EDA and Feature Engineering of Google Play Store Dataset

September 23, 2023

[1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')
```

[2]:
```
df=pd.read_csv("https://raw.githubusercontent.com/qiaochen/
  ↪DataAnalysis4GooglePlayStore/master/googleplaystore.csv")
```

[3]:
```
df.shape
```

[3]:
```
(10841, 13)
```

[4]:
```
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
```

[5]:
```
df.describe()
```

[5]:
```
             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
```

[6]:
```
##Missing values
df.isnull().sum()
```

[6]:
```
App                  0
Category             0
Rating            1474
Reviews              0
Size                 0
Installs             0
Type                 1
Price                0
Content Rating       1
Genres               0
Last Updated         0
Current Ver          8
Android Ver          3
dtype: int64
```

[7]:
```
df.head()
```

[7]:
```
                                                 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
```

[8]:
```
df['Reviews'].value_counts()
```

[8]:
```
0         596
1         272
2         214
3         175
4         137
         ...
342912      1
4272        1
5517        1
4057        1
398307      1
Name: Reviews, Length: 6002, dtype: int64
```

[9]:
```
df['Reviews'].unique()
```

[9]:
```
array(['159', '967', '87510', ..., '603', '1195', '398307'], dtype=object)
```

[10]:
```
df['Reviews'].str.isnumeric().sum()
```

[10]:
```
10840
```

[11]:
```
df[~df['Reviews'].str.isnumeric()]
```

[11]:
```
                                        App Category  Rating Reviews  \
10472  Life Made WI-Fi Touchscreen Photo Frame      1.9    19.0    3.0M

         Size Installs Type     Price Content Rating             Genres  \
10472  1,000+     Free    0  Everyone            NaN  February 11, 2018

      Last Updated Current Ver Android Ver
10472       1.0.19  4.0 and up         NaN
```

[12]:
```
df_copy=df.copy()
```

[13]:
```
df_copy=df_copy.drop(df_copy.index[10472])
```

[14]:
```
df_copy['Reviews']=df_copy['Reviews'].astype(int)
```

[15]:
```
df_copy.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10840 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             10840 non-null  object 
 1   Category        10840 non-null  object 
 2   Rating          9366 non-null   float64
 3   Reviews         10840 non-null  int64  
 4   Size            10840 non-null  object 
 5   Installs        10840 non-null  object 
 6   Type            10839 non-null  object 
 7   Price           10840 non-null  object 
 8   Content Rating  10840 non-null  object 
 9   Genres          10840 non-null  object 
 10  Last Updated    10840 non-null  object 
 11  Current Ver     10832 non-null  object 
 12  Android Ver     10838 non-null  object 
dtypes: float64(1), int64(1), object(11)
memory usage: 1.2+ MB
```

[16]:
```
df_copy['Size'].unique()
```

[16]:
```
array(['19M', '14M', '8.7M', '25M', '2.8M', '5.6M', '29M', '33M', '3.1M',
       '28M', '12M', '20M', '21M', '37M', '2.7M', '5.5M', '17M', '39M',
       '31M', '4.2M', '7.0M', '23M', '6.0M', '6.1M', '4.6M', '9.2M',
       '5.2M', '11M', '24M', 'Varies with device', '9.4M', '15M', '10M',
       '1.2M', '26M', '8.0M', '7.9M', '56M', '57M', '35M', '54M', '201k',
       '3.6M', '5.7M', '8.6M', '2.4M', '27M', '2.5M', '16M', '3.4M',
       '8.9M', '3.9M', '2.9M', '38M', '32M', '5.4M', '18M', '1.1M',
       '2.2M', '4.5M', '9.8M', '52M', '9.0M', '6.7M', '30M', '2.6M',
       '7.1M', '3.7M', '22M', '7.4M', '6.4M', '3.2M', '8.2M', '9.9M',
       '4.9M', '9.5M', '5.0M', '5.9M', '13M', '73M', '6.8M', '3.5M',
       '4.0M', '2.3M', '7.2M', '2.1M', '42M', '7.3M', '9.1M', '55M',
       '23k', '6.5M', '1.5M', '7.5M', '51M', '41M', '48M', '8.5M', '46M',
       '8.3M', '4.3M', '4.7M', '3.3M', '40M', '7.8M', '8.8M', '6.6M',
       '5.1M', '61M', '66M', '79k', '8.4M', '118k', '44M', '695k', '1.6M',
       '6.2M', '18k', '53M', '1.4M', '3.0M', '5.8M', '3.8M', '9.6M',
       '45M', '63M', '49M', '77M', '4.4M', '4.8M', '70M', '6.9M', '9.3M',
```

```
       '10.0M', '8.1M', '36M', '84M', '97M', '2.0M', '1.9M', '1.8M',
       '5.3M', '47M', '556k', '526k', '76M', '7.6M', '59M', '9.7M', '78M',
       '72M', '43M', '7.7M', '6.3M', '334k', '34M', '93M', '65M', '79M',
       '100M', '58M', '50M', '68M', '64M', '67M', '60M', '94M', '232k',
       '99M', '624k', '95M', '8.5k', '41k', '292k', '11k', '80M', '1.7M',
       '74M', '62M', '69M', '75M', '98M', '85M', '82M', '96M', '87M',
       '71M', '86M', '91M', '81M', '92M', '83M', '88M', '704k', '862k',
       '899k', '378k', '266k', '375k', '1.3M', '975k', '980k', '4.1M',
       '89M', '696k', '544k', '525k', '920k', '779k', '853k', '720k',
       '713k', '772k', '318k', '58k', '241k', '196k', '857k', '51k',
       '953k', '865k', '251k', '930k', '540k', '313k', '746k', '203k',
       '26k', '314k', '239k', '371k', '220k', '730k', '756k', '91k',
       '293k', '17k', '74k', '14k', '317k', '78k', '924k', '902k', '818k',
       '81k', '939k', '169k', '45k', '475k', '965k', '90M', '545k', '61k',
       '283k', '655k', '714k', '93k', '872k', '121k', '322k', '1.0M',
       '976k', '172k', '238k', '549k', '206k', '954k', '444k', '717k',
       '210k', '609k', '308k', '705k', '306k', '904k', '473k', '175k',
       '350k', '383k', '454k', '421k', '70k', '812k', '442k', '842k',
       '417k', '412k', '459k', '478k', '335k', '782k', '721k', '430k',
       '429k', '192k', '200k', '460k', '728k', '496k', '816k', '414k',
       '506k', '887k', '613k', '243k', '569k', '778k', '683k', '592k',
       '319k', '186k', '840k', '647k', '191k', '373k', '437k', '598k',
       '716k', '585k', '982k', '222k', '219k', '55k', '948k', '323k',
       '691k', '511k', '951k', '963k', '25k', '554k', '351k', '27k',
       '82k', '208k', '913k', '514k', '551k', '29k', '103k', '898k',
       '743k', '116k', '153k', '209k', '353k', '499k', '173k', '597k',
       '809k', '122k', '411k', '400k', '801k', '787k', '237k', '50k',
       '643k', '986k', '97k', '516k', '837k', '780k', '961k', '269k',
       '20k', '498k', '600k', '749k', '642k', '881k', '72k', '656k',
       '601k', '221k', '228k', '108k', '940k', '176k', '33k', '663k',
       '34k', '942k', '259k', '164k', '458k', '245k', '629k', '28k',
       '288k', '775k', '785k', '636k', '916k', '994k', '309k', '485k',
       '914k', '903k', '608k', '500k', '54k', '562k', '847k', '957k',
       '688k', '811k', '270k', '48k', '329k', '523k', '921k', '874k',
       '981k', '784k', '280k', '24k', '518k', '754k', '892k', '154k',
       '860k', '364k', '387k', '626k', '161k', '879k', '39k', '970k',
       '170k', '141k', '160k', '144k', '143k', '190k', '376k', '193k',
       '246k', '73k', '658k', '992k', '253k', '420k', '404k', '470k',
       '226k', '240k', '89k', '234k', '257k', '861k', '467k', '157k',
       '44k', '676k', '67k', '552k', '885k', '1020k', '582k', '619k'],
      dtype=object)
```

[17]:
```
df_copy['Size']=df_copy['Size'].str.replace('M','000')
df_copy['Size']=df_copy['Size'].str.replace('k','')
df_copy['Size']=df_copy['Size'].replace('Varies with device',np.nan)
df_copy['Size']=df_copy['Size'].astype(float)
```

[18]:
```
df_copy.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10840 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             10840 non-null  object 
 1   Category        10840 non-null  object 
 2   Rating          9366 non-null   float64
 3   Reviews         10840 non-null  int64  
 4   Size            9145 non-null   float64
 5   Installs        10840 non-null  object 
 6   Type            10839 non-null  object 
 7   Price           10840 non-null  object 
 8   Content Rating  10840 non-null  object 
 9   Genres          10840 non-null  object 
 10  Last Updated    10840 non-null  object 
 11  Current Ver     10832 non-null  object 
 12  Android Ver     10838 non-null  object 
dtypes: float64(2), int64(1), object(10)
memory usage: 1.2+ MB
```

[19]:
```
df_copy['Installs'].unique()
```

[19]:
```
array(['10,000+', '500,000+', '5,000,000+', '50,000,000+', '100,000+',
       '50,000+', '1,000,000+', '10,000,000+', '5,000+', '100,000,000+',
       '1,000,000,000+', '1,000+', '500,000,000+', '50+', '100+', '500+',
       '10+', '1+', '5+', '0+', '0'], dtype=object)
```

[20]:
```
df_copy['Price'].unique()
```

[20]:
```
array(['0', '$4.99', '$3.99', '$6.99', '$1.49', '$2.99', '$7.99', '$5.99',
       '$3.49', '$1.99', '$9.99', '$7.49', '$0.99', '$9.00', '$5.49',
       '$10.00', '$24.99', '$11.99', '$79.99', '$16.99', '$14.99',
       '$1.00', '$29.99', '$12.99', '$2.49', '$10.99', '$1.50', '$19.99',
       '$15.99', '$33.99', '$74.99', '$39.99', '$3.95', '$4.49', '$1.70',
       '$8.99', '$2.00', '$3.88', '$25.99', '$399.99', '$17.99',
       '$400.00', '$3.02', '$1.76', '$4.84', '$4.77', '$1.61', '$2.50',
       '$1.59', '$6.49', '$1.29', '$5.00', '$13.99', '$299.99', '$379.99',
       '$37.99', '$18.99', '$389.99', '$19.90', '$8.49', '$1.75',
       '$14.00', '$4.85', '$46.99', '$109.99', '$154.99', '$3.08',
       '$2.59', '$4.80', '$1.96', '$19.40', '$3.90', '$4.59', '$15.46',
       '$3.04', '$4.29', '$2.60', '$3.28', '$4.60', '$28.99', '$2.95',
       '$2.90', '$1.97', '$200.00', '$89.99', '$2.56', '$30.99', '$3.61',
       '$394.99', '$1.26', '$1.20', '$1.04'], dtype=object)
```

[21]:
```
chars_to_remove=['+',',','$']
cols_to_clean=['Installs','Price']
for item in chars_to_remove:
    for cols in cols_to_clean:
        df_copy[cols]=df_copy[cols].str.replace(item,'')
```

[22]:
```
df_copy['Price'].unique()
```

[22]:
```
array(['0', '4.99', '3.99', '6.99', '1.49', '2.99', '7.99', '5.99',
       '3.49', '1.99', '9.99', '7.49', '0.99', '9.00', '5.49', '10.00',
       '24.99', '11.99', '79.99', '16.99', '14.99', '1.00', '29.99',
       '12.99', '2.49', '10.99', '1.50', '19.99', '15.99', '33.99',
       '74.99', '39.99', '3.95', '4.49', '1.70', '8.99', '2.00', '3.88',
       '25.99', '399.99', '17.99', '400.00', '3.02', '1.76', '4.84',
       '4.77', '1.61', '2.50', '1.59', '6.49', '1.29', '5.00', '13.99',
       '299.99', '379.99', '37.99', '18.99', '389.99', '19.90', '8.49',
       '1.75', '14.00', '4.85', '46.99', '109.99', '154.99', '3.08',
       '2.59', '4.80', '1.96', '19.40', '3.90', '4.59', '15.46', '3.04',
       '4.29', '2.60', '3.28', '4.60', '28.99', '2.95', '2.90', '1.97',
       '200.00', '89.99', '2.56', '30.99', '3.61', '394.99', '1.26',
       '1.20', '1.04'], dtype=object)
```

[23]:
```
df_copy['Installs'].unique()
```

[23]:
```
array(['10000', '500000', '5000000', '50000000', '100000', '50000',
       '1000000', '10000000', '5000', '100000000', '1000000000', '1000',
       '500000000', '50', '100', '500', '10', '1', '5', '0'], dtype=object)
```

[24]:
```
df_copy['Installs']=df_copy['Installs'].astype('int')
df_copy['Price']=df_copy['Price'].astype('float')
```

[25]:
```
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
```

[26]:
```
df_copy['Last Updated']=pd.to_datetime(df_copy['Last Updated'])
df_copy['Day']=df_copy['Last Updated'].dt.day
df_copy['Month']=df_copy['Last Updated'].dt.month
df_copy['Year']=df_copy['Last Updated'].dt.year
```

[27]:
```
df_copy.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10840 entries, 0 to 10840
Data columns (total 16 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   App             10840 non-null  object
 1   Category        10840 non-null  object
 2   Rating          9366 non-null   float64
 3   Reviews         10840 non-null  int64
 4   Size            9145 non-null   float64
 5   Installs        10840 non-null  int64
 6   Type            10839 non-null  object
 7   Price           10840 non-null  float64
 8   Content Rating  10840 non-null  object
 9   Genres          10840 non-null  object
 10  Last Updated    10840 non-null  datetime64[ns]
 11  Current Ver     10832 non-null  object
 12  Android Ver     10838 non-null  object
 13  Day             10840 non-null  int64
 14  Month           10840 non-null  int64
 15  Year            10840 non-null  int64
dtypes: datetime64[ns](1), float64(3), int64(5), object(7)
memory usage: 1.4+ MB
```

[28]:
```
df_copy['Content Rating'].value_counts()
```

[28]:
```
Everyone           8714
Teen               1208
Mature 17+          499
Everyone 10+        414
Adults only 18+       3
Unrated               2
Name: Content Rating, dtype: int64
```

EDA

[29]:
```
df_copy[df_copy['App'].duplicated()]
```

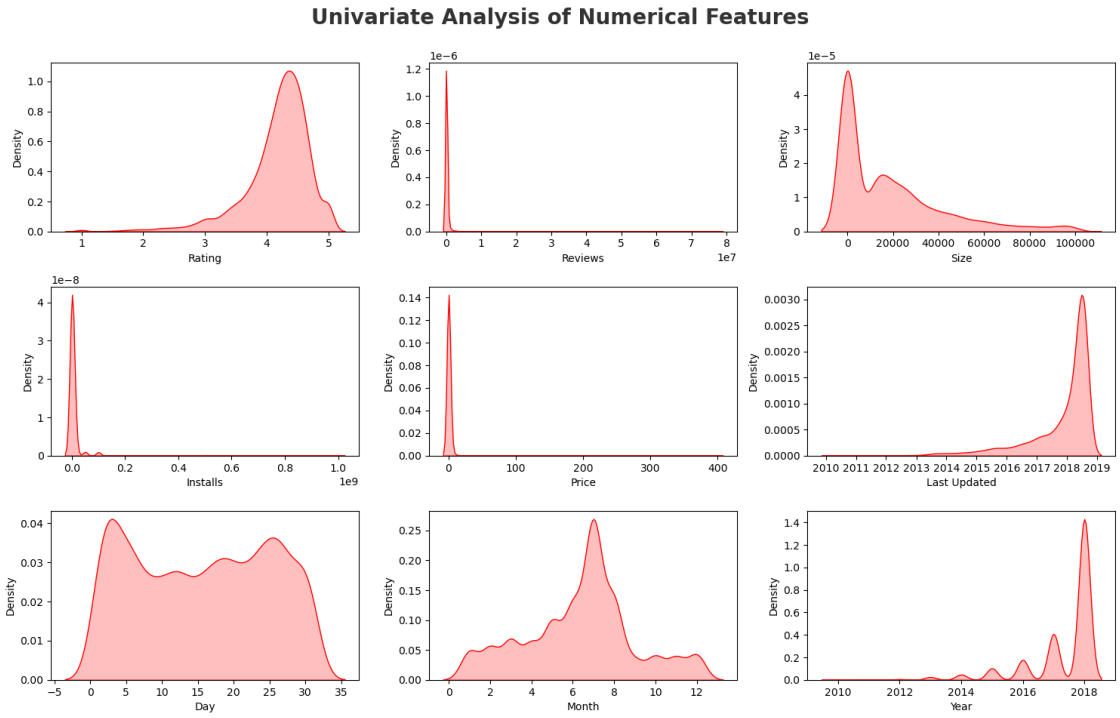
[29]:
```
                                     App       Category  Rating  Reviews  \
229          Quick PDF Scanner + OCR FREE       BUSINESS     4.2    80805
236                                   Box       BUSINESS     4.2   159872
239                  Google My Business       BUSINESS     4.4    70991
256                 ZOOM Cloud Meetings       BUSINESS     4.4    31614
261            join.me - Simple Meetings       BUSINESS     4.0     6989
…                                    …            …     …      …
10715                 FarmersOnly Dating         DATING     3.0     1145
10720  Firefox Focus: The privacy browser  COMMUNICATION     4.4    36981
10730                       FP Notebook        MEDICAL     4.5      410
10753     Slickdeals: Coupons & Shopping       SHOPPING     4.5    33599
10768                               AAFP        MEDICAL     3.8       63

          Size  Installs  Type  Price Content Rating         Genres  \
229        NaN   5000000  Free    0.0       Everyone       Business
236        NaN  10000000  Free    0.0       Everyone       Business
239        NaN   5000000  Free    0.0       Everyone       Business
256    37000.0  10000000  Free    0.0       Everyone       Business
261        NaN   1000000  Free    0.0       Everyone       Business
…          …        …    …    …             …              …
10715      1.4    100000  Free    0.0     Mature 17+         Dating
10720      4.0   1000000  Free    0.0       Everyone  Communication
10730  60000.0     50000  Free    0.0       Everyone        Medical
10753  12000.0   1000000  Free    0.0       Everyone       Shopping
10768  24000.0     10000  Free    0.0       Everyone        Medical

      Last Updated         Current Ver         Android Ver  Day  Month  Year
229     2018-02-26  Varies with device        4.0.3 and up   26      2  2018
236     2018-07-31  Varies with device  Varies with device   31      7  2018
239     2018-07-24    2.19.0.204537701          4.4 and up   24      7  2018
256     2018-07-20      4.1.28165.0716          4.0 and up   20      7  2018
261     2018-07-16           4.3.0.508          4.4 and up   16      7  2018
…              …                   …                   …  …    …     …
10715   2016-02-25                 2.2          4.0 and up   25      2  2016
10720   2018-07-06                 5.2          5.0 and up    6      7  2018
10730   2018-03-24           2.1.0.372          4.4 and up   24      3  2018
10753   2018-07-30                 3.9          4.4 and up   30      7  2018
10768   2018-06-22               2.3.1          5.0 and up   22      6  2018

[1181 rows x 16 columns]
```

[30]:
```
df_copy=df_copy.drop_duplicates(subset=['App'],keep='first')
df_copy[df_copy['App'].duplicated()].shape
```

[30]: (0, 16)

[31]:
```
numeric_features=[feature for feature in df_copy.columns if df_copy[feature].
 ↪dtype!='O']
categorical_feature=[feature for feature in df_copy.columns if df_copy[feature].
 ↪dtype=='O']
```

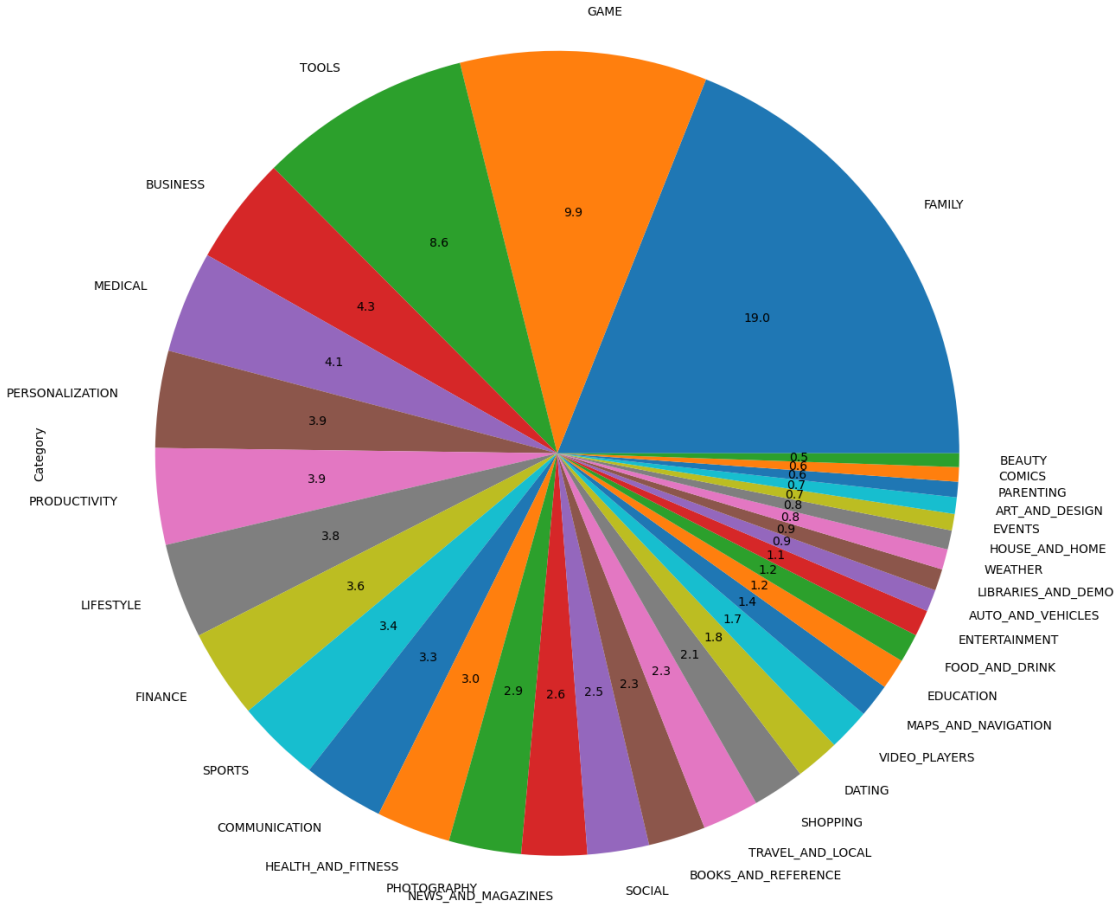
[32]:
```
## Visualisation
plt.figure(figsize=(15,15))
plt.suptitle('Univariate Analysis of Numerical␣
 ↪Features',fontsize=20,fontweight='bold',alpha=0.8,y=1.)
for i in range(0, len(numeric_features)):
    plt.subplot(5, 3, i+1)
    sns.kdeplot(x=df_copy[numeric_features[i]],shade=True, color='r')
    plt.xlabel(numeric_features[i])
    plt.tight_layout()
```



Observations Rating and Year is left skewed while Reviews,Size,Installs and Price are right skewed

[33]:
```
df_copy['Category'].value_counts().plot.
 ↪pie(y=df_copy['Category'],figsize=(15,16),autopct='%1.1f')
```

[33]: <AxesSubplot: ylabel='Category'>



0.1 observation

1.There are more apps under category of family, games & tools 2.Beauty,comic,arts and weather kinds of apps are very less in playstore

0.2 Top 10 app categories

[34]:
```
category = pd.DataFrame(df_copy['Category'].value_counts())
category.rename(columns = {'Category':'Count'},inplace=True)
```

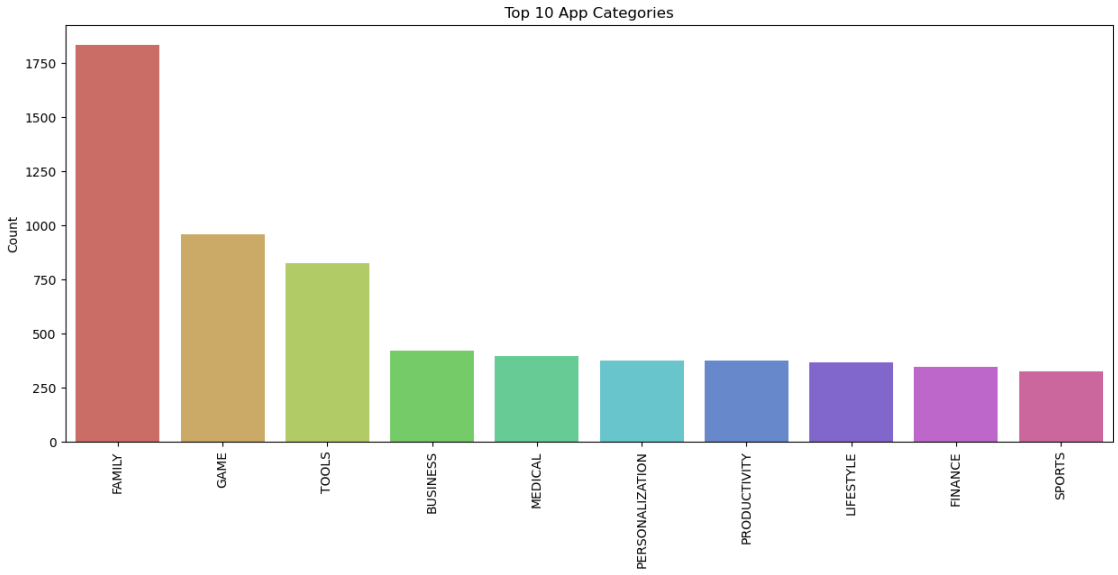
[35]:
```
category
```

[35]:

	Count
FAMILY	1832
GAME	959
TOOLS	827

```
BUSINESS               420
MEDICAL                395
PERSONALIZATION        376
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    222
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      84
WEATHER                 79
HOUSE_AND_HOME          74
EVENTS                  64
ART_AND_DESIGN          64
PARENTING               60
COMICS                  56
BEAUTY                  53
```

[36]:
```
plt.figure(figsize=(15,6))
sns.barplot(x=category.index[:10],y='Count',data=category[:10],palette='hls')
plt.title('Top 10 App Categories')
plt.xticks(rotation=90)
plt.show()
```


Top 10 App Categories
Count
1750
1500
1250
1000
750
500
250
0
FAMILY
GAME
TOOLS
BUSINESS
MEDICAL
PERSONALIZATION
PRODUCTIVITY
LIFESTYLE
FINANCE
SPORTS

[ ]: