Google Play Store Apps.

About Dataset.

Context.

While many public datasets (on Kaggle and the like) provide Apple App Store data, there are not many counterpart datasets available for Google Play Store apps anywhere on the web. On digging deeper, I found out that iTunes App Store page deploys a nicely indexed appendix-like structure to allow for simple and easy web scraping. On the other hand, Google Play Store uses sophisticated modern-day techniques (like dynamic page load) using JQuery making scraping more challenging.

Content.

Each app (row) has values for `catergory` , `rating` , `size` , and more.

Acknowledgements.

This information is scraped from the Google Play Store. This app information would not be available without it.

Inspiration.

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!

Prediction Info.

Target columns are `Rating` and `Installs`

In [ ]:
```
1
```

Section 1: Data Cleaning.

Importing Libraries.

In [1]:
```
1 import numpy as np
2 import pandas as pd
3 import matplotlib.pyplot as plt
4 import seaborn as sns
5 import warnings, re
6 warnings.filterwarnings('ignore')
7 from datetime import datetime as dt
8 import statistics as stat
```

i) Data Overview.

In [2]:
```
data = pd.read_csv('googleplaystore.csv')
data.sample(10)
```

Out[2]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	C
5900	Cures A-Z	HEALTH_AND_FITNESS	4.0	265	4.1M	100,000+	Free	0	Everyone	Health & Fitness	August 13, 2015	
7407	Calculate My IQ	FAMILY	NaN	44	7.2M	10,000+	Free	0	Everyone	Entertainment	April 3, 2017	
8001	Canon CameraWindow	PHOTOGRAPHY	3.5	12204	6.8M	1,000,000+	Free	0	Everyone	Photography	March 14, 2017	
9625	JW Library	BOOKS_AND_REFERENCE	4.9	922752	Varies with device	10,000,000+	Free	0	Everyone	Books & Reference	June 15, 2018	
10618	Results for FL Lottery (Florida)	FAMILY	NaN	1	3.2M	100+	Free	0	Mature 17+	Entertainment	November 2, 2017	
8116	Cymath - Math Problem Solver	FAMILY	4.5	10159	6.4M	1,000,000+	Free	0	Everyone	Education	April 13, 2018	
1865	Honkai Impact 3rd	GAME	4.7	59017	82M	1,000,000+	Free	0	Teen	Action	July 3, 2018	
9120	Devise Dz	FINANCE	4.0	26	3.6M	1,000+	Free	0	Everyone	Finance	May 29, 2017	
3225	Airport + Flight Tracker Radar	TRAVEL_AND_LOCAL	4.2	6762	8.5M	1,000,000+	Free	0	Everyone	Travel & Local	July 14, 2015	
701	English Communication - Learn English for Chin...	EDUCATION	4.7	2544	18M	100,000+	Free	0	Everyone	Education	December 29, 2017	

In [3]:
```
1 data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10841 entries, 0 to 10840
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   App             10841 non-null  object 
 1   Category        10841 non-null  object 
 2   Rating          9367 non-null   float64
 3   Reviews         10841 non-null  object 
 4   Size            10841 non-null  object 
 5   Installs        10841 non-null  object 
 6   Type            10840 non-null  object 
 7   Price           10841 non-null  object 
 8   Content Rating  10840 non-null  object 
 9   Genres          10841 non-null  object 
 10  Last Updated    10841 non-null  object 
 11  Current Ver     10833 non-null  object 
 12  Android Ver     10838 non-null  object 
dtypes: float64(1), object(12)
memory usage: 1.1+ MB
```

In [4]:
```
1 data.describe(include = 'O')
```

Out[4]:

	App	Category	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
count	10841	10841	10841	10841	10841	10840	10841	10840	10841	10841	10833	10838
unique	9660	34	6002	462	22	3	93	6	120	1378	2832	33
top	ROBLOX	FAMILY	0	Varies with device	1,000,000+	Free	0	Everyone	Tools	August 3, 2018	Varies with device	4.1 and up
freq	9	1972	596	1695	1579	10039	10040	8714	842	326	1459	2451

Deductions:

> Twelve features have their dtypes to be object, including `Price` and `Reviews` 😟, while `Rating` is float.

There is a number of features with missing values. However, `Rating` (float dtype) has the highest.

10841 rows are present with 13 columns.

`App` is expected to be unique throughout, but no, it isn't. 9660 out of 10841 are unique. Others have exactly the same name. Is it possible to have two apps with exactly the same name? No. Thus, there is a possibility of having duplicate app info recorded in the data.

There area a lot of irregular data entries - a whole lot! Imagine `Current Ver` having '*p*5.7.1' as an entry 😒. All these would be cleaned later.

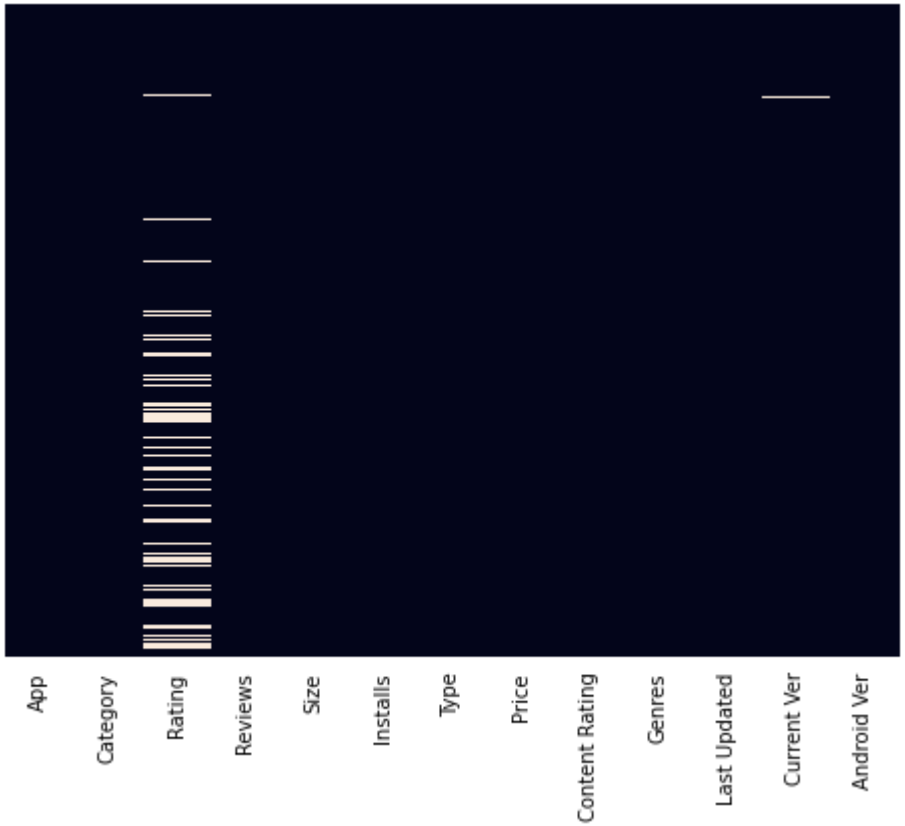
Most apps on Play Store (limited to our dataset) belong to the Family Category.

Most apps on Play Store (limited to our dataset) are free to download - they are not paid for.

In [ ]:
```
1
```

ii) Handling Missing Values.

In [5]:
```
fig, ax = plt.subplots(figsize=(8,6))
sns.heatmap(data.isnull(), cbar=False, ax=ax)
ax.set_yticks([]);
ax.tick_params(bottom='')
```



In [6]:
```
1 data.isna().sum()
```

Out[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
```

All object dtypes with missing values will be filled with the most occuring entry in their column (**mode**).

`Rating` , a float dtype will be filled with the **mean** of `Rating` column for the gerne each missing value belong to.

In [7]:
```
1 missing_obj_dtype_cols = ['Content Rating', 'Type', 'Current Ver', 'Android Ver']
2
3 for i in missing_obj_dtype_cols:
4
5     mode = stat.mode(data[i])
6
7     data[i] = data[i].fillna(mode)
```

In [8]:
```
1 avg_per_gerne = round(data.groupby('Genres').mean(), 1)
2 fill_to = avg_per_gerne.to_dict()['Rating']
3 data.Rating.index = data.Genres.values
4 data['Rating'] = pd.Series(data['Rating'].fillna(fill_to).values)
```

In [9]:
```
1 data.isnull().sum()
```

Out[9]:
```
App                0
Category           0
Rating             5
Reviews            0
Size               0
Installs           0
Type               0
Price              0
Content Rating     0
Genres             0
Last Updated       0
Current Ver        0
Android Ver        0
dtype: int64
```

What's with these redundant five nans 😓?!

Let's have a look 👩‍🦰.

In [10]:
```
redundant_data = data[data.Rating.isnull()]
redundant_data
```

Out[10]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Andr
23	Mcqueen Coloring pages	ART_AND_DESIGN	NaN	61	7.0M	100,000+	Free	0	Everyone	Art & Design;Action & Adventure	March 7, 2018	1.0.0	4.1 a
2111	Mcqueen Coloring pages	FAMILY	NaN	65	7.0M	100,000+	Free	0	Everyone	Art & Design;Action & Adventure	March 7, 2018	1.0.0	4.1 a
6829	Bu Hangi Firma?	FAMILY	NaN	8	26M	100+	Free	0	Everyone	Trivia;Education	December 10, 2017	3.3.6z	4. and
7629	Wuwu & Co.	FAMILY	NaN	9	77M	100+	Paid	$2.99	Everyone	Books & Reference;Creativity	March 22, 2017	2.49	4.1 a
9672	Masha and the Bear - Hair Salon and MakeUp Games	FAMILY	NaN	1	83M	100+	Paid	$2.49	Everyone	Role Playing;Education	March 5, 2018	1.0.1	4.1 a

Their genres belong to either 'Art & Design;Action & Adventure', 'Trivia;Education', 'Books & Reference;Creativity' or 'Role Playing;Education'.

Let's check for the values these keys belong to in the 'fill_to' dictionary.

In [11]:
```
1 fill_to.values()
```

Out[11]:
```
dict_values([4.3, 4.3, 4.2, 4.4, 4.6, 4.1, 4.3, 4.3, 4.5, 4.4, nan, 4.4, 3.9, 4.2, 4.3, 4.3, 4.0, 4.3, 4.8, 4.
3, nan, 4.2, 4.1, 4.1, 4.3, 4.4, 4.3, 4.2, 4.3, 4.5, 4.3, 4.3, 4.1, 4.2, 4.1, 4.8, 4.2, 4.2, 4.0, 4.3, 4.3, 4.
4, 4.3, 4.4, 4.2, 4.4, 3.9, 4.2, 4.2, 4.0, 4.2, 4.2, 4.1, 4.2, 4.3, 4.5, 4.4, 4.2, 4.0, 4.4, 19.0, 4.1, 4.2,
4.3, 3.9, 4.7, 4.2, 4.2, 4.1, 4.3, 4.0, 4.1, 4.2, 4.2, 4.3, 4.5, 4.1, 4.3, 3.8, 3.9, 4.3, 4.3, 4.2, 4.2, 4.4,
4.3, 4.4, 4.4, 4.6, 4.2, 4.3, 4.5, 4.3, 4.3, 4.3, nan, 4.0, 4.3, 4.2, 4.4, 4.4, 4.4, 4.3, 4.2, 4.4, 4.2, 4.6,
4.4, 4.5, 4.0, 4.5, 4.1, 4.1, 4.0, nan, 4.1, 4.1, 4.0, 4.2, 4.4])
```

In [12]:
```
1 fill_to['Trivia;Education']
```

Out[12]:
```
nan
```

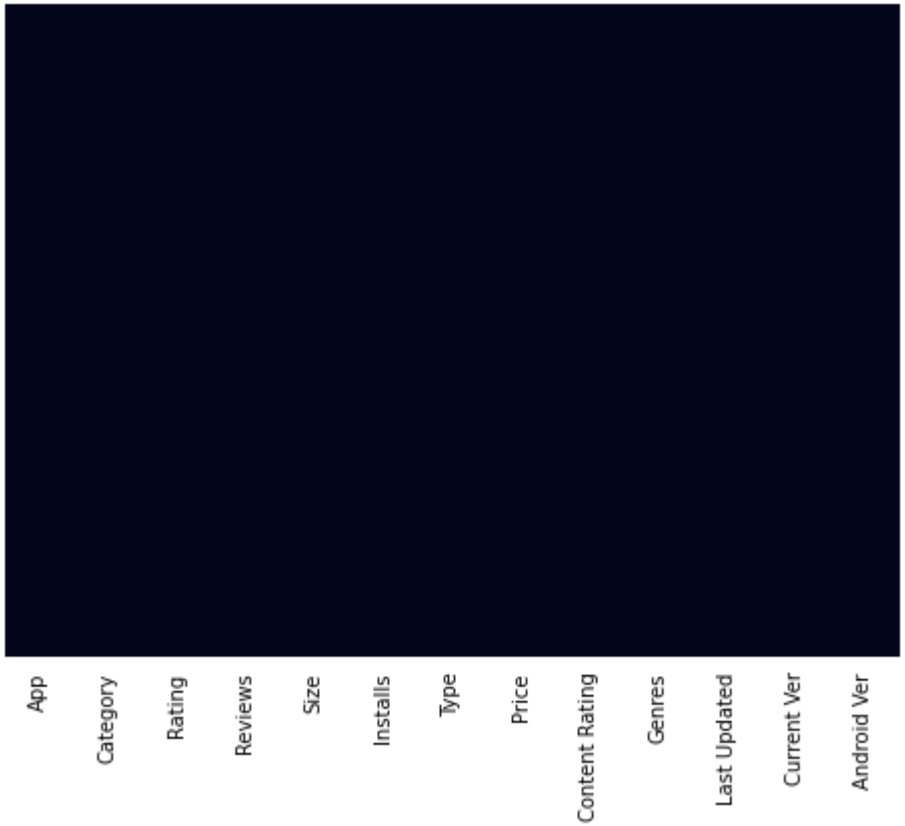
Smiles.The average value of these `Genres` was nan all along.

These missing values were *replaced* with a missing value! Hence, the missing value turned *redundant*.

There's nothing left to do than to drop these, or fill them with the overall mean 😊.

In [13]:
```
1 data['Rating'] = data['Rating'].fillna(data['Rating'].mean())
```

In [14]:
```
fig, ax = plt.subplots(figsize=(8,6))
sns.heatmap(data.isnull(), cbar=False, ax=ax)
ax.set_yticks([]);
ax.tick_params(bottom='')
```



In [15]:
```
1 data.isnull().sum()
```

Out[15]:
```
App             0
Category        0
Rating          0
Reviews         0
Size            0
Installs        0
Type            0
Price           0
Content Rating  0
Genres          0
Last Updated    0
Current Ver     0
Android Ver     0
dtype: int64
```

All done.

In [ ]:
```
1
```

iii) Cleaning Inconsistent Data Entries.

The dtypes of come columns would also be changed here.

In [16]:
```
1 data.sample(10)
```

Out[16]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver
9916	EU IP Codes	BOOKS_AND_REFERENCE	4.3	2	970k	100+	Free	0	Everyone	Books & Reference	January 8, 2014	1.0.4
5894	AZ Mobile Gizmo	BUSINESS	4.4	16	3.7M	1,000+	Free	0	Everyone	Business	April 2, 2018	3.4.4
7630	Dots & Co: A Puzzle Adventure	FAMILY	4.5	81001	85M	1,000,000+	Free	0	Everyone	Puzzle	April 27, 2018	2.15.2
3512	Dashlane Free Password Manager	PRODUCTIVITY	4.6	73695	Varies with device	1,000,000+	Free	0	Everyone	Productivity	August 6, 2018	Varies with device
7040	BZ Berner Zeitung E-Paper	NEWS_AND_MAGAZINES	4.1	4	Varies with device	1,000+	Free	0	Everyone	News & Magazines	July 30, 2018	5.1.1
959	Tubi TV - Free Movies & TV	ENTERTAINMENT	4.3	296771	11M	10,000,000+	Free	0	Teen	Entertainment	July 15, 2018	2.13.5
5683	SMS Au revoir	FAMILY	4.1	17	1.7M	5,000+	Free	0	Everyone	Entertainment	January 15, 2018	2.0.0
7366	usgang.ch	LIFESTYLE	3.7	492	Varies with device	100,000+	Free	0	Everyone 10+	Lifestyle	June 11, 2018	3.0.7
6609	Blood Pressure Diary	FAMILY	4.6	47	3.3M	5,000+	Free	0	Everyone	Simulation	August 1, 2018	1.1
3675	VLC for Android	VIDEO_PLAYERS	4.4	1032076	Varies with device	100,000,000+	Free	0	Everyone	Video Players & Editors	July 30, 2018	Varies with device

`App` : Seems normal. Anyone could name their app anything.

`Category` : I'd love to remove these 'harmless' underscores. Besides, there could be meaningless or repeated categories. We'd check for this too.

`Rating` : Perfectly filled 😍!

`Reviews` : Hmmm, I'm unsure it's perfect. We'd try converting them to integers to be sure. Having a ValueError means the column needs cleaning.

`Size` : Nicely filled 🙂. We'd still check to be sure.

`Installs` : Normal. We'd still check to be sure.

`Type` : Normal too. We'd still check to be sure.

`Price` : We'd remove the dollar sign, change its dtype to float and rename it.

`Content Rating` : I found something strange here. See below:

In [17]:
```
# Here's just one occurence.

data.iloc[141:142]
```

Out[17]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
141	Download free book with green book	BOOKS_AND_REFERENCE	4.6	4478	9.5M	100,000+	Free	0	Everyone 10+	Books & Reference	July 31, 2017	1.1	4.0 and up

'Everyone 10+'.

Downloading the game is restricted to those 10 or above. Why then, should Everyone be included? For all occurences similar to this, we'd remove Everyone from there. We'd also check other values to be sure.

`Genre` : Seems normal. We'd check to be sure.

`Last Updated` : This would be converted to datetime.

`Current Ver` : Looks nice. We'd still check to be sure.

`Android Ver` : Very perfect, but we'd still check to be sure 😊.

In [18]:
```
# Category.

data['Category'] = data['Category'].str.replace('_',' ')

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

Out[18]:
```
array(['ART AND DESIGN', 'AUTO AND VEHICLES', 'BEAUTY',
       'BOOKS AND REFERENCE', 'BUSINESS', 'COMICS', 'COMMUNICATION',
       'DATING', 'EDUCATION', 'ENTERTAINMENT', 'EVENTS', 'FINANCE',
       'FOOD AND DRINK', 'HEALTH AND FITNESS', 'HOUSE AND HOME',
       'LIBRARIES AND DEMO', 'LIFESTYLE', 'GAME', 'FAMILY', 'MEDICAL',
       'SOCIAL', 'SHOPPING', 'PHOTOGRAPHY', 'SPORTS', 'TRAVEL AND LOCAL',
       'TOOLS', 'PERSONALIZATION', 'PRODUCTIVITY', 'PARENTING', 'WEATHER',
       'VIDEO PLAYERS', 'NEWS AND MAGAZINES', 'MAPS AND NAVIGATION',
       '1.9'], dtype=object)
```

The last element in the output above seems off.

Let's peep at the whole data of rows with their category being '1.9'.

In [19]:
```
data[data['Category']=='1.9']
```

Out[19]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
10472	Life Made WI-Fi Touchscreen Photo Frame	1.9	19.0	3.0M	1,000+	Free	0	Everyone	Everyone	February 11, 2018	1.0.19	4.0 and up	4.1 and up

Wow!

1. ***Its categoty is numerical.***
2. ***Its rating is above 5.***
3. ***`Last Updated` is a datetype, but its has a perplexing entry itself.***

4. Its gerne is 'February 11, 2018' - an odd value.
5. Its type is odd as well.
6. While most of the entries in `Reviews` are integers, this one chose to be 3.0M.

I better drop this entire row, or what do you think 😊?

In [20]:
```
data = data.drop(10472)
```

In [21]:
```
# Reviews
data['Reviews'] = data['Reviews'].astype('int')
```

No ValueError, nice 😍!

In [22]:
```
# Size
data['Size'].unique()
```

Out[22]:
```
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)
```

As expected, everything seems alright.

In [23]:
```
# Installs
data['Installs'].unique()
```

Out[23]:
```
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)
```

As expected, everything seems alright here too.

In [24]:
```
# Type
data['Type'].unique()
```

Out[24]:
```
array(['Free', 'Paid'], dtype=object)
```

Nice!

In [25]:
```
# Price
data['Price'] = data['Price'].str.replace('$', '')

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

Nice!

In [26]:
```
# Coontent Rating
absurd = data[data['Content Rating'].str.contains('Everyone ')]
absurd
# Checks for those that had more than just 'Everyone'as an entry.
```

Out[26]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
22	Superheroes Wallpapers | 4K Backgrounds	ART AND DESIGN	4.7	7699	4.2M	500,000+	Free	0.0	Everyone 10+	Art & Design	July 12, 2018	2.2.6.2	4.0.3 and up
77	Police Detector (Speed Camera Radar)	AUTO AND VEHICLES	4.3	3574	3.9M	1,000,000+	Free	0.0	Everyone 10+	Auto & Vehicles	July 4, 2018	1.6	4.0 and up
113	Wrinkles and rejuvenation	BEAUTY	4.3	182	5.7M	100,000+	Free	0.0	Everyone 10+	Beauty	September 20, 2017	8.0	3.0 and up
130	Recipes and tips for losing weight	BEAUTY	4.3	35	3.1M	10,000+	Free	0.0	Everyone 10+	Beauty	December 11, 2017	2.0	3.0 and up
141	Download free book with green book	BOOKS AND REFERENCE	4.6	4478	9.5M	100,000+	Free	0.0	Everyone 10+	Books & Reference	July 31, 2017	1.1	4.0 and up
...	...	...	...	...	...	...	...	...	...	...	...	...	...
10419	Fast Motorcycle Driver 2016	GAME	4.2	28151	49M	1,000,000+	Free	0.0	Everyone 10+	Racing	December 25, 2016	1.2	2.3.3 and up
10639	Florida Today	NEWS AND MAGAZINES	3.3	202	38M	10,000+	Free	0.0	Everyone 10+	News & Magazines	June 20, 2018	5.9.5	5.0 and up
10779	Fortune Quest: Savior	FAMILY	3.6	135	75M	10,000+	Free	0.0	Everyone 10+	Role Playing	June 1, 2018	1.022	4.4 and up
10784	Big Hunter	GAME	4.3	245455	84M	10,000,000+	Free	0.0	Everyone 10+	Action	May 31, 2018	2.8.6	4.0 and up
10789	Modern Counter Global Strike 3D V2	GAME	4.0	368	48M	50,000+	Free	0.0	Everyone 10+	Action	March 28, 2018	1.7	4.1 and up

414 rows × 13 columns

In [27]:
```
absurd['Content Rating'].unique() # Checks if there are other categories of Content Rating. E.g 'Everyone 2
```

Out[27]:
```
array(['Everyone 10+'], dtype=object)
```

WOW!

More than 400 rows are *'absurd'*.

In [28]:
```
data['Content Rating'] = data['Content Rating'].str.replace('Everyone 10', '10')

data['Content Rating'].value_counts()
```

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

Oh, wow, 'Unrated' should also fall under 'Everyone', don't you think?

In [29]:
```
data['Content Rating'] = data['Content Rating'].str.replace('Unrated', 'Everyone')

data['Content Rating'].value_counts()
```

Out[29]:
```
Everyone           8716
Teen               1208
Mature 17+          499
10+                 414
Adults only 18+       3
Name: Content Rating, dtype: int64
```

In [30]:
```
# Genres
data['Genres'].unique()
```

Out[30]:
```
array(['Art & Design', 'Art & Design;Pretend Play',
       'Art & Design;Creativity', 'Art & Design;Action & Adventure',
       'Auto & Vehicles', 'Beauty', 'Books & Reference', 'Business',
       'Comics', 'Comics;Creativity', 'Communication', 'Dating',
       'Education;Education', 'Education', 'Education;Creativity',
       'Education;Music & Video', 'Education;Action & Adventure',
       'Education;Pretend Play', 'Education;Brain Games', 'Entertainment',
       'Entertainment;Music & Video', 'Entertainment;Brain Games',
       'Entertainment;Creativity', 'Events', 'Finance', 'Food & Drink',
       'Health & Fitness', 'House & Home', 'Libraries & Demo',
       'Lifestyle', 'Lifestyle;Pretend Play',
       'Adventure;Action & Adventure', 'Arcade', 'Casual', 'Card',
       'Casual;Pretend Play', 'Action', 'Strategy', 'Puzzle', 'Sports',
       'Music', 'Word', 'Racing', 'Casual;Creativity',
       'Casual;Action & Adventure', 'Simulation', 'Adventure', 'Board',
       'Trivia', 'Role Playing', 'Simulation;Education',
       'Action;Action & Adventure', 'Casual;Brain Games',
       'Simulation;Action & Adventure', 'Educational;Creativity',
       'Puzzle;Brain Games', 'Educational;Education', 'Card;Brain Games',
       'Educational;Brain Games', 'Educational;Pretend Play',
       'Entertainment;Education', 'Casual;Education',
       'Music;Music & Video', 'Racing;Action & Adventure',
       'Arcade;Pretend Play', 'Role Playing;Action & Adventure',
       'Simulation;Pretend Play', 'Puzzle;Creativity',
       'Sports;Action & Adventure', 'Educational;Action & Adventure',
       'Arcade;Action & Adventure', 'Entertainment;Action & Adventure',
       'Puzzle;Action & Adventure', 'Strategy;Action & Adventure',
       'Music & Audio;Music & Video', 'Health & Fitness;Education',
       'Adventure;Education', 'Board;Brain Games',
       'Board;Action & Adventure', 'Board;Pretend Play',
       'Casual;Music & Video', 'Role Playing;Pretend Play',
       'Entertainment;Pretend Play', 'Video Players & Editors;Creativity',
       'Card;Action & Adventure', 'Medical', 'Social', 'Shopping',
       'Photography', 'Travel & Local',
       'Travel & Local;Action & Adventure', 'Tools', 'Tools;Education',
       'Personalization', 'Productivity', 'Parenting',
       'Parenting;Music & Video', 'Parenting;Education',
       'Parenting;Brain Games', 'Weather', 'Video Players & Editors',
       'Video Players & Editors;Music & Video', 'News & Magazines',
       'Maps & Navigation', 'Health & Fitness;Action & Adventure',
```

```
'Educational', 'Casino', 'Adventure;Brain Games',
'Trivia;Education', 'Lifestyle;Education',
'Books & Reference;Creativity', 'Books & Reference;Education',
'Puzzle;Education', 'Role Playing;Education',
'Role Playing;Brain Games', 'Strategy;Education',
'Racing;Pretend Play', 'Communication;Creativity',
'Strategy;Creativity'], dtype=object)
```

Seems so dirty 😒.

Let's have a closer peep.

In [31]:
```
1 data['Genres'].value_counts()[:20]
```

Out[31]:
```
Tools                842
Entertainment        623
Education            549
Medical              463
Business             460
Productivity         424
Sports               398
Personalization      392
Communication        387
Lifestyle            381
Finance              366
Action               365
Health & Fitness     341
Photography          335
Social               295
News & Magazines     283
Shopping             260
Travel & Local       257
Dating               234
Books & Reference    231
Name: Genres, dtype: int64
```

Of 117 unique values, the first 20 seem ideal.

In [32]:
```
1 data['Genres'].value_counts()[20:40]
```

Out[32]:
```
Arcade                   220
Simulation               200
Casual                   193
Video Players & Editors  173
Puzzle                   140
Maps & Navigation        137
Food & Drink             127
Role Playing             109
Strategy                 107
Racing                    98
House & Home              88
Libraries & Demo          85
Auto & Vehicles           85
Weather                   82
Adventure                 75
Events                    64
Comics                    59
Art & Design              58
Beauty                    53
Education;Education       50
Name: Genres, dtype: int64
```

Yet nice.

In [33]:
```
1 data['Genres'].value_counts()[40:60]
```

Out[33]:
```
Card                          48
Parenting                     46
Board                         44
Educational;Education         41
Casino                        39
Trivia                        38
Educational                   37
Casual;Pretend Play           31
Word                          29
Entertainment;Music & Video   27
Education;Pretend Play        23
Music                         22
Casual;Action & Adventure     21
Racing;Action & Adventure     20
Puzzle;Brain Games            19
Educational;Pretend Play      19
Action;Action & Adventure     17
Arcade;Action & Adventure     16
Board;Brain Games             15
Casual;Brain Games            13
Name: Genres, dtype: int64
```

Up till music, everything seems perfect. 'Puzzle;Brain Games' should not be a separate gerne, but should be merged with 'Puzzle'. The same goes for the rest, downwards.

In [34]:
```
1 data['Genres'].value_counts()[60:]
```

Out[34]:
```
Adventure;Action & Adventure             13
Simulation;Action & Adventure            11
Entertainment;Brain Games                 8
Art & Design;Creativity                   7
Education;Creativity                      7
Casual;Creativity                         7
Role Playing;Action & Adventure           7
Parenting;Education                       7
Educational;Brain Games                   6
Education;Action & Adventure              6
Parenting;Music & Video                   6
Education;Brain Games                     5
Educational;Creativity                    5
Puzzle;Action & Adventure                 5
Role Playing;Pretend Play                 5
Education;Music & Video                   5
Educational;Action & Adventure            4
Simulation;Pretend Play                   4
Sports;Action & Adventure                 4
Entertainment;Creativity                  3
Video Players & Editors;Music & Video     3
Simulation;Education                      3
Music;Music & Video                       3
Casual;Education                          3
Board;Action & Adventure                  3
Entertainment;Action & Adventure          3
Strategy;Action & Adventure               2
Books & Reference;Education               2
Art & Design;Pretend Play                 2
Art & Design;Action & Adventure           2
Video Players & Editors;Creativity        2
Puzzle;Creativity                         2
Entertainment;Pretend Play                2
Casual;Music & Video                      2
Adventure;Education                       2
Card;Action & Adventure                   2
Adventure;Brain Games                     1
Communication;Creativity                  1
Racing;Pretend Play                       1
Strategy;Education                        1
Role Playing;Brain Games                  1
```

```
Role Playing;Education                  1
Puzzle;Education                        1
Books & Reference;Creativity            1
Lifestyle;Education                     1
Trivia;Education                        1
Health & Fitness;Education              1
Music & Audio;Music & Video             1
Board;Pretend Play                      1
Health & Fitness;Action & Adventure     1
Comics;Creativity                       1
Entertainment;Education                 1
Card;Brain Games                        1
Arcade;Pretend Play                     1
Parenting;Brain Games                   1
Travel & Local;Action & Adventure       1
Lifestyle;Pretend Play                  1
Tools;Education                         1
Strategy;Creativity                     1
Name: Genres, dtype: int64
```

Trend:

The genre is the word just before the semi-colon. This can be extracted.

In [35]:
```
data['Genres'] = data['Genres'].str.replace(r';[a-z &]*','', flags = re.I)
```

Let's confirm what we've done.

In [36]:
```
1 data['Genres'].value_counts()
```

Out[36]:

Tools	843
Entertainment	667
Education	645
Medical	463
Business	460
Productivity	424
Sports	402
Personalization	392
Communication	388
Lifestyle	383
Action	382
Finance	366
Health & Fitness	343
Photography	335
Social	295
News & Magazines	283
Casual	270
Shopping	260
Travel & Local	258
Arcade	237
Books & Reference	234
Dating	234
Simulation	218
Video Players & Editors	178
Puzzle	167
Maps & Navigation	137
Food & Drink	127
Role Playing	123
Racing	119
Educational	112
Strategy	111
Adventure	91
House & Home	88
Auto & Vehicles	85
Libraries & Demo	85
Weather	82
Art & Design	69
Events	64
Board	63
Parenting	60
Comics	60

```
Beauty                      53
Card                        51
Trivia                      39
Casino                      39
Word                        29
Music                       25
Music & Audio                1
Name: Genres, dtype: int64
```

Educational should be merged with Education

Music & Audio should be merged with Music.

In [37]:
```
data['Genres'] = data['Genres'].str.replace('Educational','Education').str.replace('Music & Audio','Music')
data['Genres'].unique()
```

Out[37]:
```
array(['Art & Design', 'Auto & Vehicles', 'Beauty', 'Books & Reference',
       'Business', 'Comics', 'Communication', 'Dating', 'Education',
       'Entertainment', 'Events', 'Finance', 'Food & Drink',
       'Health & Fitness', 'House & Home', 'Libraries & Demo',
       'Lifestyle', 'Adventure', 'Arcade', 'Casual', 'Card', 'Action',
       'Strategy', 'Puzzle', 'Sports', 'Music', 'Word', 'Racing',
       'Simulation', 'Board', 'Trivia', 'Role Playing',
       'Video Players & Editors', 'Medical', 'Social', 'Shopping',
       'Photography', 'Travel & Local', 'Tools', 'Personalization',
       'Productivity', 'Parenting', 'Weather', 'News & Magazines',
       'Maps & Navigation', 'Casino'], dtype=object)
```

Nice.

In [38]:
```
# Last Updated
data['Last Updated'] = pd.to_datetime(data['Last Updated'])
```

There is an inconsistent data entry here. We'd deal with that later for some reason.

In [39]:
```
1 data['Android Ver'].unique()
```

Out[39]:
```
array(['4.0.3 and up', '4.2 and up', '4.4 and up', '2.3 and up',
       '3.0 and up', '4.1 and up', '4.0 and up', '2.3.3 and up',
       'Varies with device', '2.2 and up', '5.0 and up', '6.0 and up',
       '1.6 and up', '1.5 and up', '2.1 and up', '7.0 and up',
       '5.1 and up', '4.3 and up', '4.0.3 - 7.1.1', '2.0 and up',
       '3.2 and up', '4.4W and up', '7.1 and up', '7.0 - 7.1.1',
       '8.0 and up', '5.0 - 8.0', '3.1 and up', '2.0.1 and up',
       '4.1 - 7.1.1', '5.0 - 6.0', '1.0 and up', '2.2 - 7.1.1',
       '5.0 - 7.1.1'], dtype=object)
```

I can spot '4.4W and up' here. I believe the W there should be erased.

In [40]:
```
1 data['Android Ver'] = data['Android Ver'].str.replace('W','')
```

Confirm it's done:

In [41]:
```
1 data['Android Ver'].unique()
```

Out[41]:
```
array(['4.0.3 and up', '4.2 and up', '4.4 and up', '2.3 and up',
       '3.0 and up', '4.1 and up', '4.0 and up', '2.3.3 and up',
       'Varies with device', '2.2 and up', '5.0 and up', '6.0 and up',
       '1.6 and up', '1.5 and up', '2.1 and up', '7.0 and up',
       '5.1 and up', '4.3 and up', '4.0.3 - 7.1.1', '2.0 and up',
       '3.2 and up', '7.1 and up', '7.0 - 7.1.1', '8.0 and up',
       '5.0 - 8.0', '3.1 and up', '2.0.1 and up', '4.1 - 7.1.1',
       '5.0 - 6.0', '1.0 and up', '2.2 - 7.1.1', '5.0 - 7.1.1'],
      dtype=object)
```

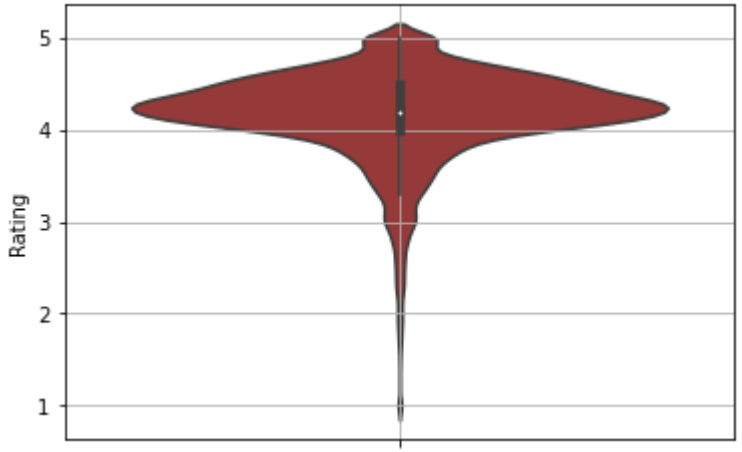
All done.

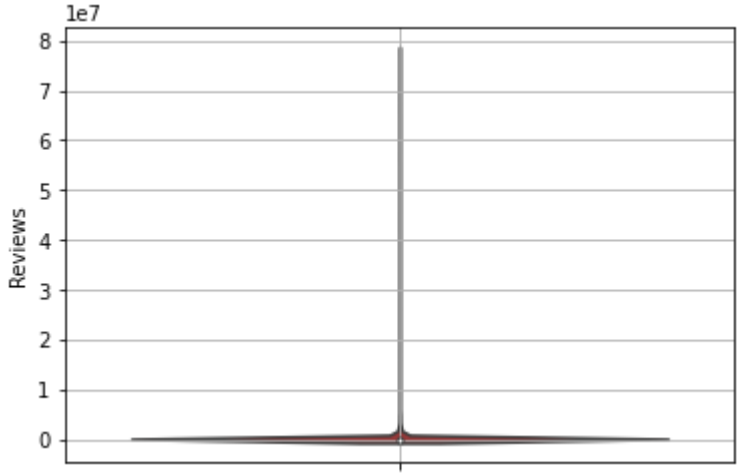
In [ ]:
```
1
```

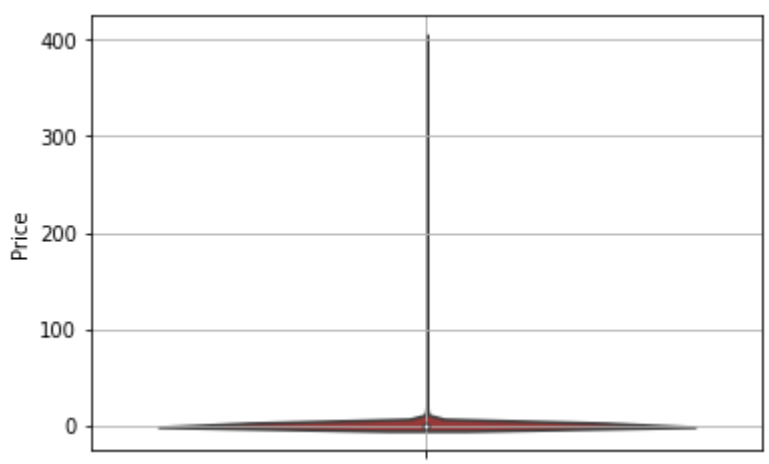
iv) Removing Outliers, if any.

This can only be done with numerical columns.

In [121]:
```
for i in data.select_dtypes(['int', 'float']):
    sns.violinplot(y = data[i], color = 'brown')
    plt.grid()
    plt.show()
```







They all seems to be without 'outliers' since they are all within resonable ranges.

All done.

In [ ]:
```
1
```

Further Data Cleaning.

App is expected to be unique throughout, but it isn't. We'd deal with that here.

In [43]:
```
# Before dropping
Apps = data['App'].value_counts()
Apps[Apps>1]
```

Out[43]:
```
ROBLOX                                               9
CBS Sports App - Scores, News, Stats & Watch Live    8
ESPN                                                 7
Duolingo: Learn Languages Free                       7
Candy Crush Saga                                     7
                                                    ..
Transenger – Ts Dating and Chat for Free             2
Random Video Chat                                    2
Clover Dating App                                    2
Docs To Go™ Free Office Suite                        2
English Dictionary - Offline                         2
Name: App, Length: 798, dtype: int64
```

Wow there are almost 800 apps repeated.

Let's check a few of them.

In [44]:
```
1 data[data.App=='ROBLOX']
```

Out[44]:

	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	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
1701	ROBLOX	GAME	4.5	4447346	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
1748	ROBLOX	GAME	4.5	4448791	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
1841	ROBLOX	GAME	4.5	4449882	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
1870	ROBLOX	GAME	4.5	4449910	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
2016	ROBLOX	FAMILY	4.5	4449910	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
2088	ROBLOX	FAMILY	4.5	4450855	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
2206	ROBLOX	FAMILY	4.5	4450890	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up
4527	ROBLOX	FAMILY	4.5	4443407	67M	100,000,000+	Free	0.0	10+	Adventure	2018-07-31	2.347.225742	4.1 and up

This is definitely a duplicate!

In [45]:
```
1 data[data.App=='ESPN']
```

Out[45]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
2959	ESPN	SPORTS	4.2	521138	Varies with device	10,000,000+	Free	0.0	10+	Sports	2018-07-19	Varies with device	5.0 and up
3010	ESPN	SPORTS	4.2	521138	Varies with device	10,000,000+	Free	0.0	10+	Sports	2018-07-19	Varies with device	5.0 and up
3018	ESPN	SPORTS	4.2	521138	Varies with device	10,000,000+	Free	0.0	10+	Sports	2018-07-19	Varies with device	5.0 and up
3048	ESPN	SPORTS	4.2	521140	Varies with device	10,000,000+	Free	0.0	10+	Sports	2018-07-19	Varies with device	5.0 and up
3060	ESPN	SPORTS	4.2	521140	Varies with device	10,000,000+	Free	0.0	10+	Sports	2018-07-19	Varies with device	5.0 and up
3072	ESPN	SPORTS	4.2	521140	Varies with device	10,000,000+	Free	0.0	10+	Sports	2018-07-19	Varies with device	5.0 and up
4069	ESPN	SPORTS	4.2	521081	Varies with device	10,000,000+	Free	0.0	10+	Sports	2018-07-19	Varies with device	5.0 and up

This, as well.

In [46]:
```
1 data[data.App == 'Clover Dating App']
```

Out[46]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
495	Clover Dating App	DATING	4.1	11633	23M	500,000+	Free	0.0	Mature 17+	Dating	2018-07-24	2.5.1	4.1 and up
550	Clover Dating App	DATING	4.1	11633	23M	500,000+	Free	0.0	Mature 17+	Dating	2018-07-24	2.5.1	4.1 and up

This too.

It would not be too much if an assumption to say that those 798 apps were duplicated when gathering the data.

I'd, therefore, be dropping duplicates.

In [47]:
```
# Before dropping
data.shape
```

Out[47]:
```
(10840, 13)
```

In [48]:
```
duplicate = data[data.App.duplicated()]
duplicate
```

Out[48]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Curren
229	Quick PDF Scanner + OCR FREE	BUSINESS	4.2	80805	Varies with device	5,000,000+	Free	0.0	Everyone	Business	2018-02-26	Varies with d
236	Box	BUSINESS	4.2	159872	Varies with device	10,000,000+	Free	0.0	Everyone	Business	2018-07-31	Varies with d
239	Google My Business	BUSINESS	4.4	70991	Varies with device	5,000,000+	Free	0.0	Everyone	Business	2018-07-24	2.19.0.20453
256	ZOOM Cloud Meetings	BUSINESS	4.4	31614	37M	10,000,000+	Free	0.0	Everyone	Business	2018-07-20	4.1.28165.
261	join.me - Simple Meetings	BUSINESS	4.0	6989	Varies with device	1,000,000+	Free	0.0	Everyone	Business	2018-07-16	4.3.(
...	...	...	...	...	...	...	...	...	...	...	...	
10715	FarmersOnly Dating	DATING	3.0	1145	1.4M	100,000+	Free	0.0	Mature 17+	Dating	2016-02-25	
10720	Firefox Focus: The privacy browser	COMMUNICATION	4.4	36981	4.0M	1,000,000+	Free	0.0	Everyone	Communication	2018-07-06	
10730	FP Notebook	MEDICAL	4.5	410	60M	50,000+	Free	0.0	Everyone	Medical	2018-03-24	2.1.(
10753	Slickdeals: Coupons & Shopping	SHOPPING	4.5	33599	12M	1,000,000+	Free	0.0	Everyone	Shopping	2018-07-30	
10768	AAFP	MEDICAL	3.8	63	24M	10,000+	Free	0.0	Everyone	Medical	2018-06-22	

1181 rows × 13 columns

In [49]:
```
data = data.drop(duplicate.index)
```

In [50]:
```
# After dropping
data.shape
```

Out[50]: (9659, 13)

In [51]:
```
# After dropping
Apps = data['App'].value_counts()
Apps[Apps>1]
```

Out[51]: Series([], Name: App, dtype: int64)

Data Cleaned.

I'd go ahead and save the cleaned version of it.

In [52]:
```
data.to_csv('CLEANED Playstore App Dataset.csv')
```

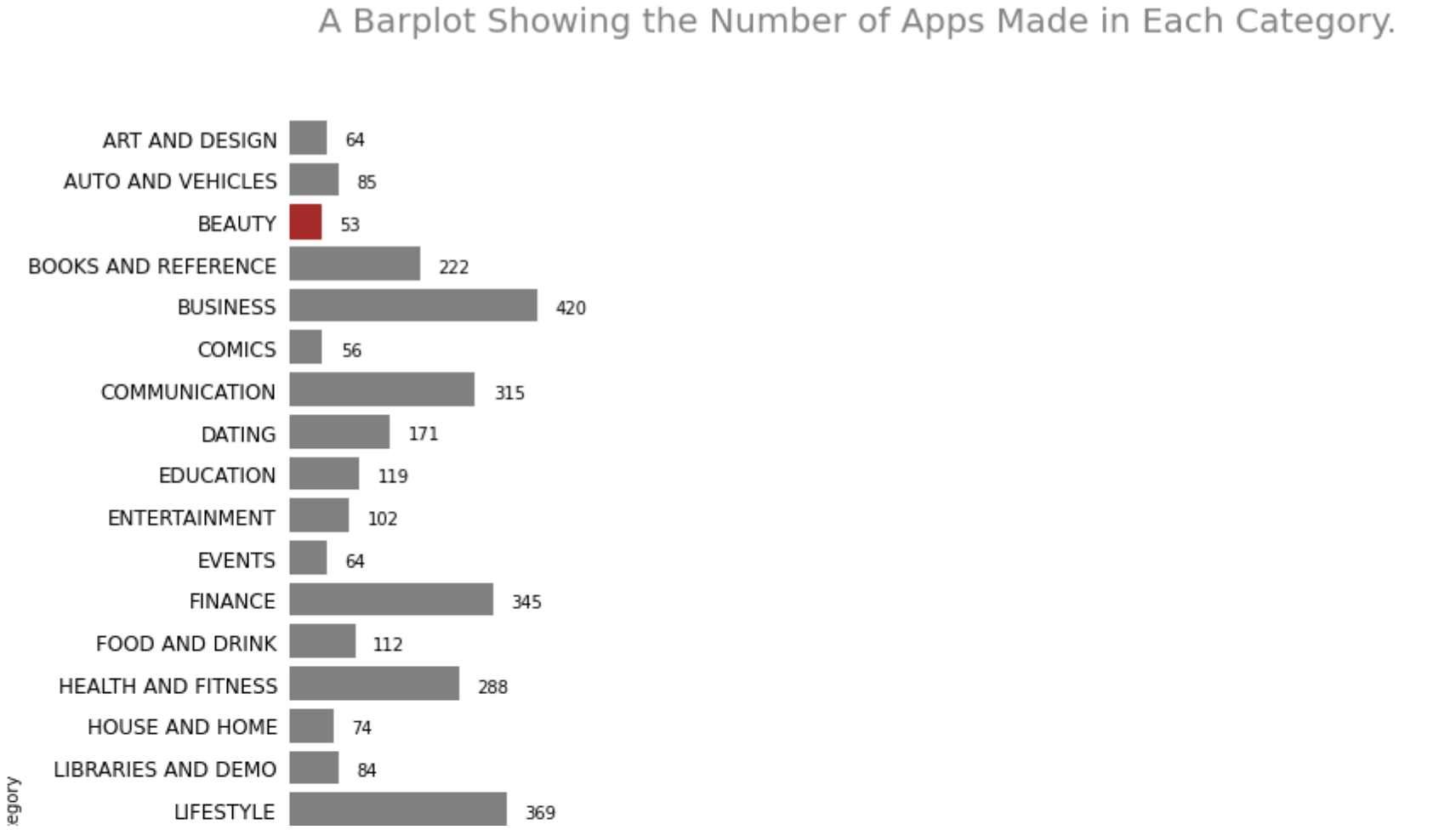
In [ ]:
```

```

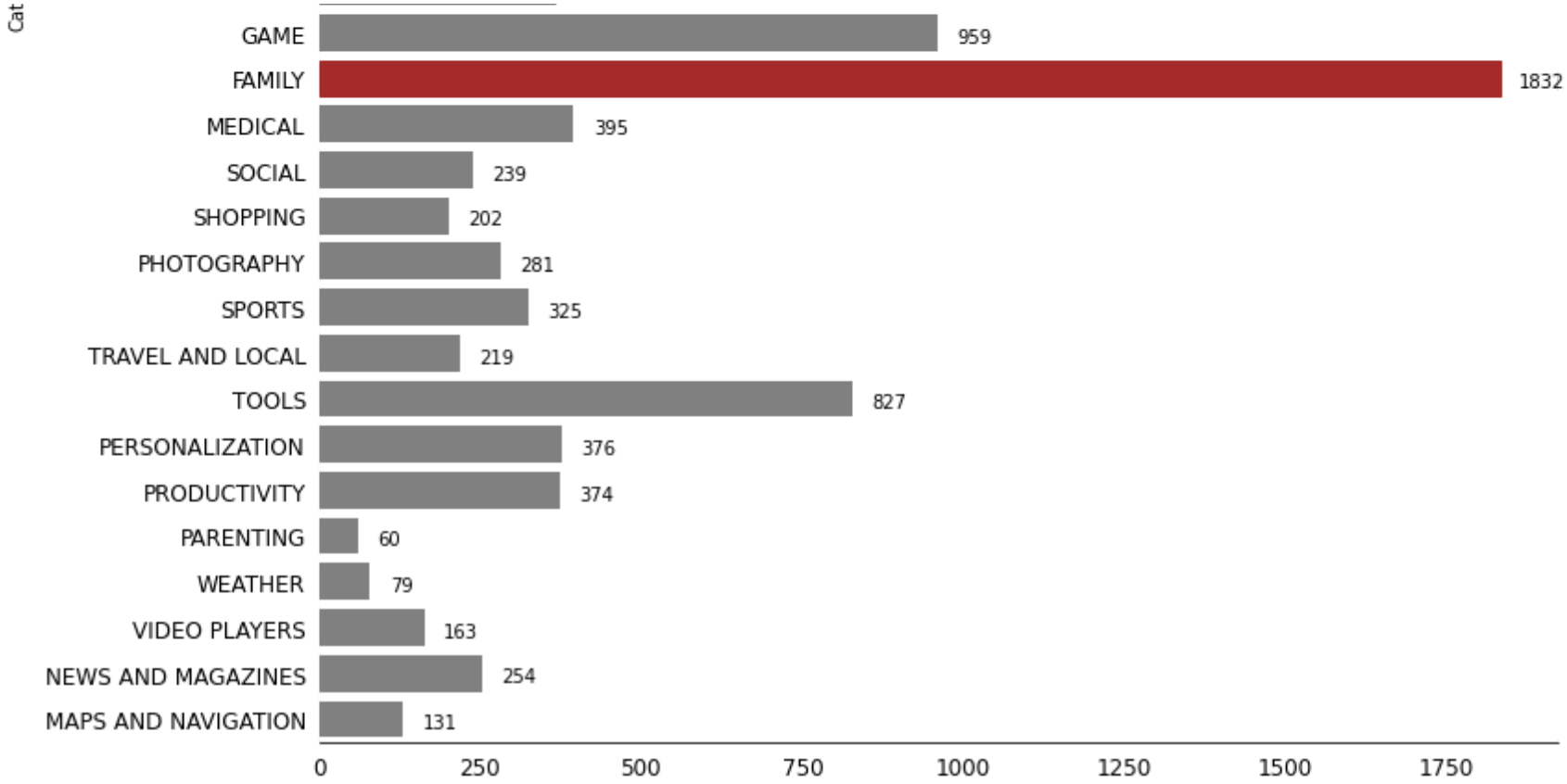
In [ ]:
```

```

Section 2: Exploratory Data Analysis.

Google Play Store has a whole lot of category. I'm curious to know which category most of the apps there fall to.

In [53]:
```
fig, ax = plt.subplots(figsize=(12,15))
plot = sns.countplot(y = data['Category'], ax=ax, color = 'grey')
for i in plot.patches:
    plot.annotate(i.get_width(), (i.get_width()+30, i.get_y()+0.6))
    if i.get_width()==data['Category'].value_counts().max():
        i.set_color('brown')
    if i.get_width()==data['Category'].value_counts().min():
        i.set_color('brown')
for i in ['left', 'right', 'top']:
    ax.spines[i].set_visible(False)
ax.tick_params(bottom = False, left = False, labelsize = 'large')
plt.xlabel('')
plt.title('A Barplot Showing the Number of Apps Made in Each Category.\n\n',fontsize = 20, color = 'grey');
```





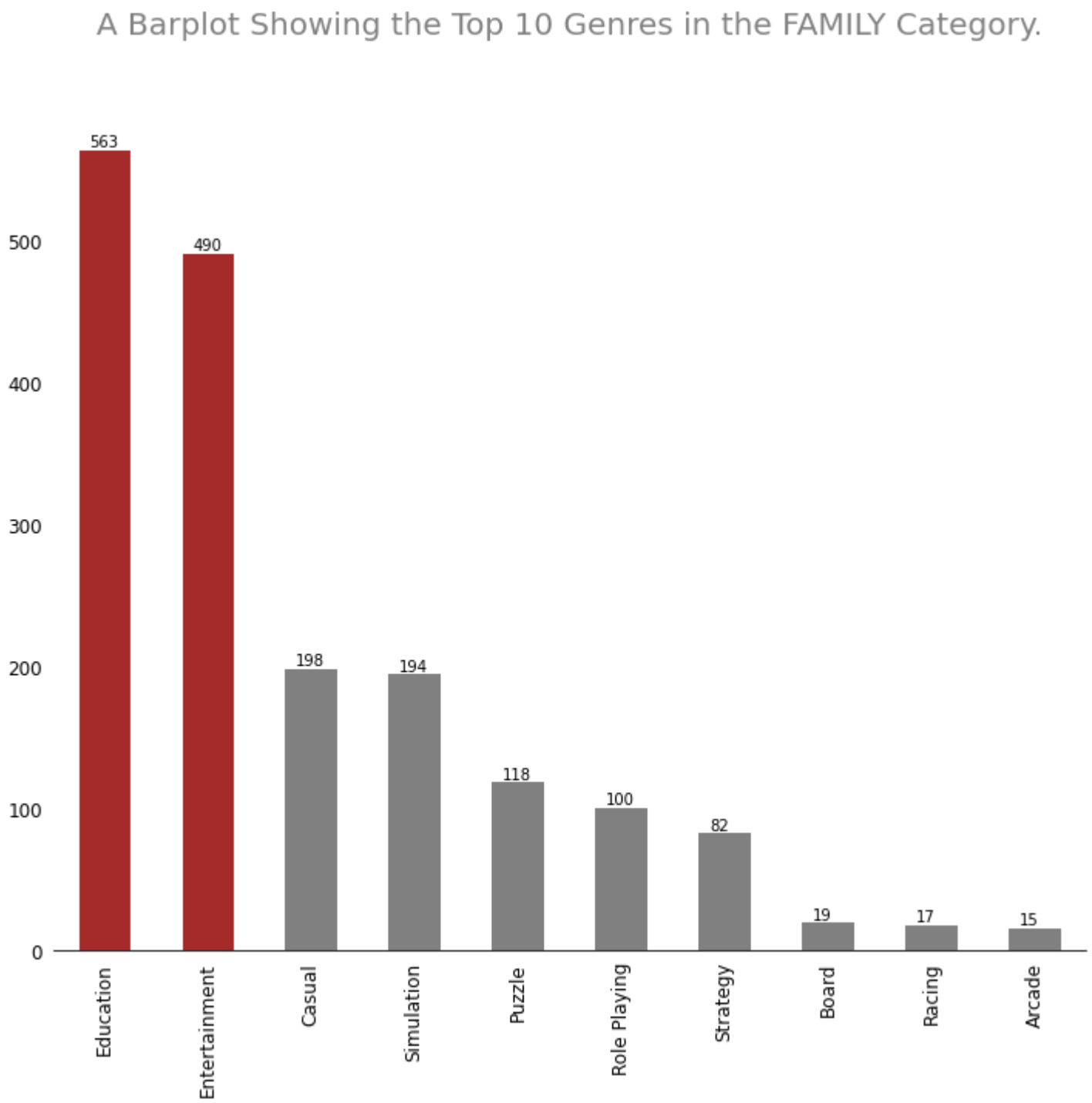
Family!

Most of the Google Play Store Apps are of the Family category, while the least is Comics.

Of the Family Category, which genre (sub-category) is the most famous?

In [54]:

```
fig, ax = plt.subplots(figsize=(12,10))
Family_genre = data['Genres'][data['Category']=='FAMILY']

plott = Family_genre.value_counts()[:10].plot.bar(color=['brown','brown','grey','grey','grey','grey','grey'

for i in plott.patches:
    plott.annotate(i.get_height(), (i.get_x()+0.1, i.get_height()+3))

for i in ['left', 'right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelsize = 'large')

plt.xlabel('')
plt.title('A Barplot Showing the Top 10 Genres in the FAMILY Category.\n\n',fontsize = 20, color = 'grey');
```

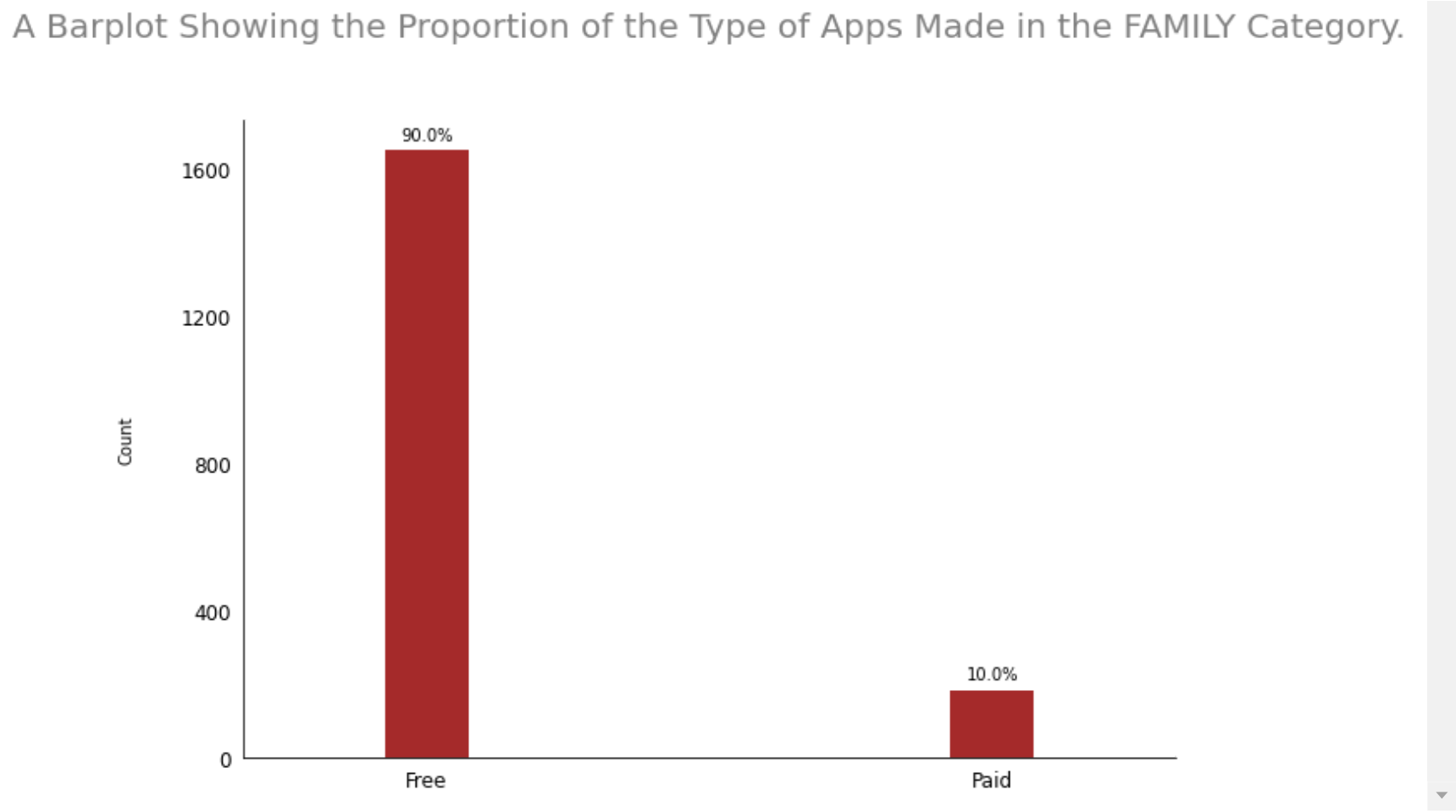

A Barplot Showing the Top 10 Genres in the FAMILY Category.
563
490
198
194
118
100
82
19
17
15
500
400
300
200
100
0
Education
Entertainment
Casual
Simulation
Puzzle
Role Playing
Strategy
Board
Racing
Arcade

"Around the world today, a larger fraction of developers are developing apps in the Family Category to majorly educate or entertain them." - Our data just revealed this to us!

Do they sell most of their apps or place them for free?

In [55]:

```
Family_Type = data['Type'][data['Category']=='FAMILY']
fig, ax = plt.subplots(figsize=(10,7))
plott = Family_Type.value_counts().plot.bar(color = 'brown', width = .15)

for i in ['right', 'top']:
    ax.spines[i].set_visible(False)

for i in plott.patches:
    plott.annotate('{}%'.format(round(i.get_height()/len(Family_Type)*100)), (i.get_x()+0.03, i.get_height(

ax.tick_params(bottom = False, left = False, labelsize = 'large', rotation = 0)

plt.ylabel('Count\n\n')
plt.yticks([0,400,800,1200,1600])
plt.title('A Barplot Showing the Proportion of the Type of Apps Made in the FAMILY Category.\n\n',fontsize
```



A whole lot of the apps made under this 'popular' category are free! Infact, most apps from our data are free to download.

In [ ]:
```
1
```

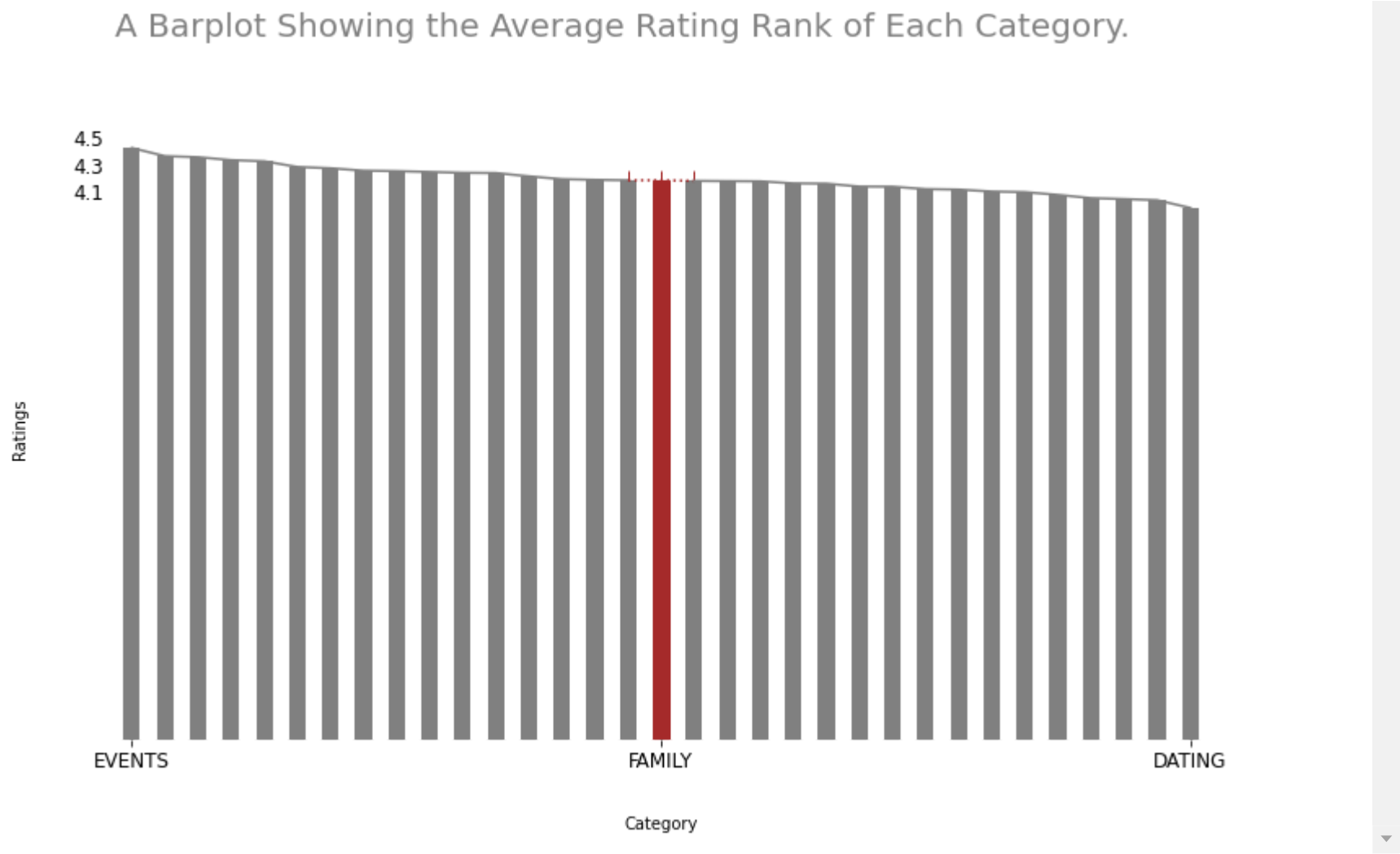
Do they get a high rating for their apps, compared to other categories?

In [56]:
```
Family_Rating = data['Rating'].groupby(data['Category']).mean().sort_values(ascending = False)
Family_Rating
```

Out[56]:
```
Category
EVENTS                 4.425000
EDUCATION              4.363866
ART AND DESIGN         4.356106
BOOKS AND REFERENCE    4.334234
PERSONALIZATION        4.325532
BEAUTY                 4.283019
PARENTING              4.273333
SOCIAL                 4.255230
HEALTH AND FITNESS     4.251736
GAME                   4.245464
WEATHER                4.239241
SHOPPING               4.237624
SPORTS                 4.212923
AUTO AND VEHICLES      4.191765
PRODUCTIVITY           4.186631
LIBRARIES AND DEMO     4.183333
FAMILY                 4.183173
COMICS                 4.178571
FOOD AND DRINK         4.176786
MEDICAL                4.175443
PHOTOGRAPHY            4.160142
HOUSE AND HOME         4.158108
COMMUNICATION          4.136190
ENTERTAINMENT          4.135294
NEWS AND MAGAZINES     4.117323
FINANCE                4.113623
BUSINESS               4.099048
LIFESTYLE              4.094580
TRAVEL AND LOCAL       4.073973
VIDEO PLAYERS          4.049693
MAPS AND NAVIGATION    4.042748
TOOLS                  4.034341
DATING                 3.976608
Name: Rating, dtype: float64
```

In [57]:

```
fig, ax = plt.subplots(figsize=(12,7))
ax.plot(Family_Rating[:16], color = 'grey',)
ax.plot(Family_Rating[15:18], color = 'brown', alpha = 1, marker = 2, ls = ':')
ax.plot(Family_Rating[17:], color = 'grey')
plot = Family_Rating.plot.bar(color='grey')
for i in plot.patches:
    if i.get_height()==Family_Rating[16]:
        i.set_color('brown')

for i in ['top','right','left', 'bottom']:
    ax.spines[i].set_visible(False)
ax.tick_params(left = False, labelsize = 'large')
plt.xticks(['EVENTS','FAMILY','DATING'], rotation=0)
plt.xlabel('\n\nCategory')
plt.ylabel('Ratings\n\n')
plt.title('A Barplot Showing the Average Rating Rank of Each Category.\n\n',fontsize = 20, color = 'grey',l
plt.yticks([4.1,4.3,4.5]);
```



Though the FAMILY Category has the highest number of apps, it has no important `Rating` rank among other categories.

EVENTS and DATING have the highest and lowest ranks, respectively.

In [ ]:
```
1
```

Still on the FAMILY Category:

What is the minimum number of `Installs` they get? What's the maximum? What's the avarage, with respect to the other categories?

In [58]:
```
1 data['Installs'].groupby(data['Category']).min().sort_values(ascending=False)
```

Out[58]:
```
Category
ENTERTAINMENT          1,000,000+
WEATHER                    1,000+
BEAUTY                     1,000+
VIDEO PLAYERS              1,000+
COMICS                     1,000+
SHOPPING                   1,000+
EDUCATION                  1,000+
PHOTOGRAPHY                1,000+
PARENTING                  1,000+
MAPS AND NAVIGATION        1,000+
LIBRARIES AND DEMO         1,000+
HEALTH AND FITNESS             1+
TOOLS                          1+
SPORTS                         1+
AUTO AND VEHICLES              1+
HOUSE AND HOME                 1+
GAME                           1+
FOOD AND DRINK                 1+
BOOKS AND REFERENCE            1+
COMMUNICATION                  1+
DATING                         1+
EVENTS                         1+
PERSONALIZATION                0+
NEWS AND MAGAZINES             0+
PRODUCTIVITY                   0+
MEDICAL                        0+
SOCIAL                         0+
FINANCE                        0+
BUSINESS                       0+
TRAVEL AND LOCAL               0+
LIFESTYLE                      0+
ART AND DESIGN                 0+
FAMILY                          0
Name: Installs, dtype: object
```

In [59]:
```
1 data['Installs'].groupby(data['Category']).max().sort_values(ascending=False)
```

Out[59]:
```
Category
PRODUCTIVITY           500,000,000+
VIDEO PLAYERS          500,000,000+
TOOLS                  500,000,000+
HEALTH AND FITNESS     500,000,000+
COMMUNICATION          500,000,000+
SOCIAL                 500,000,000+
GAME                   500,000,000+
NEWS AND MAGAZINES     500,000,000+
PERSONALIZATION            500,000+
MEDICAL                    500,000+
PARENTING                  500,000+
ART AND DESIGN             500,000+
PHOTOGRAPHY                500,000+
LIFESTYLE                  500,000+
SHOPPING                   500,000+
SPORTS                     500,000+
TRAVEL AND LOCAL           500,000+
MAPS AND NAVIGATION        500,000+
HOUSE AND HOME             500,000+
LIBRARIES AND DEMO         500,000+
AUTO AND VEHICLES          500,000+
FOOD AND DRINK             500,000+
FINANCE                    500,000+
FAMILY                     500,000+
EVENTS                     500,000+
ENTERTAINMENT              500,000+
EDUCATION                  500,000+
DATING                     500,000+
COMICS                     500,000+
BUSINESS                   500,000+
BOOKS AND REFERENCE        500,000+
BEAUTY                     500,000+
WEATHER                    500,000+
Name: Installs, dtype: object
```

Smiles.

The FAMILY Category ranks the lowest in both Series. Its maximum `Installs` value is so low! What's more shocking? There is even an app with zero installs and this is found in the FAMILY Category! I'd like to download that app, though 😂.

In [60]:
```
1 data[data['Installs']=='0']
```

Out[60]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
9148	Command & Conquer: Rivals	FAMILY	4.2	0	Varies with device	0	Free	0.0	10+	Strategy	2018-06-28	Varies with device	Varies with device

Command & Conquer: Rivals 😍. I'd drop a review as well 🙌.

In [ ]:
```
1
```

Which apps in the Google Play Store are famous? Apps with the highest installs would reveal this to us.

Under which category do most of them fall?

In [61]:
```
famous_apps = data[data.Installs==data.Installs.max()]
famous_apps
```

Out[61]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	
342	Viber Messenger	COMMUNICATION	4.3	11334799	Varies with device	500,000,000+	Free	0.0	Everyone	Communication	2018-07-18	Va
347	imo free video calls and chat	COMMUNICATION	4.3	4785892	11M	500,000,000+	Free	0.0	Everyone	Communication	2018-06-08	9.8
371	Google Duo - High Quality Video Calls	COMMUNICATION	4.6	2083237	Varies with device	500,000,000+	Free	0.0	Everyone	Communication	2018-07-31	37.1.2060178(
378	UC Browser - Fast Download Private & Secure	COMMUNICATION	4.5	17712922	40M	500,000,000+	Free	0.0	Teen	Communication	2018-08-02	
403	LINE: Free Calls & Messages	COMMUNICATION	4.2	10790289	Varies with device	500,000,000+	Free	0.0	Everyone	Communication	2018-07-26	Va
1655	Candy Crush Saga	GAME	4.4	22426677	74M	500,000,000+	Free	0.0	Everyone	Casual	2018-07-05	
1661	Temple Run 2	GAME	4.3	8118609	62M	500,000,000+	Free	0.0	Everyone	Action	2018-07-05	
1662	Pou	GAME	4.3	10485308	24M	500,000,000+	Free	0.0	Everyone	Casual	2018-05-25	
1722	My Talking Tom	GAME	4.5	14891223	Varies with device	500,000,000+	Free	0.0	Everyone	Casual	2018-07-19	
2546	Facebook Lite	SOCIAL	4.3	8606259	Varies with device	500,000,000+	Free	0.0	Teen	Social	2018-08-01	Va

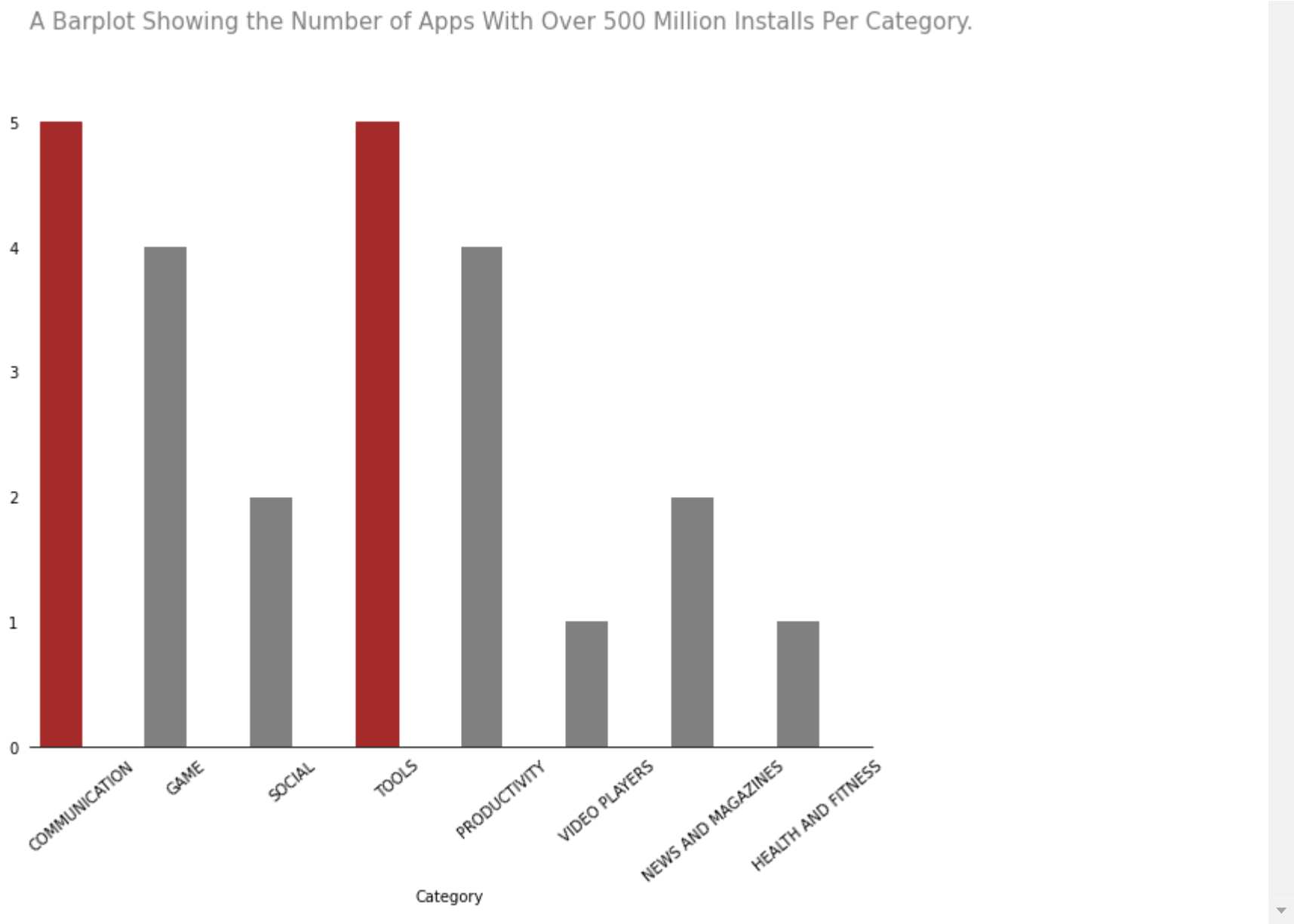
	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	
2550	Snapchat	SOCIAL	4.0	17014787	Varies with device	500,000,000+	Free	0.0	Teen	Social	2018-07-30	Va
3235	Google Translate	TOOLS	4.4	5745093	Varies with device	500,000,000+	Free	0.0	Everyone	Tools	2018-08-04	Va
3255	SHAREit - Transfer & Share	TOOLS	4.6	7790693	17M	500,000,000+	Free	0.0	Everyone	Tools	2018-07-30	
3265	Gboard - the Google Keyboard	TOOLS	4.2	1859115	Varies with device	500,000,000+	Free	0.0	Everyone	Tools	2018-07-31	Va
3450	Microsoft Word	PRODUCTIVITY	4.5	2084126	Varies with device	500,000,000+	Free	0.0	Everyone	Productivity	2018-07-11	16
3473	Dropbox	PRODUCTIVITY	4.4	1861310	61M	500,000,000+	Free	0.0	Everyone	Productivity	2018-08-01	Va
3476	Google Calendar	PRODUCTIVITY	4.2	858208	Varies with device	500,000,000+	Free	0.0	Everyone	Productivity	2018-08-06	Va
3574	Cloud Print	PRODUCTIVITY	4.1	282460	Varies with device	500,000,000+	Free	0.0	Everyone	Productivity	2018-05-23	Va
3703	MX Player	VIDEO PLAYERS	4.5	6474426	Varies with device	500,000,000+	Free	0.0	Everyone	Video Players & Editors	2018-08-06	Va
3739	Twitter	NEWS AND MAGAZINES	4.3	11667403	Varies with device	500,000,000+	Free	0.0	Mature 17+	News & Magazines	2018-08-06	Va
3755	Flipboard: News For Our Time	NEWS AND MAGAZINES	4.4	1284017	Varies with device	500,000,000+	Free	0.0	10+	News & Magazines	2018-08-03	Va
4005	Clean Master- Space Cleaner & Antivirus	TOOLS	4.7	42916526	Varies with device	500,000,000+	Free	0.0	Everyone	Tools	2018-08-03	Va

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated
5596	Samsung Health	HEALTH AND FITNESS	4.3	480208	70M	500,000,000+	Free	0.0	Everyone	Health & Fitness	2018-07-31
7536	Security Master - Antivirus, VPN, AppLock, Boo...	TOOLS	4.7	24900999	Varies with device	500,000,000+	Free	0.0	Everyone	Tools	2018-08-04

As expected, they are all free to download, and most of them do not limit any age group from downloading them.

In [62]:

```
fig, ax = plt.subplots(figsize = (10,8))
plot = sns.countplot(famous_apps['Category'], color = 'grey')
for i in plot.patches:
    i.set_width(0.4)
    if i.get_height()==famous_apps['Category'].value_counts().max():
        i.set_color('brown')
for i in ['left', 'right', 'top']:
    ax.spines[i].set_visible(False)
ax.tick_params(bottom = False, left = False)
plt.xticks(rotation = 40)
plt.ylabel('')
plt.title('A Barplot Showing the Number of Apps With Over 500 Million Installs Per Category.\n\n',
          fontsize = 15, color = 'grey', loc = 'left');
```



A whole lot of people have downloaded more apps in the COMMUNICATION and TOOLS Categories, than any other Category. W'd look deeper into the apps under these 'famous' Categories.

In [63]:
```
famous_apps[(famous_apps['Category']=='COMMUNICATION') | (famous_apps['Category']=='TOOLS')]['App'].values
```

Out[63]:
```
array(['Viber Messenger', 'imo free video calls and chat',
       'Google Duo - High Quality Video Calls',
       'UC Browser - Fast Download Private & Secure',
       'LINE: Free Calls & Messages', 'Google Translate',
       'SHAREit - Transfer & Share', 'Gboard - the Google Keyboard',
       'Clean Master- Space Cleaner & Antivirus',
       'Security Master - Antivirus, VPN, AppLock, Booster'], dtype=object)
```

These are popular apps indeed.

In [ ]:
```

```

Which app(s) in the Google Play Store are the least famous?

In [64]:
```
infamous_apps = data[data.Installs==data.Installs.min()]
infamous_apps
```

Out[64]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
9148	Command & Conquer: Rivals	FAMILY	4.2	0	Varies with device	0	Free	0.0	10+	Strategy	2018-06-28	Varies with device	Varies with device

Though it is free to download, it still has no downloads.

In [ ]:
```

```

About how many years does this data span about? When is the latest date?

In [65]:
```
data['Last Updated'].min(), data['Last Updated'].max()
```

Out[65]:
```
(Timestamp('2010-05-21 00:00:00'), Timestamp('2018-08-08 00:00:00'))
```

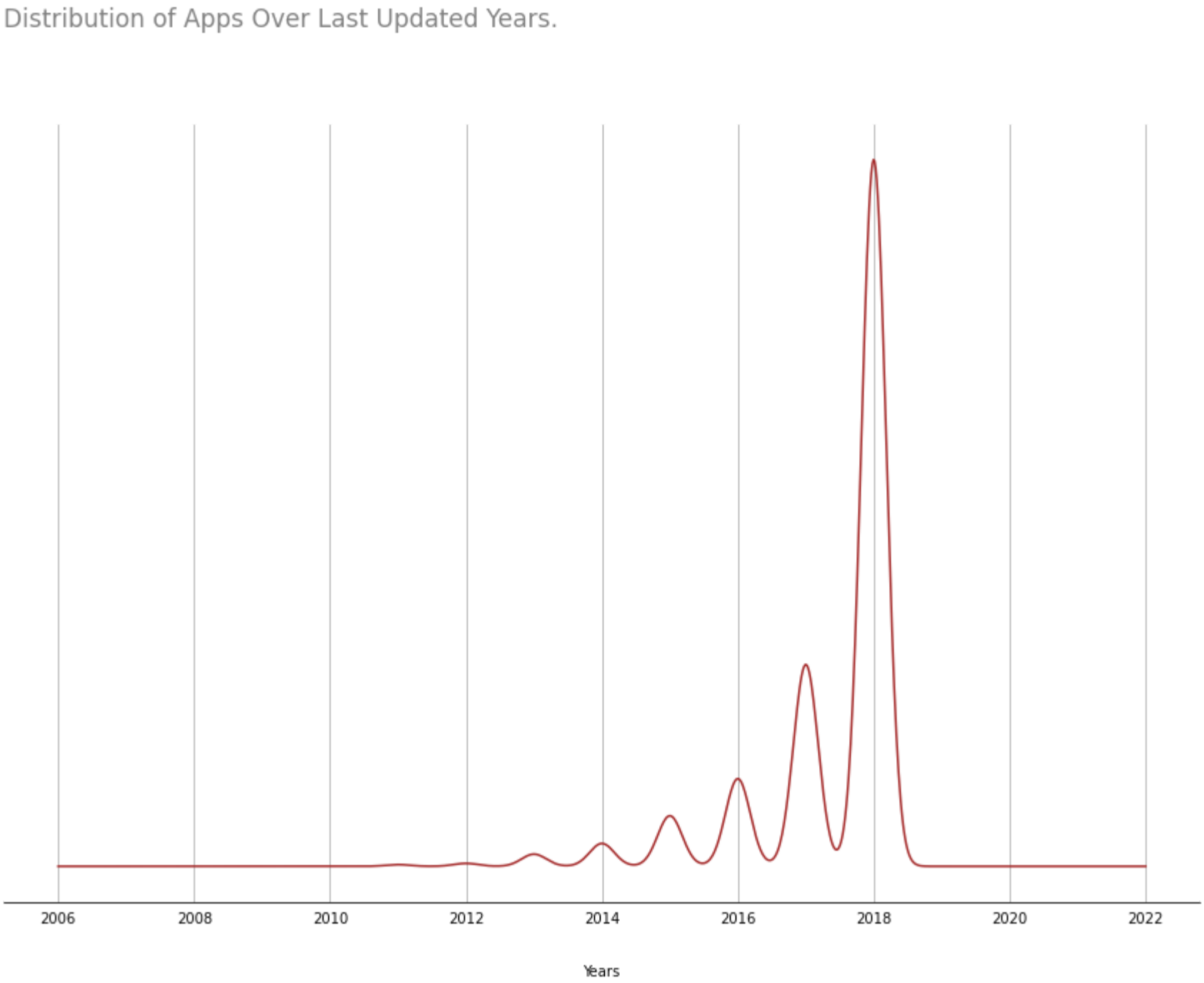
`Last Updated` spans for about eight years, from the 21st of May 2010, to the 8th of August, 2018.

No app was updated beyond this range.

The highest number of updates took place in what year?

In [66]:

```
fig, ax = plt.subplots(figsize = (15,10))

data['Last Updated'].dt.year.plot(kind='kde', color = 'brown')

for i in ['left', 'right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelleft = '')

#plt.xlim([2010,2018])
plt.ylabel('')
plt.xlabel('\n\nYears')
plt.grid(axis = 'x')
plt.title('Distribution of Apps Over Last Updated Years.\n\n\n', loc = 'left', color = 'grey', fontsize = 1
```


Distribution of Apps Over Last Updated Years.
2006
2008
2010
2012
2014
2016
2018
2020
2022
Years

Obviously, most apps were lastly updated in 2018 (July, precisely), than the previous years.

In [ ]:
```
1
```

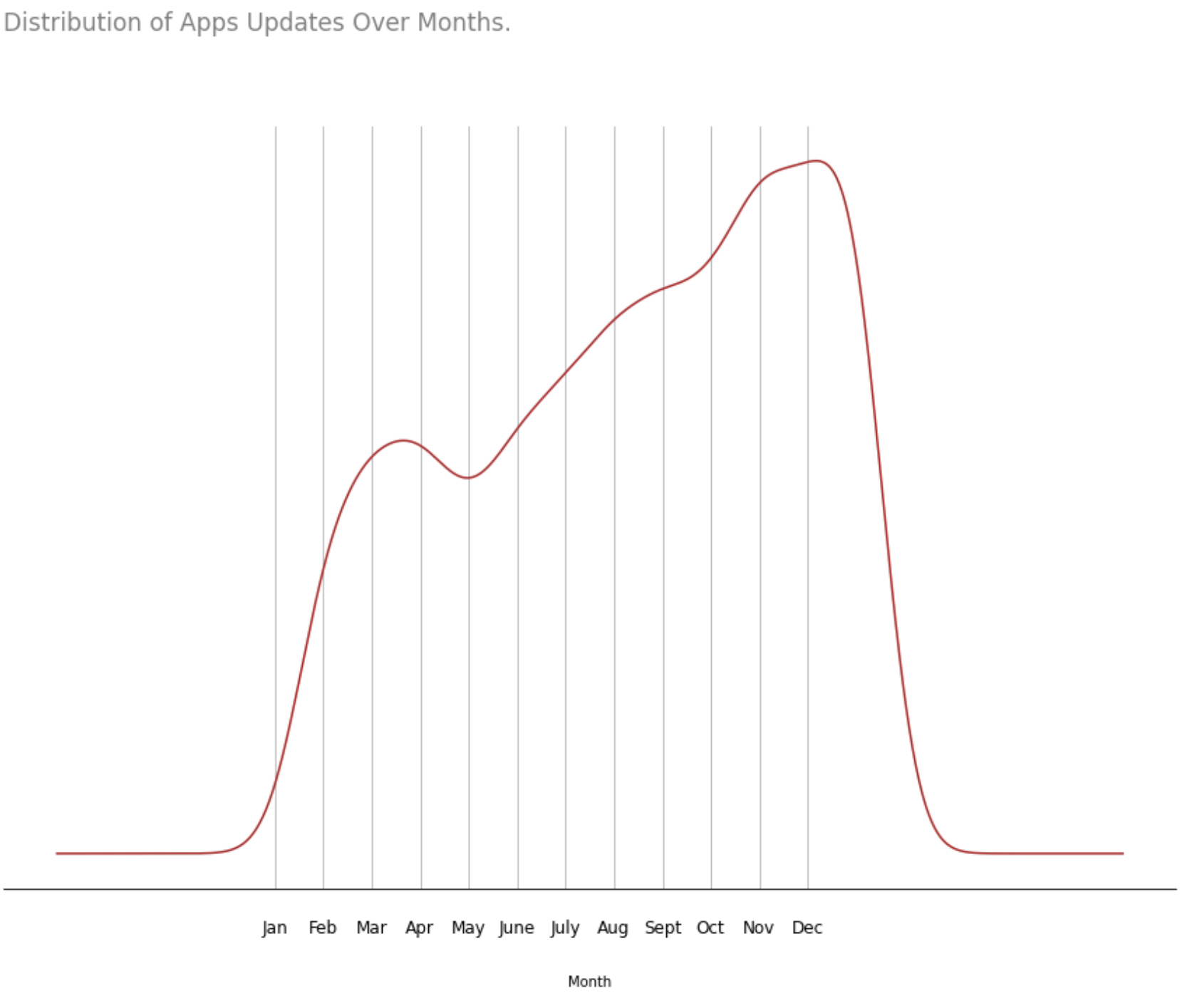
Which month does updates occur more frequently? Least freqently?

The answer to the latter question would be deduced from years having complete months (Years excluding 2010 and 2018).

In [67]:
```
1 df = data[(data['Last Updated'].dt.year>2010) & (data['Last Updated'].dt.year<2018)]
```

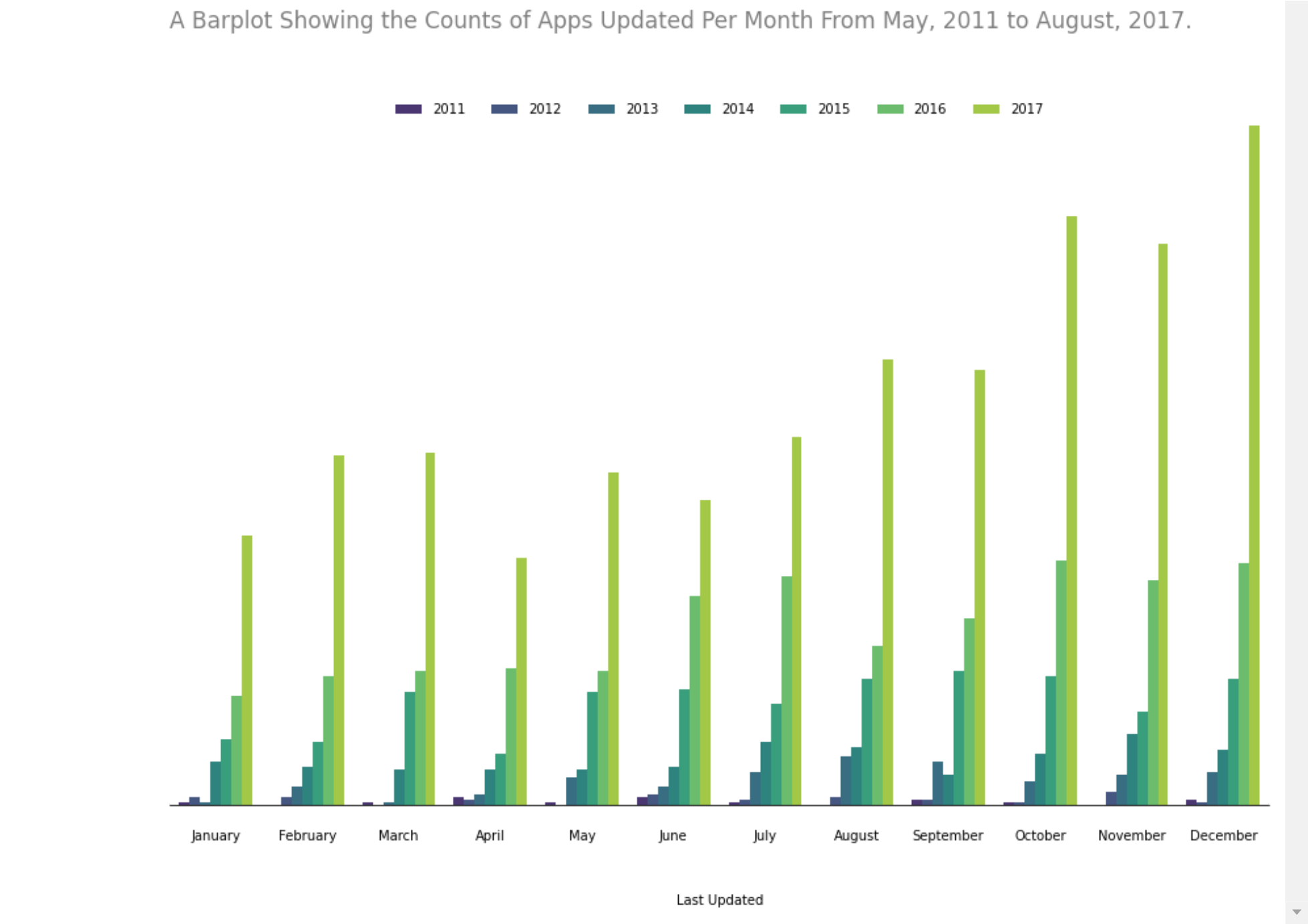
In [68]:

```
fig, ax = plt.subplots(figsize = (15,10))

a=df['Last Updated'].dt.month.plot(kind='kde', color = 'brown')

for i in ['left', 'right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelleft = '')

plt.xticks(np.arange(12), ['\nJan','\nFeb','\nMar','\nApr', '\nMay', '\nJune',
                           '\nJuly', '\nAug', '\nSept','\nOct','\nNov','\nDec'], size = 'large')
plt.ylabel('')
plt.xlabel('\n\nMonth')
plt.grid(axis = 'x')
plt.title('Distribution of Apps Updates Over Months.\n\n\n', loc = 'left', color = 'grey', fontsize = 17);
```


Distribution of Apps Updates Over Months.
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Month

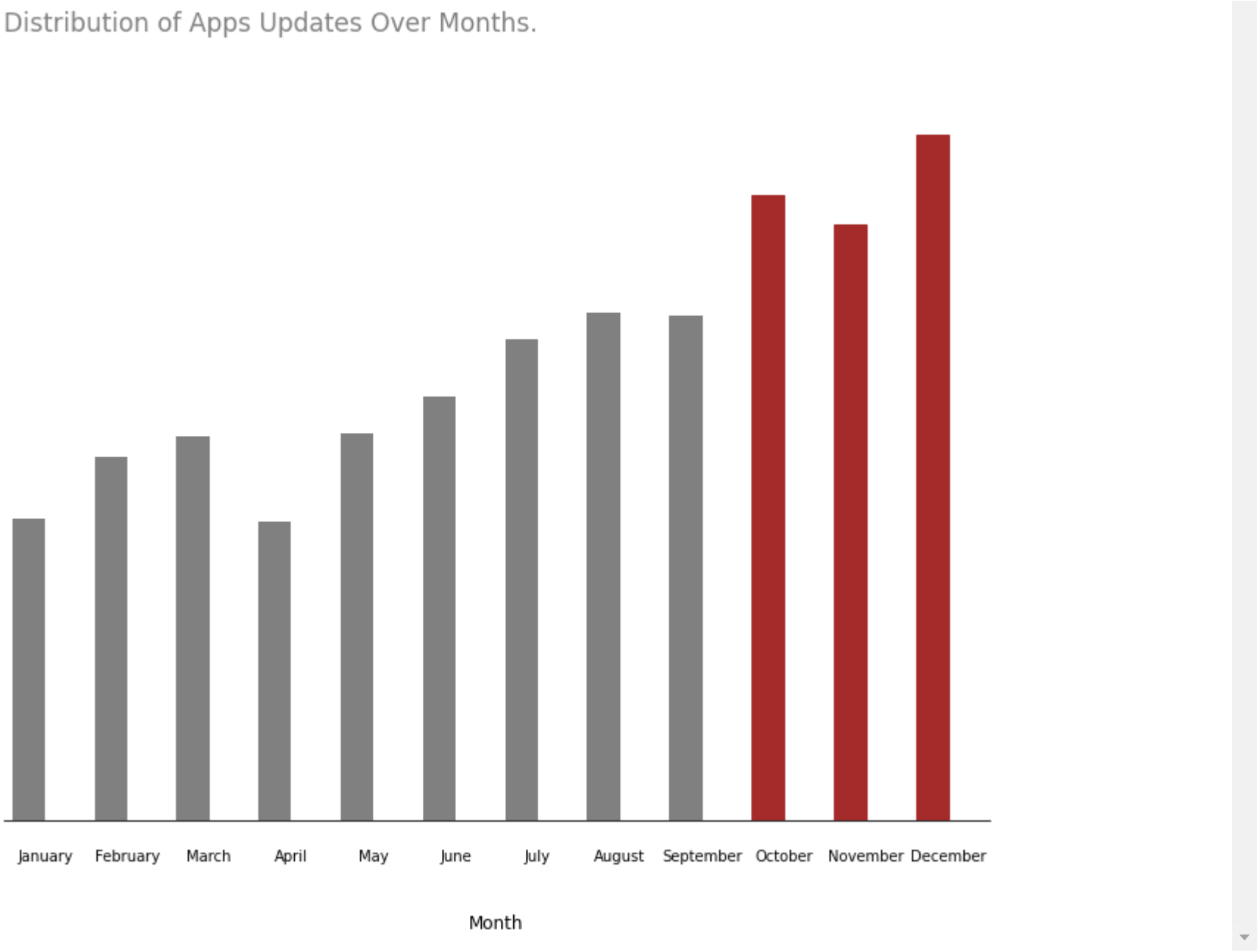
In [69]:

```
fig, ax = plt.subplots(figsize = (15,10))

plot = sns.countplot(df['Last Updated'].dt.month, hue = df['Last Updated'].dt.year, ax=ax, palette = 'viridi

ax.legend(loc = 9, frameon = False, ncol = df['Last Updated'].dt.year.nunique())

for i in ['left', 'right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelleft = '')

plt.xticks(np.arange(12), ['\nJanuary','\nFebruary','\nMarch','\nApril', '\nMay', '\nJune',
                           '\nJuly', '\nAugust', '\nSeptember','\nOctober','\nNovember','\nDecember'])



plt.ylabel('')
#plt.grid(axis = 'x')
plt.xlabel('\n\n\nLast Updated')
plt.title('A Barplot Showing the Counts of Apps Updated Per Month From May, 2011 to August, 2017.\n\n', loc
```


A Barplot Showing the Counts of Apps Updated Per Month From May, 2011 to August, 2017.
2011
2012
2013
2014
2015
2016
2017
January
February
March
April
May
June
July
August
September
October
November
December
Last Updated

In [70]:

```
fig, ax = plt.subplots(figsize = (12,9))

plot = sns.countplot(df['Last Updated'].dt.month, color = 'grey')

for i in plot.patches:
    i.set_width(.4)
    if i in plot.patches[-3:]:
        i.set_color('brown')

for i in ['left', 'right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelleft = '')

plt.xticks(np.arange(12), ['\nJanuary','\nFebruary','\nMarch','\nApril', '\nMay', '\nJune',
                           '\nJuly', '\nAugust', '\nSeptember','\nOctober','\nNovember','\nDecember'])
plt.ylabel('')
plt.xlabel('\n\nMonth', fontsize = 'large')
plt.title('Distribution of Apps Updates Over Months.\n\n', loc = 'left', color = 'grey', fontsize = 17);
```



Deductively, most apps had their updates in December. Most developers want to make their app-updates before entering a new year.

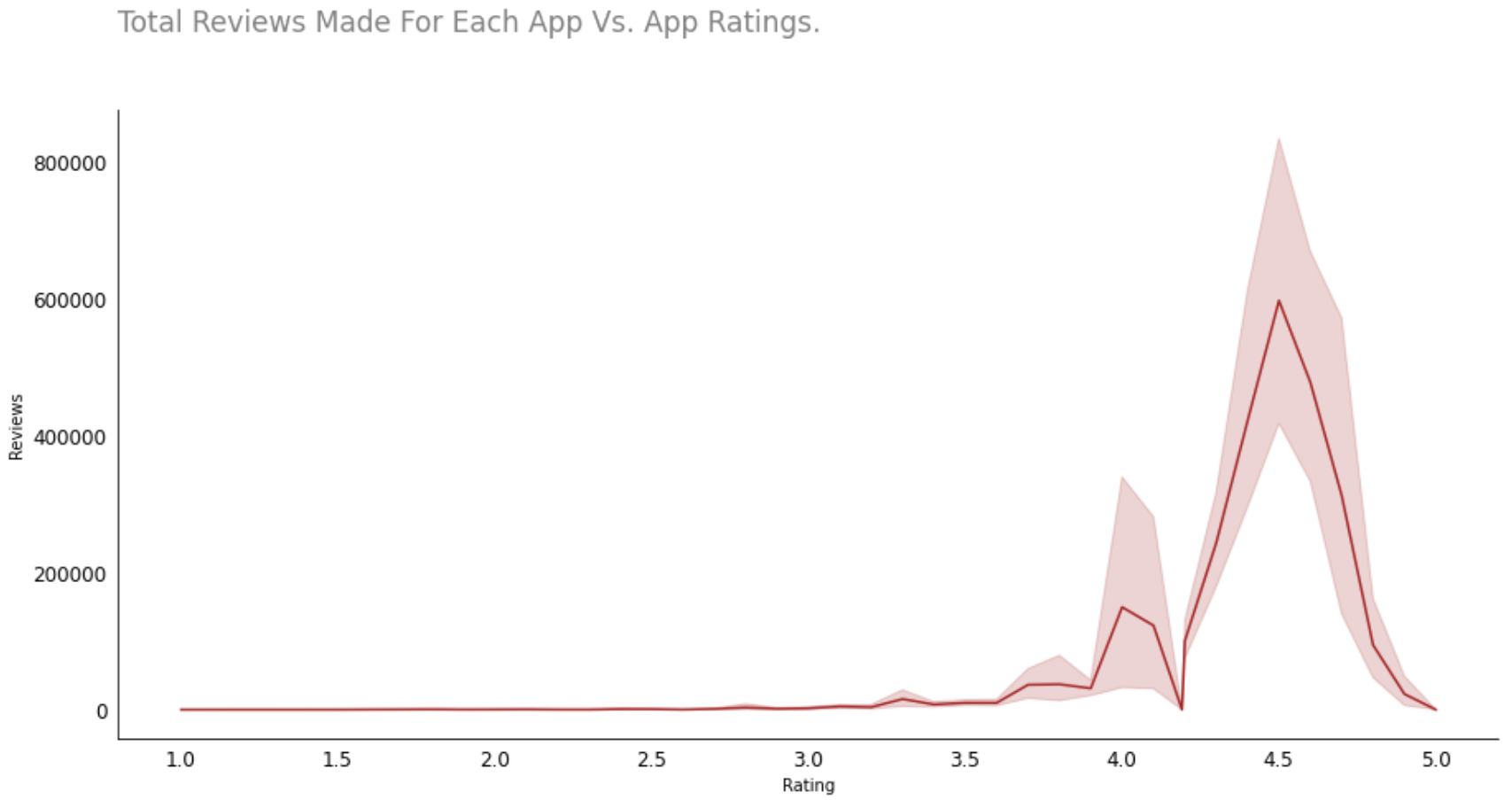
Also, towards the end of the year (from October), a large fraction of apps are updated.

What's so special about April? Nothing 😋. *Thus* , few developers make their app-updates in April.

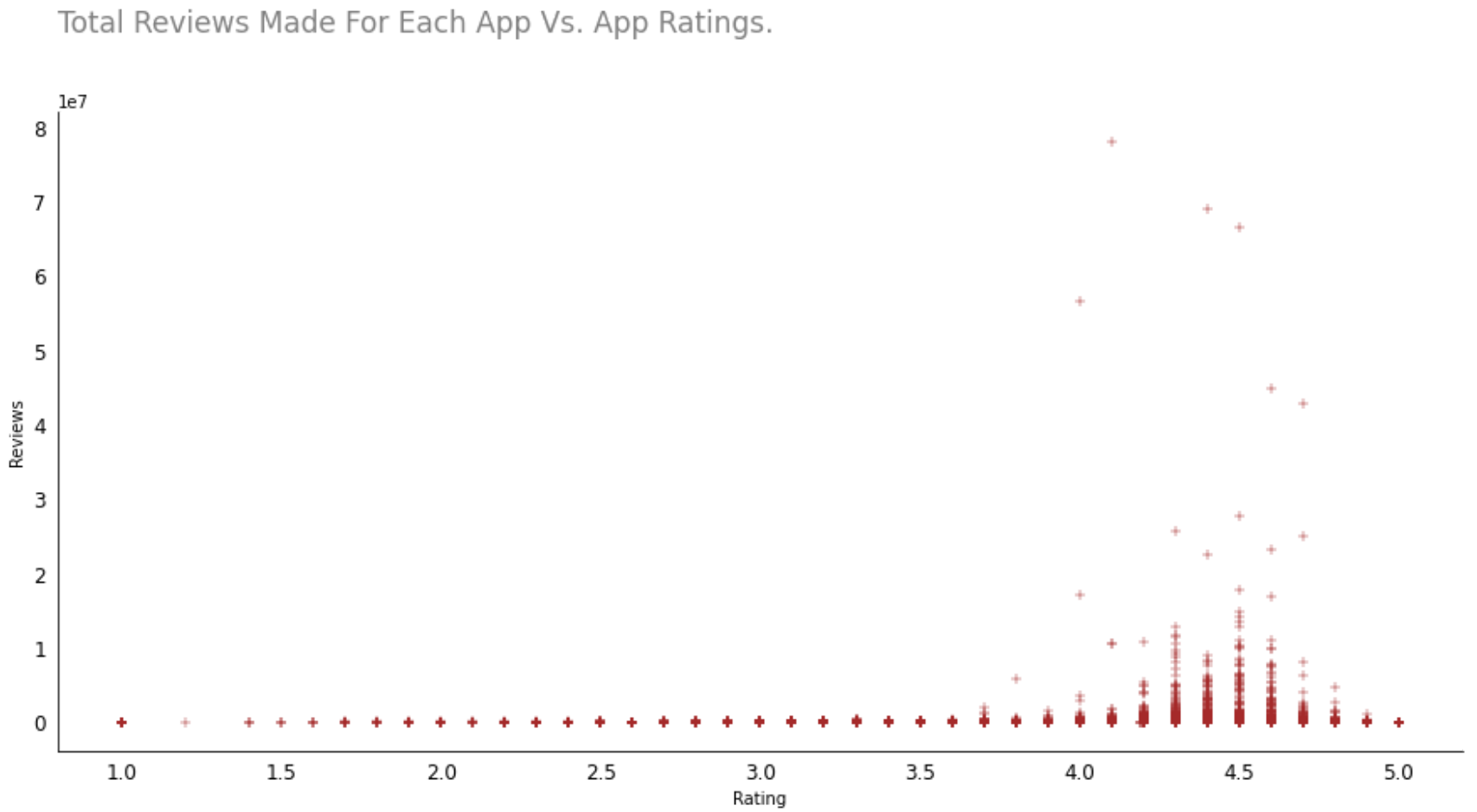
In [ ]:
```
1
```

If my app has a high number of reviews, will it be highly rated?

In [71]:
```
fig, ax = plt.subplots(figsize = (15,7))

plot = sns.lineplot(x = data['Rating'], y = data['Reviews'], color = 'brown', ax = ax);

for i in ['right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelsize = 'large')

plt.title('Total Reviews Made For Each App Vs. App Ratings.\n\n', loc = 'left', color = 'grey', fontsize =
```



In [72]:
```
fig, ax = plt.subplots(figsize = (15,7))

plot = sns.scatterplot(x = 'Rating', y = 'Reviews', color = 'brown', marker = '+', data = data, ax = ax);

for i in ['right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelsize = 'large')

plt.title('Total Reviews Made For Each App Vs. App Ratings.\n\n', loc = 'left', color = 'grey', fontsize =
```



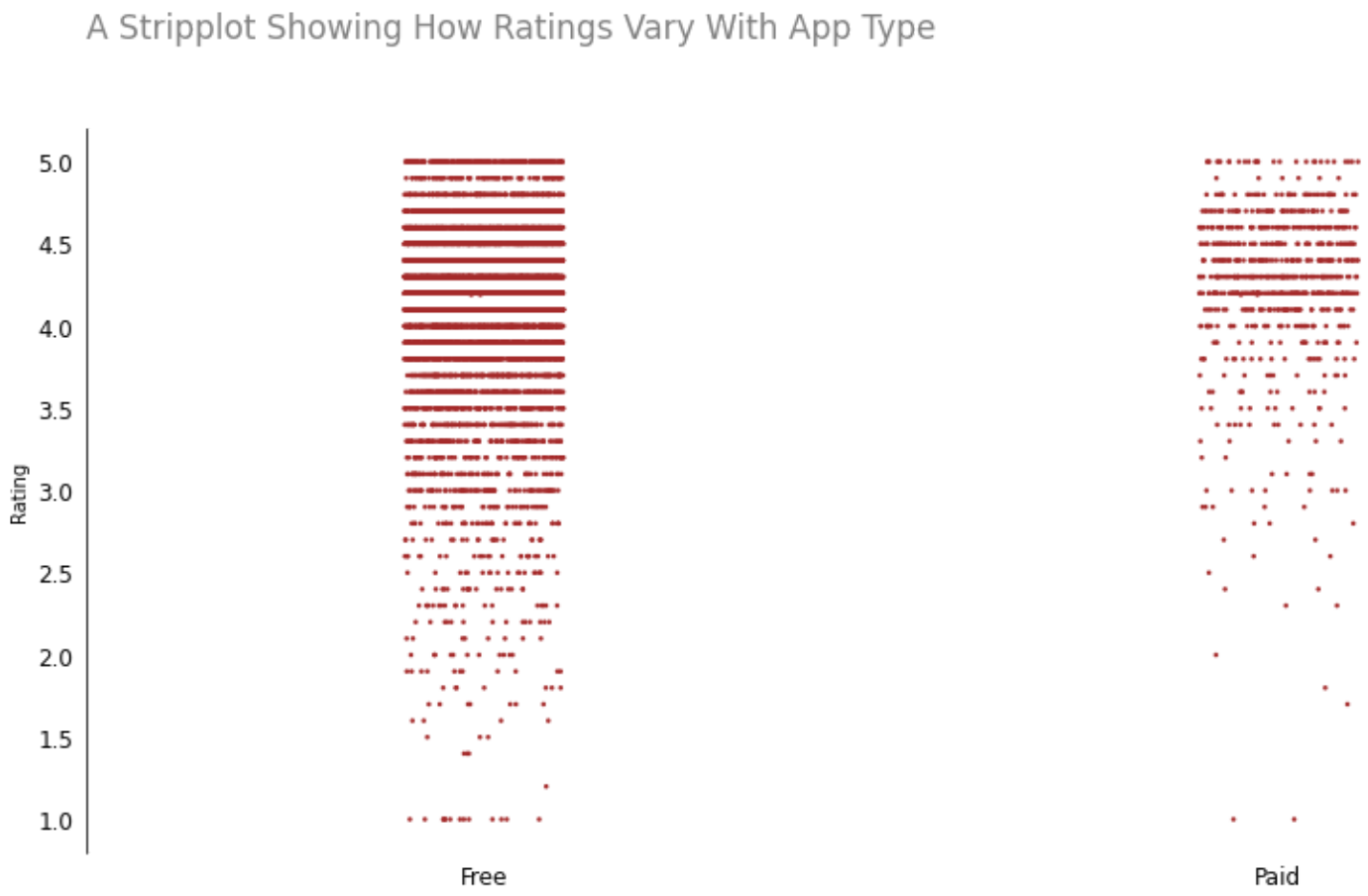
Yes, a highly rated app has a lot of people passing down their reviews.

The higher the `Rating`, the higher the `Reviews`.

In [ ]:
```
1
```

Between free and paid apps, which one of them has a higher chance of being highly rated?

In [73]:
```
fig, ax = plt.subplots(figsize = (15,7))

sns.stripplot(y = 'Rating', x = 'Type', color = 'brown', marker = '.', data = data)

for i in ['right', 'top', 'bottom']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelsize = 'large')

plt.xlabel('')

plt.title('A Stripplot Showing How Ratings Vary With App Type\n\n', loc = 'left', color = 'grey', fontsize =
```



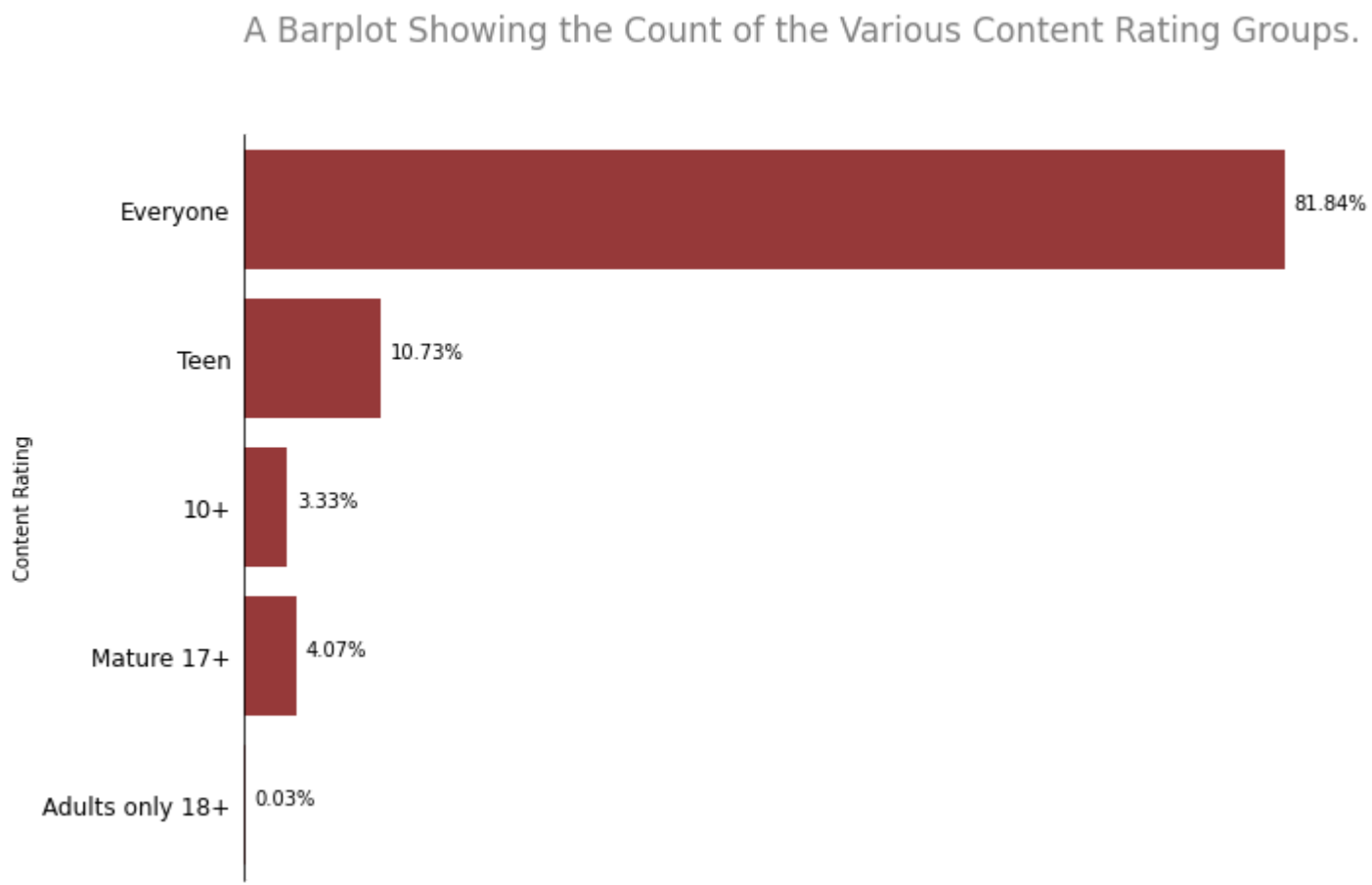
Apps paid for rarely get a low rating (they don't disappoint).

In [ ]:
```
1
```

`Content Rating` - What is the proportion of each group?

In [74]:

```
fig, ax = plt.subplots(figsize = (10,7))

plot = sns.countplot(y = data['Content Rating'], color = 'brown')

for i in plot.patches:
    text = i.get_width()*100/data.shape[0]
    plot.annotate('{:.2f}%'.format(text), (i.get_width()+70, i.get_y()+0.4))

for i in ['right', 'top', 'bottom']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelsize = 'large', labelbottom = '')

plt.xlabel('')

plt.title('A Barplot Showing the Count of the Various Content Rating Groups.\n\n',
          loc = 'left', color = 'grey', fontsize = 17);
```



Most apps have no age group restriction. Anyone can download them.

However, a few apps are solely for adults. A closer peep, please.

In [75]:
```
1 data[data['Content Rating']=='Adults only 18+']
```

Out[75]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
298	Manga Master - Best manga & comic reader	COMICS	4.6	24005	4.9M	500,000+	Free	0.0	Adults only 18+	Comics	2018-07-04	1.1.7.0	4.1 and up
3043	DraftKings - Daily Fantasy Sports	SPORTS	4.5	50017	41M	1,000,000+	Free	0.0	Adults only 18+	Sports	2018-07-24	3.21.324	4.4 and up
6424	Manga Books	COMICS	3.8	7326	Varies with device	500,000+	Free	0.0	Adults only 18+	Comics	2018-08-03	Varies with device	Varies with device

These apps have an average high rating, are free to download, and are of two Genres - Comics and Sports.

In [ ]:
```
1
```

For apps with the

> *1. maximum rating*

> *2. minimum rating,*

let's give insights into their features.

Most of them fall under which `Category` ?

Most of them are of which `Type` ?

In [76]:
```
minimum = data[data.Rating==data.Rating.min()]

maximum = data[data.Rating==data.Rating.max()]
```

In [77]:
```
maximum.Category.value_counts()
```

Out[77]:
```
FAMILY                67
LIFESTYLE             29
MEDICAL               25
BUSINESS              18
TOOLS                 17
GAME                  12
HEALTH AND FITNESS    12
PERSONALIZATION       10
SOCIAL                 8
PRODUCTIVITY           8
FINANCE                8
NEWS AND MAGAZINES     7
BOOKS AND REFERENCE    6
DATING                 6
SHOPPING               6
EVENTS                 6
PHOTOGRAPHY            6
COMMUNICATION          5
SPORTS                 4
TRAVEL AND LOCAL       3
COMICS                 2
FOOD AND DRINK         2
LIBRARIES AND DEMO     2
PARENTING              1
ART AND DESIGN         1
Name: Category, dtype: int64
```

In [78]:
```
1 minimum.Category.value_counts()
```

Out[78]:
```
FAMILY          3
MEDICAL         3
TOOLS           3
FINANCE         2
DATING          1
GAME            1
PRODUCTIVITY    1
COMMUNICATION   1
BUSINESS        1
Name: Category, dtype: int64
```

The highest rated apps, as well as the least rated apps are found mainly in the FAMILY Category and are definitely free to download.

In [ ]:
```
1
```

Moving on to `Size` .

In [79]:
```
1 data.Size.value_counts().head()
```

Out[79]:
```
Varies with device    1227
11M                    182
12M                    181
14M                    177
13M                    177
Name: Size, dtype: int64
```

Most of the sizes recorded are not definite. Hence, we cannot really work with this column as we ought to.

I'd create a temporal custom dataframe with rows having "Varies with device" as `Size` filtered out.

In [80]:
```
dataframe = data[data.Size!='Varies with device']
dataframe.Size.value_counts().head()
```

Out[80]:
```
11M    182
12M    181
13M    177
14M    177
15M    163
Name: Size, dtype: int64
```

Done. We can now work with this.

The target is to make `Size` column an integer type. This column should have megabyte as its unit.

First, 'M' (symbolizing megabyte) will be removed.

Second, those ending with 'k' (symbolizing kilobyte) will have their integer part divided by 1024 (1024Kb makes 1Mb)

Third, 'k' will be removed.

Lastly, the column would be converted to a float type and renamed.

In [81]:
```
def to_meg(x):
    if x[-1]=='k':
        return float(x[:-1])/1024
    else:
        return x
dataframe.Size = dataframe.Size.str.replace('M','').apply(to_meg).astype('float')
dataframe = dataframe.rename(columns = {'Size':'Size In Mb'})
```

In [82]:
```
1 dataframe['Size In Mb'].describe()
```

Out[82]:
```
count    8432.000000
mean       20.394897
std        21.827898
min         0.008301
25%         4.600000
50%        12.000000
75%        28.000000
max       100.000000
Name: Size In Mb, dtype: float64
```

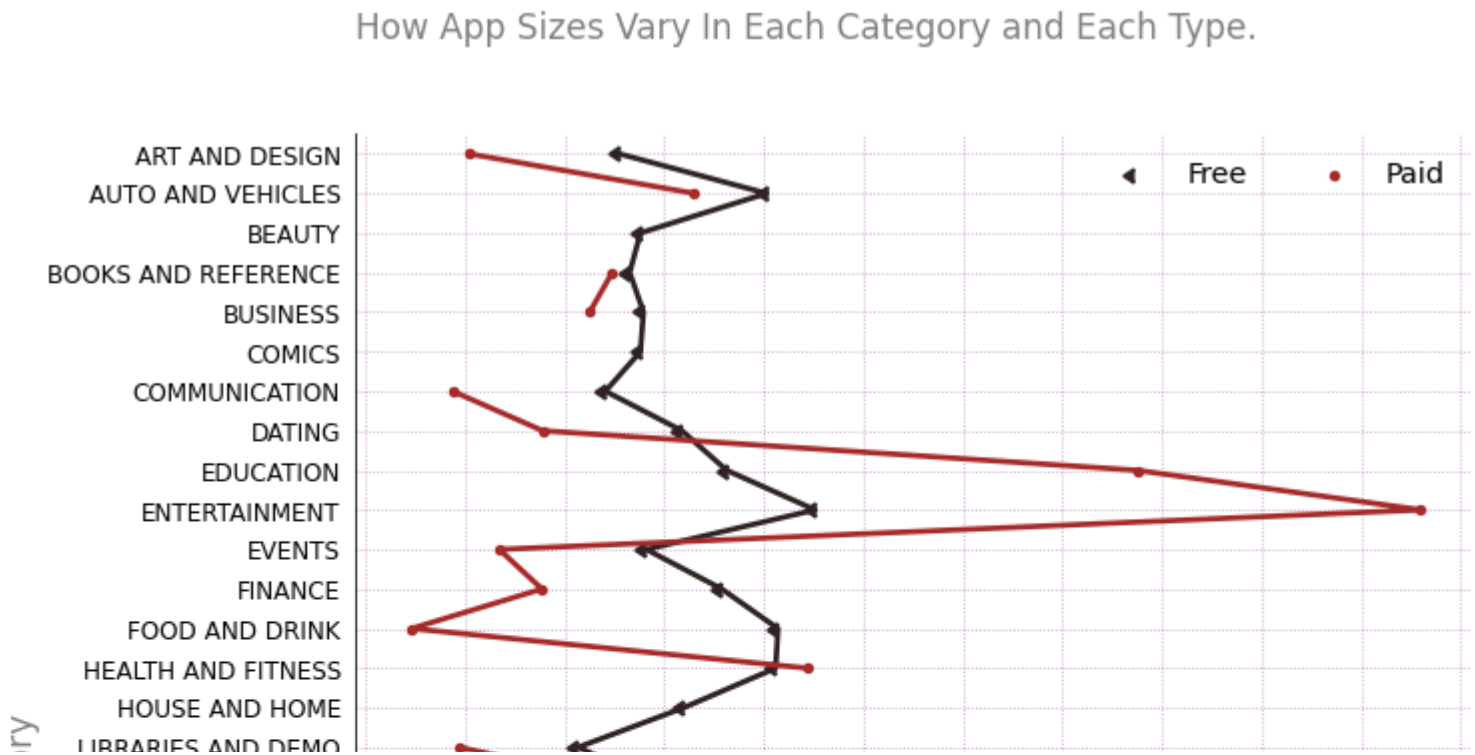
Done.

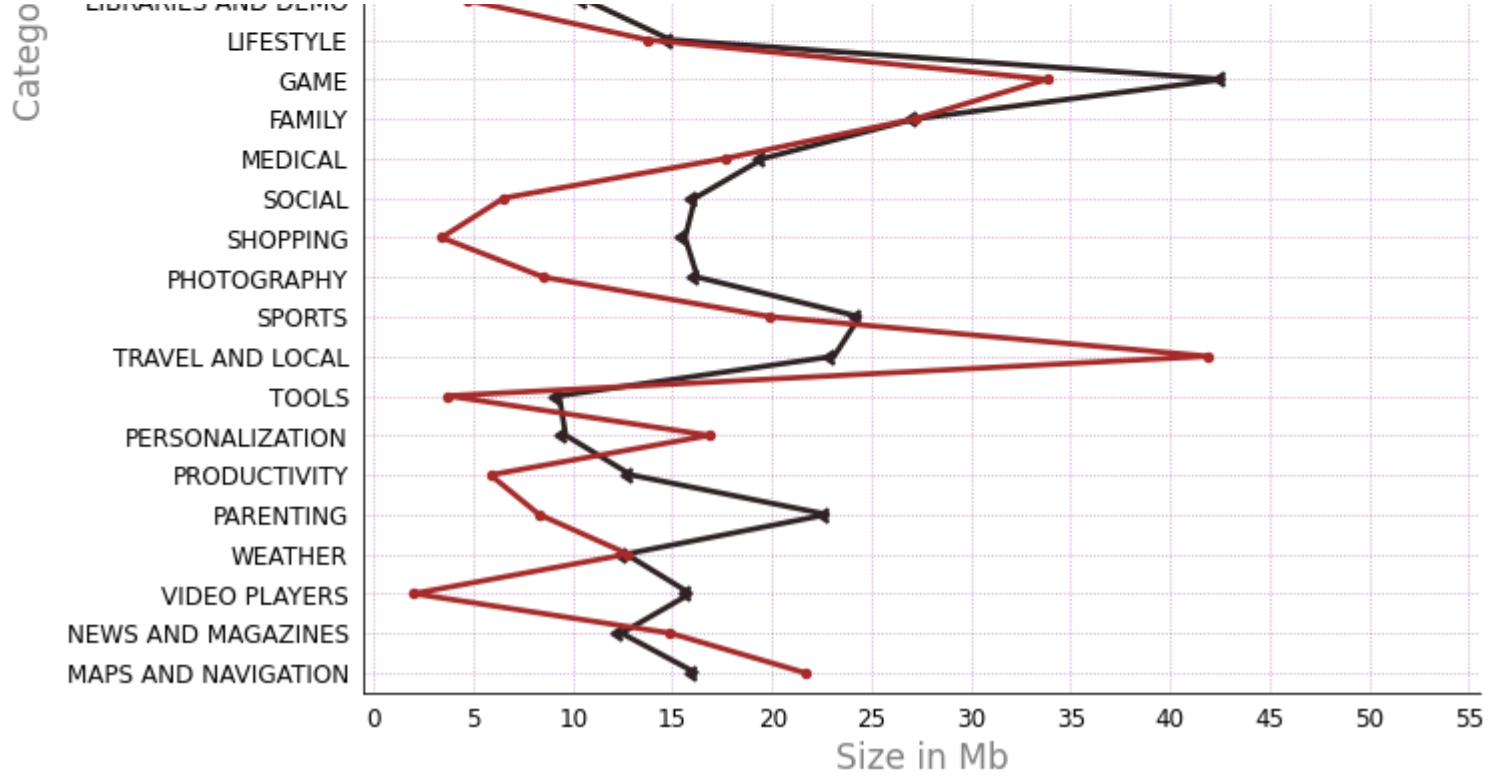
The average size an app from Play Store has is about 20 Mb.

Does the `Category` an app belong to affect how sized the app is? Which category has the least app size? Which one has the highest?

In [113]:

```
fig, ax = plt.subplots(figsize = (10,12))

sns.pointplot('Size In Mb', 'Category', data = dataframe, hue = 'Type', color = 'brown',
              ci = None, markers = [8,'.'], ax = ax)

plt.legend(ncol = 2, frameon = False, fontsize = 'x-large')

for i in ['right', 'top']:
    ax.spines[i].set_visible(False)

ax.tick_params(bottom = False, left = False, labelsize = 'large')

plt.xlabel('Size in Mb', color = 'grey', fontsize = 17)
plt.ylabel('Category', color = 'grey', fontsize = 17)

plt.xticks(np.arange(0,56,5))

plt.grid(color = 'purple', ls = ':', alpha=.4)

plt.title('How App Sizes Vary In Each Category and Each Type.\n\n', loc = 'left', color = 'grey', fontsize =
```





For Paid apps (brown colored line), two spikes are seen in the <u>ENTERTAINMENT</u> and <u>TRADE AND LOCAL</u> Categories with average sizes of about 53 Mb and 42 Mb respectively.

Free apps' (most apps fall under this type, denoted by the black colored line), however has a lower spike and this is found in the <u>GAME</u> Category. It has an average size of about 43 Mb.

Paid apps are usually larger in size.

Also, apps with a low relatively low sizes (less than 5 Mb) are found majorly in these categories:

ART AND DESIGN

COMMUNICATION

FOOD AND DRINK

LIBRARIES AND DEMO

SHOPPING

TOOLS

VIDEO PLAYERS

In [ ]:
```
1
```

In [ ]:
```
1
```

In [ ]:
```
1
```

Section 3: Predictive Modelling

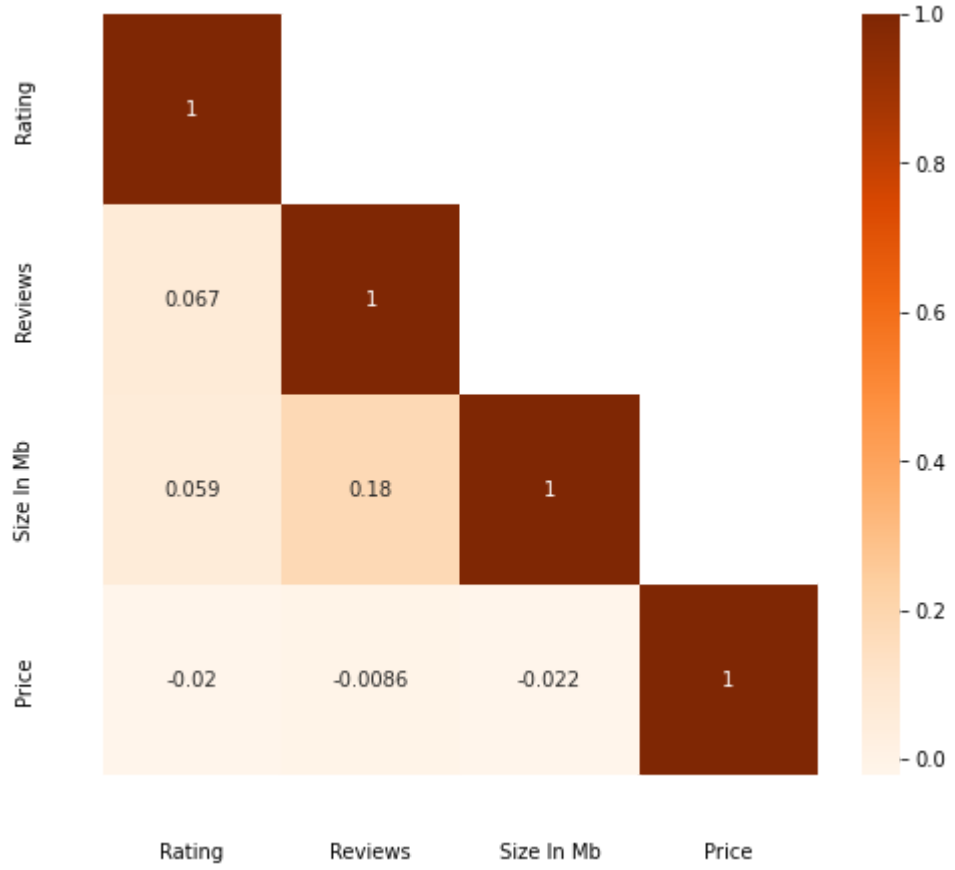
To choose a suitable model to train our data with, checking out for the correlation between these features is essential.

In [84]:
```
1 dataframe.corr()
```

Out[84]:

	Rating	Reviews	Size In Mb	Price
Rating	1.000000	0.066669	0.058595	-0.019598
Reviews	0.066669	1.000000	0.179321	-0.008649
Size In Mb	0.058595	0.179321	1.000000	-0.022441
Price	-0.019598	-0.008649	-0.022441	1.000000

In [85]:
```
mask = np.zeros((4,4))
for i in range(3):
    mask[i+1:, i]=1
mask = mask.T

plt.figure(figsize = (8,7))
sns.heatmap(dataframe.corr(), mask = mask, annot = True, cmap = 'Oranges')
plt.tick_params(bottom = '', left = '', pad = 30)
```



The heatmap from above makes it so obvious that the linearity between these continuous columns is so low. Hence, fitting a linear model is out of it.

Since one of the target features is continuous (`Rating`) and it has no co-linearity, fitting a Decision Tree Regressor would be the best.

`Installs` , the other target feature is categorical. I'd love to fit a Decision Tree Clsassifier among others.

In [ ]:
```
1
```

In [86]:
```
#Importing libraries from scikit learn.

from sklearn.tree import DecisionTreeClassifier, DecisionTreeRegressor
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score, accuracy_score
```

Making a Classification Model.

Here, we're to predict how many installs an app will have, based on other features.

Splting the data into dependent (y) and independent (X) features.

To determine which feature could affect `Installs` , we'd examine each of the features.

In [87]:
```
1 dataframe.sample(5)
```

Out[87]:

	App	Category	Rating	Reviews	Size In Mb	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver	Android Ver
9528	Sanu Ek Pal Chain Song Videos - RAID Movie Songs	FAMILY	4.9	11	4.3	5,000+	Free	0.0	Everyone	Entertainment	2018-03-08	1.2.8	4.0.3 and up
7747	Cypress College Library	BOOKS AND REFERENCE	4.3	0	2.1	100+	Free	0.0	Everyone	Books & Reference	2015-12-07	4.7.2	1.6 and up
8260	Superheroes, Marvel, DC, Comics, TV, Movies News	COMICS	5.0	34	12.0	5,000+	Free	0.0	Everyone	Comics	2018-07-31	1.0.5	5.0 and up
5375	I Am Wizard	FAMILY	4.2	1493	57.0	100,000+	Free	0.0	Everyone	Strategy	2018-04-01	1.0.9	4.1 and up
9751	ER Emergency Hospital - Brain, Knee, Eye Surgery	FAMILY	3.8	25	41.0	1,000+	Free	0.0	Teen	Education	2017-07-21	1.1	2.3 and up

Breakdown:

`App` : The name of the app definitely has no impact on if I'd get 20 or 200000 Installs.

`Category` : The number of Installs could depend on the category an app is.

`Rating` : A highly installed app could attract high ratings.

`Reviews` : Ealier on (in the EDA section), we saw that a highly rated app attracts more reviews. Thus, an app is meant to have a lot of users (pontential reviewers) because it has a high number of reviews.

`Size` : `Installs` would definitely depend on the app size. 'Varies with device' as an entry would have no certain impact on `Installs` , thus would be dropped ('dataframe' would be used for the data modelling rather than 'data', for obvious reasons).

`Type` : A free app could have more users installing them.

`Price` : The same thing goes for this feature.

`Content Rating` : This, as well.

`Last Updated` : The number of installs cannot be predicted from when last an app was updated.

`Current Ver` : Likewise this.

`Android Ver` : This could affect `Installs` . If my android version is not compatible with the app's required version, I would decide not to download it. I'd rather go with an alternative app.

In [88]:
```
X = dataframe.drop(['App', 'Last Updated', 'Current Ver'], axis = 1)

y = dataframe['Installs']
```

In [89]:
```
Encoder = LabelEncoder()
for i in X.select_dtypes('O'):
    X[i] = Encoder.fit_transform(X[i])
```

Splitting:

In [90]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, stratify = y, random_state = 0)
```

Fitting:

In [91]:
```
model = DecisionTreeClassifier()
model.fit(X_train, y_train)
```

Out[91]:
```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=None, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

Predicting:

In [92]:
```
y_pred = model.predict(X_test)
```

Model Evaluation:

In [93]:
```
accuracy_score(y_test, y_pred)
```

Out[93]:
```
1.0
```

Smiles.

In [ ]:
```

```

Making a Regression Model.

Here, we're to predict what the rating of an app will be, based on other features.

Breakdown:

`App` : The name of the app definitely has no impact on if I'd get a star or 5 stars.

`Category` : The rating could depend on the category an app is.

`Installs` : A highly installed app could attract high ratings.

`Reviews` : Everone who drops a review drops a rating.

`Size` : `Rating` would definitely depend on the app size.

`Type` : A free app could have more users highly rating it.

`Price` : The same thing goes for this feature.

`Content Rating` : This, as well.

`Last Updated` : `Rating` cannot be predicted from when last an app was updated.

`Current Ver` : Likewise this.

`Android Ver` : This could affect `Rating` . If my android version is not compatible with the app's required version, I could get furious and give it just a star.

In [94]:
```
X = dataframe.drop(['App', 'Last Updated', 'Current Ver'], axis = 1)

y = dataframe['Rating']
```

In [95]:
```
Encoder = LabelEncoder()
for i in X.select_dtypes('O'):
    X[i] = Encoder.fit_transform(X[i])
```

Splitting:

In [96]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state = 2)
```

Fitting:

In [97]:
```
model = DecisionTreeRegressor(random_state = 2)
model.fit(X_train, y_train)
```

Out[97]:
```
DecisionTreeRegressor(ccp_alpha=0.0, criterion='mse', max_depth=None,
                      max_features=None, max_leaf_nodes=None,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=2,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=2, splitter='best')
```

Predicting:

In [98]:
```
y_pred = model.predict(X_test)
```

Model Evaluation:

In [99]:
```
r2_score(y_test, y_pred)
```

Out[99]:
```
1.0
```

In [ ]:
```

```