premium, high-quality content to justify the cost and attract long-term users.

4. Prioritize Categories with High Download Potential

Insight: Categories like Communication, Social Media, and Entertainment have the highest download counts.

Recommendation: Developers looking for maximum exposure should focus on high-demand categories. However, they should be aware of the competitive nature of these categories and differentiate their product with unique features or user experiences. For marketers, concentrating advertising efforts in these popular categories can yield higher returns on investment.

5. Focus on Mobile Optimization and Update Frequency

Insight: Some apps in the dataset have outdated versions or are not optimized for recent Android versions.

Recommendation: Ensuring compatibility with the latest Android versions and frequent updates can improve user satisfaction and retention. By supporting a wide range of devices and optimizing for mobile usage, developers can reach a larger audience. Consistent updates not only resolve bugs but also introduce new features that keep users engaged.

6. Explore Freemium Models for Long-Term Monetization

Insight: Free apps tend to have higher download counts, but paid apps and apps with in-app purchases can achieve higher long-term profitability.

Recommendation: Consider adopting a freemium model, where the app is free to download but offers premium features through in-app purchases. This strategy can attract a larger user base initially and gradually convert free users to paying customers. Offering trials or discounts on premium features can also help in user acquisition.