Part 1: Initial Setup and Data Loading

In [3]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import nltk
import spacy
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score
import tensorflow as tf
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Embedding, LSTM, Dense, Dropout
import tensorflow.compat.v1 as tf_compat

import spacy



tf_compat.logging.set_verbosity(tf_compat.logging.ERROR)
```

```
WARNING:tensorflow:From C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\s
ite-packages\keras\src\losses.py:2976: The name tf.losses.sparse_softmax_cross_entro
py is deprecated. Please use tf.compat.v1.losses.sparse_softmax_cross_entropy instea
d.

WARNING:tensorflow:From C:\Users\Tareq\AppData\Local\Temp\ipykernel_19640\449387512.
py:23: The name tf.logging.set_verbosity is deprecated. Please use tf.compat.v1.logg
ing.set_verbosity instead.
```

In [2]:
```
import pandas as pd


books_data = pd.read_csv(r"C:\Users\Tareq\Desktop\Ryareson\820 files\archive\books_
books_rating = pd.read_csv(r"C:\Users\Tareq\Desktop\Ryareson\820 files\archive\Book
```

In [4]:
```
books_data.head()
```

Out[4]:

	Title	description	authors	image	
0	Its Only Art If Its Well Hung!	NaN	['Julie Strain']	http://books.google.com/books/content?id=DykPA...	http://books.goo id=DykPA
1	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	http://books.google.com/books/content?id=IjvHQ...	http://books.goo id=IjvHQ
2	Wonderful Worship in Smaller Churches	This resource includes twelve principles in un...	['David R. Ray']	http://books.google.com/books/content?id=2tsDA...	http://books.goo id=2tsDA
3	Whispers of the Wicked Saints	Julia Thomas finds her life spinning out of co...	['Veronica Haddon']	http://books.google.com/books/content?id=aRSIg...	http://books.goo id=aRSI
4	Nation Dance: Religion, Identity and Cultural ...	NaN	['Edward Long']	NaN	http://books.goo id=399SP

In [2]:
```
books_rating.head()
```

Out[2]:

	Id	Title	Price	User_id	profileName	review/helpfulness	re
0	1882931173	Its Only Art If Its Well Hung!	NaN	AVCGYZL8FQQTD	Jim of Oz "jim-of-oz"	7/7	
1	0826414346	Dr. Seuss: American Icon	NaN	A30TK6U7DNS82R	Kevin Killian	10/10	
2	0826414346	Dr. Seuss: American Icon	NaN	A3UH4UZ4RSVO82	John Granger	10/11	
3	0826414346	Dr. Seuss: American Icon	NaN	A2MVUWT453QH61	Roy E. Perry "amateur philosopher"	7/7	
4	0826414346	Dr. Seuss: American Icon	NaN	A22X4XUPKF66MR	D. H. Richards "ninthwavestore"	3/3	

In [3]:
```
# here i combine the data
import pandas as pd
combined_data = pd.merge(books_data, books_rating, on="Title", how="inner")
```

In [67]:
```
combined_data.head()
```

Out[67]:

	Title	description	authors	image	pr
0	Its Only Art If Its Well Hung!	NaN	['Julie Strain']	http://books.google.com/books/content?id=DykPA...	http://books.google id=DykPAAA
1	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	http://books.google.com/books/content?id=IjvHQ...	http://books.google id=IjvHQsC
2	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	http://books.google.com/books/content?id=IjvHQ...	http://books.google id=IjvHQsC
3	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	http://books.google.com/books/content?id=IjvHQ...	http://books.google id=IjvHQsC
4	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	http://books.google.com/books/content?id=IjvHQ...	http://books.google id=IjvHQsC

In [4]:
```
combined_data.shape
```

Out[4]:
```
(3000000, 19)
```

Part 2: Data Exploration and Cleaning

In [6]:
```
# Explore textual columns in combined_data DataFrame
text_columns = ["Title", "description", "authors", "publisher", "categories", "revi
for col in text_columns:
    print(f"Column: {col}")
    print(combined_data[col].head())
```

```
Column: Title
0    Its Only Art If Its Well Hung!
1          Dr. Seuss: American Icon
2          Dr. Seuss: American Icon
3          Dr. Seuss: American Icon
4          Dr. Seuss: American Icon
Name: Title, dtype: object
Column: description
0                                                   NaN
1    Philip Nel takes a fascinating look into the k...
2    Philip Nel takes a fascinating look into the k...
3    Philip Nel takes a fascinating look into the k...
4    Philip Nel takes a fascinating look into the k...
Name: description, dtype: object
Column: authors
0    ['Julie Strain']
1      ['Philip Nel']
2      ['Philip Nel']
3      ['Philip Nel']
4      ['Philip Nel']
Name: authors, dtype: object
Column: publisher
0          NaN
1    A&C Black
2    A&C Black
3    A&C Black
4    A&C Black
Name: publisher, dtype: object
Column: categories
0      ['Comics & Graphic Novels']
1    ['Biography & Autobiography']
2    ['Biography & Autobiography']
3    ['Biography & Autobiography']
4    ['Biography & Autobiography']
Name: categories, dtype: object
Column: review/summary
0             Nice collection of Julie Strain images
1                                Really Enjoyed It
2    Essential for every personal and Public Library
3    Phlip Nel gives silly Seuss a serious treatment
4                           Good academic overview
Name: review/summary, dtype: object
Column: review/text
0    This is only for Julie Strain fans. It's a col...
1    I don't care much for Dr. Seuss but after read...
2    If people become the books they read and if "t...
3    Theodore Seuss Geisel (1904-1991), aka &amp;quot;D...
4    Philip Nel - Dr. Seuss: American IconThis is b...
Name: review/text, dtype: object
```

In [5]:
```
print(combined_data.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3000000 entries, 0 to 2999999
Data columns (total 19 columns):
 #   Column              Dtype
---  ------              -----
 0   Title               object
 1   description         object
 2   authors             object
 3   image               object
 4   previewLink         object
 5   publisher           object
 6   publishedDate       object
 7   infoLink            object
 8   categories          object
 9   ratingsCount        float64
 10  Id                  object
 11  Price               float64
 12  User_id             object
 13  profileName         object
 14  review/helpfulness  object
 15  review/score        float64
 16  review/time         int64
 17  review/summary      object
 18  review/text         object
dtypes: float64(3), int64(1), object(15)
memory usage: 434.9+ MB
None
```

In [70]:
```
print(combined_data.describe())
```

```
       ratingsCount          Price  review/score   review/time
count  1.639306e+06  481171.000000  3.000000e+06  3.000000e+06
mean   2.720647e+02      21.762656  4.215289e+00  1.132307e+09
std    7.887721e+02      26.206541  1.203054e+00  1.493202e+08
min    1.000000e+00       1.000000  1.000000e+00 -1.000000e+00
25%    3.000000e+00      10.780000  4.000000e+00  9.999072e+08
50%    1.000000e+01      14.930000  5.000000e+00  1.128298e+09
75%    5.500000e+01      23.950000  5.000000e+00  1.269130e+09
max    4.895000e+03     995.000000  5.000000e+00  1.362355e+09
```

In [10]:
```
print(combined_data.isnull().sum())
```

```
Title                     208
description            640225
authors                390634
image                  540306
previewLink            330623
publisher              782617
publishedDate          354581
infoLink               330623
categories             551498
ratingsCount          1360694
Id                          0
Price                2518829
User_id               561787
profileName           561905
review/helpfulness         0
review/score               0
review/time                0
review/summary           407
review/text                8
dtype: int64
```

Extraction of relevant attributes to my study/project

In [4]:
```
#i extract attributes related to my project
relevant_attributes = combined_data[
    ["Title", "description", "authors", "categories", "ratingsCount", "review/score
]
```

In [7]:
```
relevant_attributes.head()
```

Out[7]:

	Title	description	authors	categories	ratingsCount	review/score	review/sum
0	Its Only Art If Its Well Hung!	NaN	['Julie Strain']	['Comics & Graphic Novels']	NaN	4.0	Nice collecti Julie S im
1	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	['Biography & Autobiography']	NaN	5.0	Really Enjoy
2	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	['Biography & Autobiography']	NaN	5.0	Essential for persona Public Li
3	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	['Biography & Autobiography']	NaN	4.0	Phlip Nel silly Se serious treat
4	Dr. Seuss: American Icon	Philip Nel takes a fascinating look into the k...	['Philip Nel']	['Biography & Autobiography']	NaN	4.0	Good acac ove

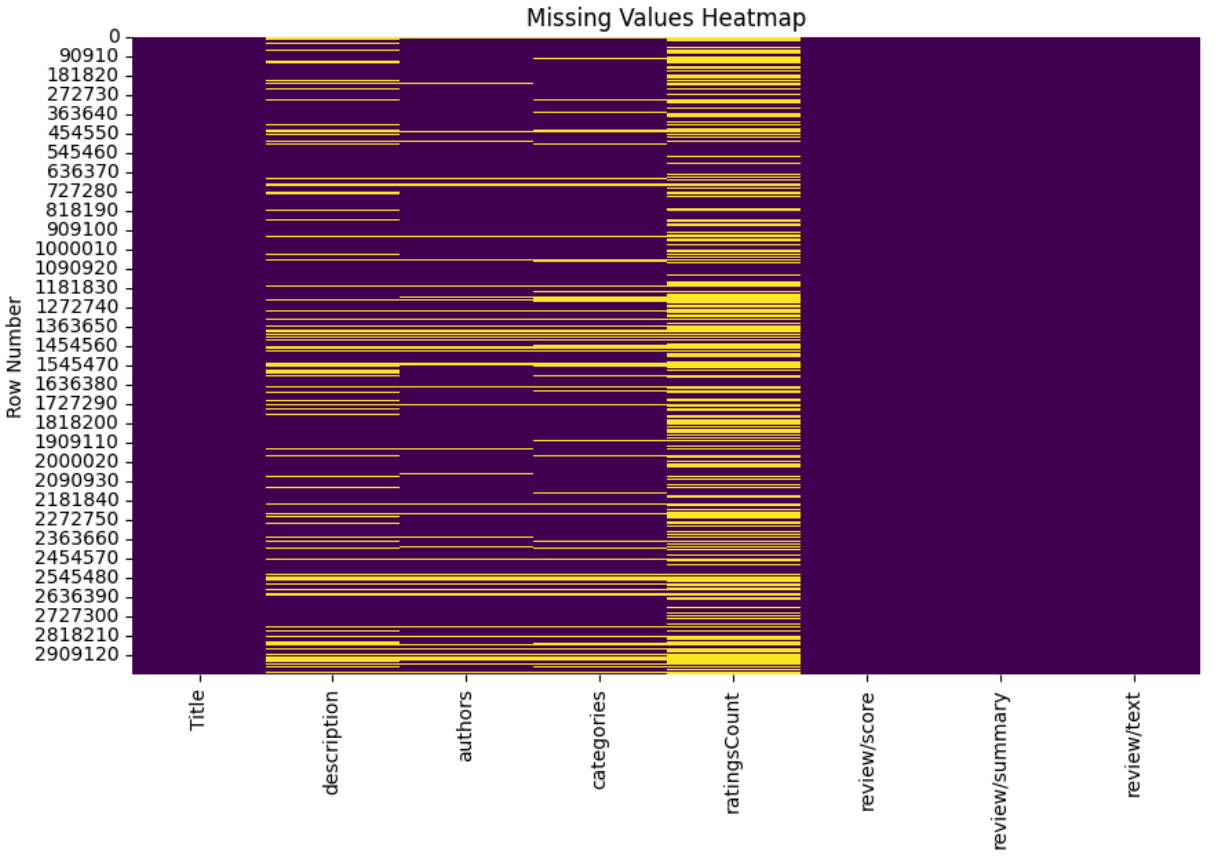
In [13]:
```
relevant_attributes.shape
```

Out[13]:
```
(3000000, 8)
```

In [9]:
```
# here Checking for duplicates and for NaN values
duplicates = relevant_attributes.duplicated().sum()
print("Number of duplicate rows:", duplicates)

# Check for NaN values
nan_values = relevant_attributes.isna().sum()
print("\nNumber of NaN values per column:")
print(nan_values)
```

```
Number of duplicate rows: 378849

Number of NaN values per column:
Title                 208
description        640225
authors            390634
categories         551498
ratingsCount      1360694
review/score            0
review/summary        407
review/text             8
dtype: int64
```

In [17]:
```
# Visualize Missing Values

plt.figure(figsize=(10, 6))
sns.heatmap(relevant_attributes.isnull(), cbar=False, cmap='viridis')
plt.title("Missing Values Heatmap")
plt.ylabel("Row Number")
plt.show()
```



In [15]:
```
#Explore Categorical Variables

unique_authors = relevant_attributes['authors'].unique()
print("Unique Authors:", unique_authors)
print("Number of Unique Authors:", len(unique_authors))

unique_categories = relevant_attributes['categories'].unique()
print("\nUnique Categories:", unique_categories)
print("Number of Unique Categories:", len(unique_categories))
```

```
unique_reviews = relevant_attributes['review/text'].unique()
print("\nUnique Reviews:", unique_reviews)
print("Number of Unique Reviews:", len(unique_reviews))
```

Unique Authors: ["['Julie Strain']" "['Philip Nel']" "['David R. Ray']" ...
 "['Daniel Banach', 'Travis Jones']" "['Wild Wild Cabbage']"
 "['David B. Johnson', 'Thomas A. Mowry']"]
Number of Unique Authors: 127279

Unique Categories: ["['Comics & Graphic Novels']" "['Biography & Autobiography']"
 "['Religion']" ... "['Portsmouth Island (N.C.)']" "['Tobacco']"
 "['Flame in the wind (Motion picture)']"]
Number of Unique Categories: 10884

Unique Reviews: ["This is only for Julie Strain fans. It's a collection of her photos -- about 80 pages worth with a nice section of paintings by Olivia.If you're looking for heavy literary content, this isn't the place to find it -- there's only about 2 pages with text and everything else is photos.Bottom line: if you only want one book, the Six Foot One ... is probably a better choice, however, if you like Julie like I like Julie, you won't go wrong on this one either."
 "I don't care much for Dr. Seuss but after reading Philip Nel's book I changed my mind--that's a good testimonial to the power of Rel's writing and thinking. Rel plays Dr. Seuss the ultimate compliment of treating him as a serious poet as well as one of the 20th century's most interesting visual artists, and after reading his book I decided that a trip to the Mandeville Collections of the library at University of California in San Diego was in order, so I could visit some of the incredible Seuss/Geisel holdings they have there.There's almost too much to take in, for, like William Butler Yeats, Seuss led a career that constantly shifted and metamoprhized itself to meet new historical and political cirsumstances, so he seems to have been both a leftist and a conservative at different junctures of his career, both in politics and in art. As Nel shows us, he was once a cartoonist for the fabled PM magazine and, like Andy Warhol, he served his time slaving in the ad business too. All was in the service of amusing and broadening the minds of US children. Nel doesn't hesitate to administer a sound spanking to the Seuss industry that, since his death, has seen fit to license all kinds of awful products including the recent CAT IN THE HAT film with Mike Myers. Oh, what a cat-astrophe!The book is great and I can especially recommend the work of the picture editor who has given us a bounty of good illustrations."
 'If people become the books they read and if "the child is father to the man," then Dr. Seuss (Theodor Seuss Geisel) is the most influential author, poet, and artist of modern times. For me, a daddy to a large family who learned to read with Dr. Seuss and who has memorized too many of the books via repeated readings to young children, Prof. Nel\'s brilliant \'American Icon\' is a long awaited treat. At last a serious treatment of this remarkable genius that is both an engaging read and filled with remarkable insights! I especially enjoyed (and learned more than I care to admit from) Prof. Nel\'s discussions of the Disneyfication of Seuss - which Nel links to failings in American copyright law, "the other sides of Dr. Seuss" - all of which sides were new to me, and the political genesis of his secular morality in the WWII cartoon work he did at PM magazine. The chapters on Geisel\'s poetry and artwork and the link Nel makes between Seuss and the historical avant guarde alone make this book a "must buy" for parents and serious readers, not to mention public libraries. Readers of Nel\'s other books will find the same engaging writing style that makes the book a fun read while imparting a mountain of information and important ideas. This is simply the best and most comprehensive book yet written on the work of Seuss Geisel and what will certainly be the standard for many years to come. Thank you, Prof. Nel, wherever you are, from a reader who grew up with the good doctor and who is growing up with him again years later. Your book, written from your encyclopeadic knowledge of children\'s literature and the media of this genre - from scanning verse to cubist painting! - explains the power, limits, and popularity of the Seuss phenomenon.'
 ...
 'This book is well written and easy to use, well organized and easy to use.'

```
 'This book is the companion to the text. It provides step by step solutions to help
in arriving to an answer. However, it only provides a solution to the odd questions,
and only to about half of those. It seems to skip the majority of problems that I go
t stuck on. For example: I had a problem on question #15, but the manual provided an
swers for 11 and then proceeded to #17. This was aggravating. $40? I think not. I ma
y have paid $4 if I had been warned. DO YOURSELF A FAVOR AND SKIP THIS PIECE OF TRAS
H.'
 "A very useful book for this type of course. It might not be exactly what you're lo
oking for if you want something to read on your own."]
Number of Unique Reviews: 2062649
```

In [7]:
```python
# samples of text/review

sample_reviews = relevant_attributes['review/text'].sample(n=3)
for review in sample_reviews:
    print(review)
```

```
I just really liked this. I'm the kind of girl who likes outdoor activities, includi
ng diving, so I really got into Crash Dive. The author clearly knows what he's talki
ng about, and has a knack for description, 'specially underwater. Very exciting and
kind of relevant since we just got hit by terrorists for real. An exciting read that
makes you think. This writer has another fan.
I had read Fagles new translation, but nothing prepared me for the influential versi
on. This is how the Iliad should be and the fabulous translation makes this accessib
le and easy to understand. A few parts are boring (the enumeration of ships and sold
iers is boring), but this is a compelling story. The book is clear and easy to under
stand, evenly paced without dragging. Definitely a recommendation!
Using this stationary is fun and I am WAY out of the intended demographic. Even gran
dmothers can use this handy kit, and it brings a bit of enjoyment and wizardry to ou
r correspondence. Paper - 25 sheets!! Envelopes - 12?? Could be more, a rather awkwa
rd brown calligraphy pen, and the best of all - 32 Harry Potter stickers. I love it.
Not babyish, and a bit wacky - can be used as a lap table because the kit is its own
writing suface and the stickers and pen and envelopes hide with your postage stamps
in a drawer - the whole thing is the size of a Harry Potter book.
```

In [5]:
```python
# Check for NaN values
nan_values = relevant_attributes.isna().sum()
print("\nNumber of NaN values per column:")
print(nan_values)
```

```
Number of NaN values per column:
Title                208
description        640225
authors            390634
categories         551498
ratingsCount      1360694
review/score            0
review/summary        407
review/text             8
dtype: int64
```

I Am Droping rows with missing values in the "review/text" column they are only few

In [6]:
```python
relevant_attributes = relevant_attributes.dropna(subset=['review/text']).copy()
```

Here, Impute missing values in the "ratingsCount" column

In [7]:
```
#Here, Impute missing values in the "ratingsCount" column

from sklearn.impute import SimpleImputer

imputer = SimpleImputer(strategy='median')
relevant_attributes.loc[:, 'ratingsCount'] = imputer.fit_transform(relevant_attribu
```

In [8]:
```
# Drop duplicate rows
relevant_attributes.drop_duplicates(inplace=True)
print("Number of duplicate rows after dropping:", relevant_attributes.duplicated().
```

```
Number of duplicate rows after dropping: 0
```

In [9]:
```
#Replacing missing values in "authors" and "categories" columns with "Unknown"

relevant_attributes['authors'] = relevant_attributes['authors'].fillna('Unknown')
relevant_attributes['categories'] = relevant_attributes['categories'].fillna('Unkno
```

In [10]:
```
# Droping rows with missing values in Title and review/summary columns

relevant_attributes.dropna(subset=['Title', 'review/summary', 'description'], inpla
```

In [11]:
```
# Replace "Unknown" with "General" for the first half and "Other" for the second ha

condition = (np.arange(len(relevant_attributes)) < len(relevant_attributes) / 2)

relevant_attributes.loc[condition, 'authors'] = relevant_attributes.loc[condition,
relevant_attributes.loc[~condition, 'authors'] =relevant_attributes.loc[~condition,
```

In [12]:
```
# Replace "Unknown" with "General" for the first half and "Other" for the second ha
import numpy as np

condition = (np.arange(len(relevant_attributes)) < len(relevant_attributes) / 2)

relevant_attributes.loc[condition, 'categories'] = relevant_attributes.loc[conditio
relevant_attributes.loc[~condition, 'categories'] = relevant_attributes.loc[~condit
```

In [13]:
```
# Custom function to clean author names
import pandas as pd
import numpy as np

def clean_and_join_authors(authors):
    if isinstance(authors, str):
        cleaned_authors = [author.strip().strip("'") for author in authors.strip("[
        return ', '.join(cleaned_authors).replace(',', ', ')
    else:
        return np.nan

relevant_attributes.loc[:,'authors'] = relevant_attributes['authors'].apply(clean_a

print(relevant_attributes['authors'])
```

```
1                                  Philip Nel
2                                  Philip Nel
3                                  Philip Nel
4                                  Philip Nel
5                                  Philip Nel
                           ...
2999995                           Zadie Smith
2999996    David B. Johnson,  Thomas A. Mowry
2999997    David B. Johnson,  Thomas A. Mowry
2999998    David B. Johnson,  Thomas A. Mowry
2999999    David B. Johnson,  Thomas A. Mowry
Name: authors, Length: 2048532, dtype: object
```

In [14]:
```python
# Custom function to clean remove leading/trailing spaces and single quotes from ea

import numpy as np

def clean_and_join_categories(categories):
    if isinstance(categories, str):
        cleaned_categories = [category.strip("', ") for category in categories.stri
        return ', '.join(cleaned_categories)
    else:
        return np.nan

relevant_attributes['categories'] = relevant_attributes['categories'].apply(clean_a

print(relevant_attributes['categories'])
```

```
1          Biography & Autobiography
2          Biography & Autobiography
3          Biography & Autobiography
4          Biography & Autobiography
5          Biography & Autobiography
                     ...
2999995                      Fiction
2999996                        Other
2999997                        Other
2999998                        Other
2999999                        Other
Name: categories, Length: 2048532, dtype: object
```

In [15]:
```python
relevant_attributes.shape
```

Out[15]:
```
(2048532, 8)
```

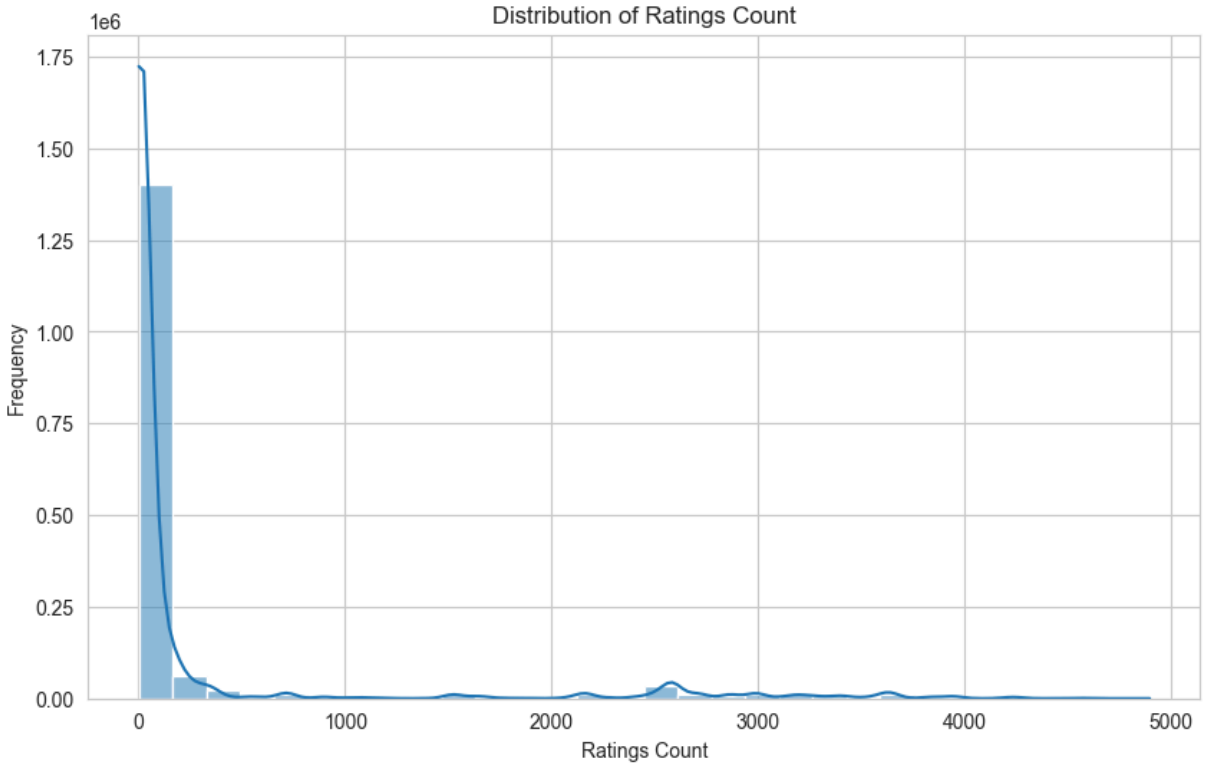
In [19]:
```python
print(relevant_attributes.info())
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 2048532 entries, 1 to 2999999
Data columns (total 8 columns):
 #   Column          Dtype  
---  ------          -----  
 0   Title           object 
 1   description     object 
 2   authors         object 
 3   categories      object 
 4   ratingsCount    float64
 5   review/score    float64
 6   review/summary  object 
 7   review/text     object 
dtypes: float64(2), object(6)
memory usage: 140.7+ MB
None
```

In [20]:
```
import matplotlib.pyplot as plt
import seaborn as sns

sns.set_style("whitegrid")

plt.figure(figsize=(10, 6))
sns.histplot(data=combined_data, x='ratingsCount', bins=30, kde=True)
plt.title('Distribution of Ratings Count')
plt.xlabel('Ratings Count')
plt.ylabel('Frequency')
```

```
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```

Out[20]:
```
Text(0, 0.5, 'Frequency')
```



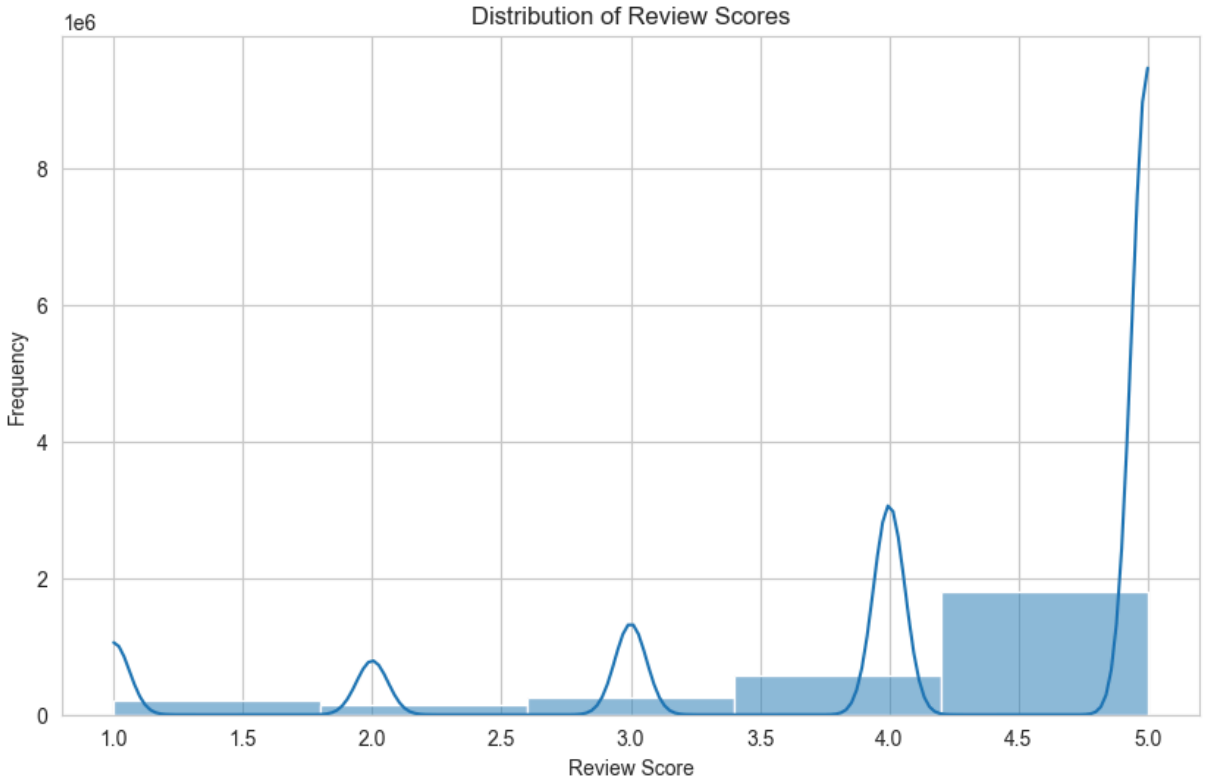
Here i am checking the categories attribute which largest category/genre

In [22]:
```
category_counts = relevant_attributes['categories'].value_counts()

sorted_categories = category_counts.sort_values(ascending=False)

 top_ten_counts = sorted_categories.head(10)

rest_count = sorted_categories[10:].sum()

print("Count of the top ten categories:")
print(top_ten_counts)

print("\nCount of the rest of the categories combined:")
print(rest_count)
```

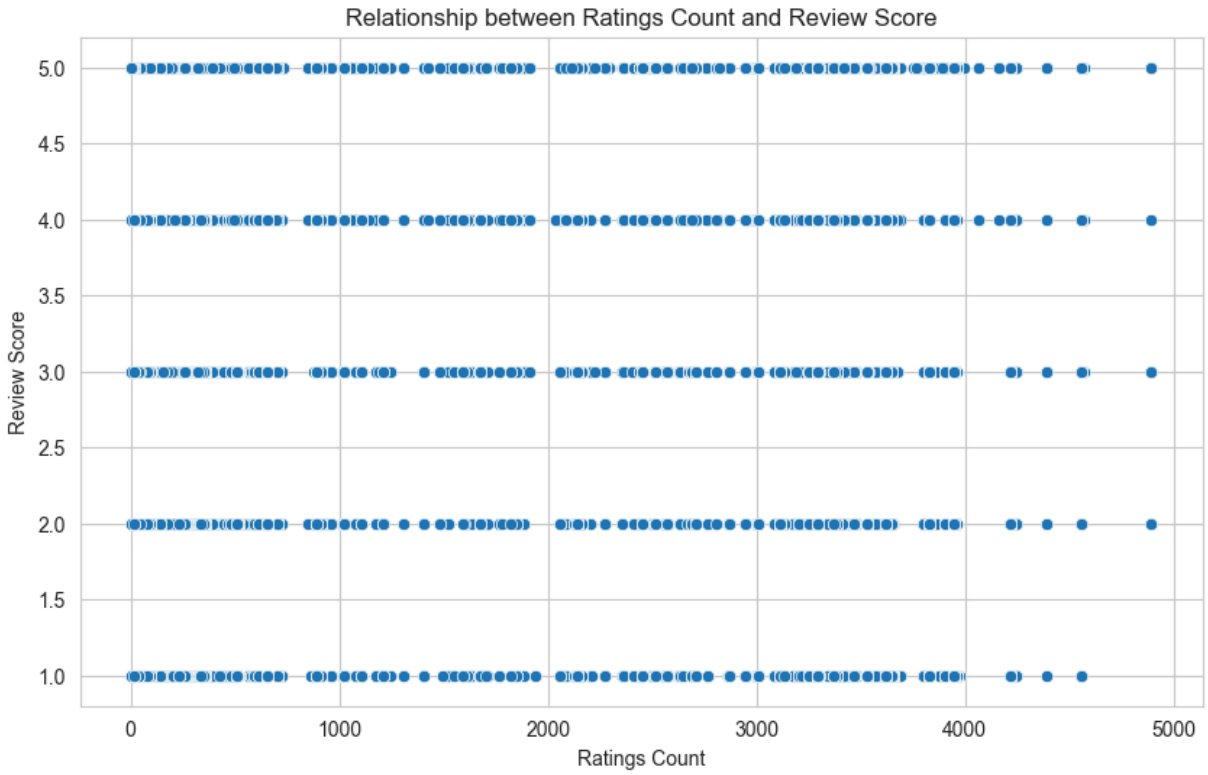
```
Count of the top ten categories:
categories
Fiction                      668204
Juvenile Fiction             168555
Biography & Autobiography     94016
Religion                      82896
History                       81201
Business & Economics          59693
Unspecified                   41052
Other                         40891
Computers                     40780
Cooking                       28208
Name: count, dtype: int64

Count of the rest of the categories combined:
743036
```

In [37]:
```
# Visualizing the distribution of review scores
import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(10, 6))
sns.histplot(data=relevant_attributes, x='review/score', bins=5, kde=True)
plt.title('Distribution of Review Scores')
plt.xlabel('Review Score')
plt.ylabel('Frequency')
plt.show()
```

```
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```



In [28]:
```
# Visualizing the relationship between review score and ratings count
import matplotlib.pyplot as plt
import seaborn as sns


# Visualizing the relationship between review score and ratings count
plt.figure(figsize=(10, 6))
sns.scatterplot(data=relevant_attributes, x='ratingsCount', y='review/score')
plt.title('Relationship between Ratings Count and Review Score')
plt.xlabel('Ratings Count')
plt.ylabel('Review Score')
plt.show()
```



In [31]:
```
# Calculate summary statistics
mean = relevant_attributes['review/score'].mean()
median = relevant_attributes['review/score'].median()
std_dev = relevant_attributes['review/score'].std()
skewness = relevant_attributes['review/score'].skew()
kurtosis = relevant_attributes['review/score'].kurtosis()

print(f"Mean: {mean}")
print(f"Median: {median}")
print(f"Standard Deviation: {std_dev}")
print(f"Skewness: {skewness}")
print(f"Kurtosis: {kurtosis}")
```

```
Mean: 4.215289333333334
Median: 5.0
Standard Deviation: 1.2030537472334013
Skewness: -1.5191028505130895
Kurtosis: 1.2064600645925103
```

In [23]:
```
# Check for NaN values
nan_values = relevant_attributes.isna().sum()
print("\nNumber of NaN values per column:")
print(nan_values)
```

```
Number of NaN values per column:
Title             0
description       0
authors           0
categories        0
ratingsCount      0
review/score      0
review/summary    0
review/text       0
dtype: int64
```

Part 3: Sklearn sample

here i am taking 10% Stratified sample from the totql data using sklearn library and choocing gategories variable as a target variable,or basically dependent variable

In [20]:
```
from sklearn.model_selection import StratifiedShuffleSplit
import pandas as pd
np.random.seed(42)

X = relevant_attributes.drop(['categories'], axis=1)
y = relevant_attributes['categories']

sss = StratifiedShuffleSplit(n_splits=1, test_size=0.1, random_state=1)


sampled_df = pd.DataFrame()
sampled_df = pd.DataFrame()
for train_index, test_index in sss.split(X, y):
    X_sample = X.iloc[test_index]
    y_sample = y.iloc[test_index]
    sampled_df = X_sample.copy()
    sampled_df['categories'] = y_sample


print(sampled_df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 204854 entries, 2661854 to 2695702
Data columns (total 8 columns):
 #   Column          Non-Null Count   Dtype  
---  ------          --------------   -----  
 0   Title           204854 non-null  object 
 1   description     204854 non-null  object 
 2   authors         204854 non-null  object 
 3   ratingsCount    204854 non-null  float64
 4   review/score    204854 non-null  float64
 5   review/summary  204854 non-null  object 
 6   review/text     204854 non-null  object 
 7   categories      204854 non-null  object 
dtypes: float64(2), object(6)
memory usage: 14.1+ MB
None
```

In [21]:
```
sampled_df.head()
```

Out[21]:

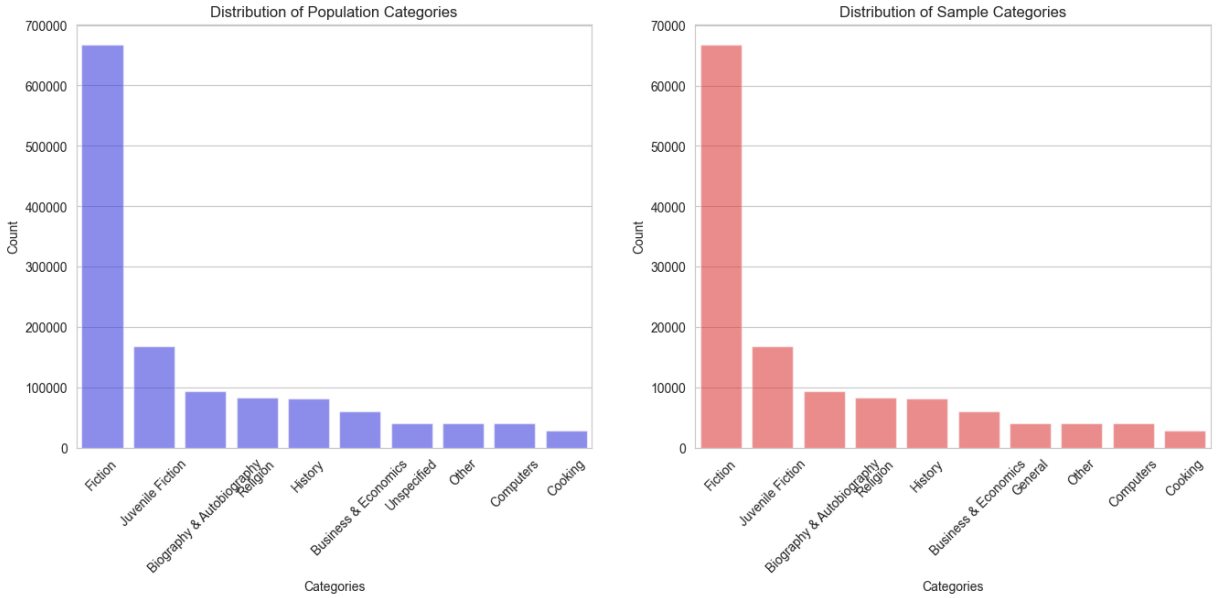
	Title	description	authors	ratingsCount	review/score	review/summary
2661854	Eldest (Inheritance, Book 2)	After successfully evading an Urgals ambush, E...	Christopher Paolini	167.0	5.0	Happy
2701459	Hammock: How to Make Your Own and Lie in It	Information on the history of the hammock prec...	Denison Andrews	10.0	5.0	I love th SPRANG (pronounce "sprong" hammock
782292	The Dogs of War	#1 New York Times bestselling author Frederick...	Frederick Forsyth	8.0	5.0	Not Free S Reade
349600	Year of Wonders (Turtleback School & Library B...	"New Mexico's rich and varied history is easil...	Arthur Pike & David Pike	10.0	5.0	Year of Wonder
458230	Out of the Dust	Acclaimed author Karen Hesse's Newbery Medal-w...	Karen Hesse	156.0	5.0	Great Book!

Validation the Sample

The code visualizes the distribution of the top 10 most common categories in both the population and a stratified sample. to comparing the counts of categories between the population dataset

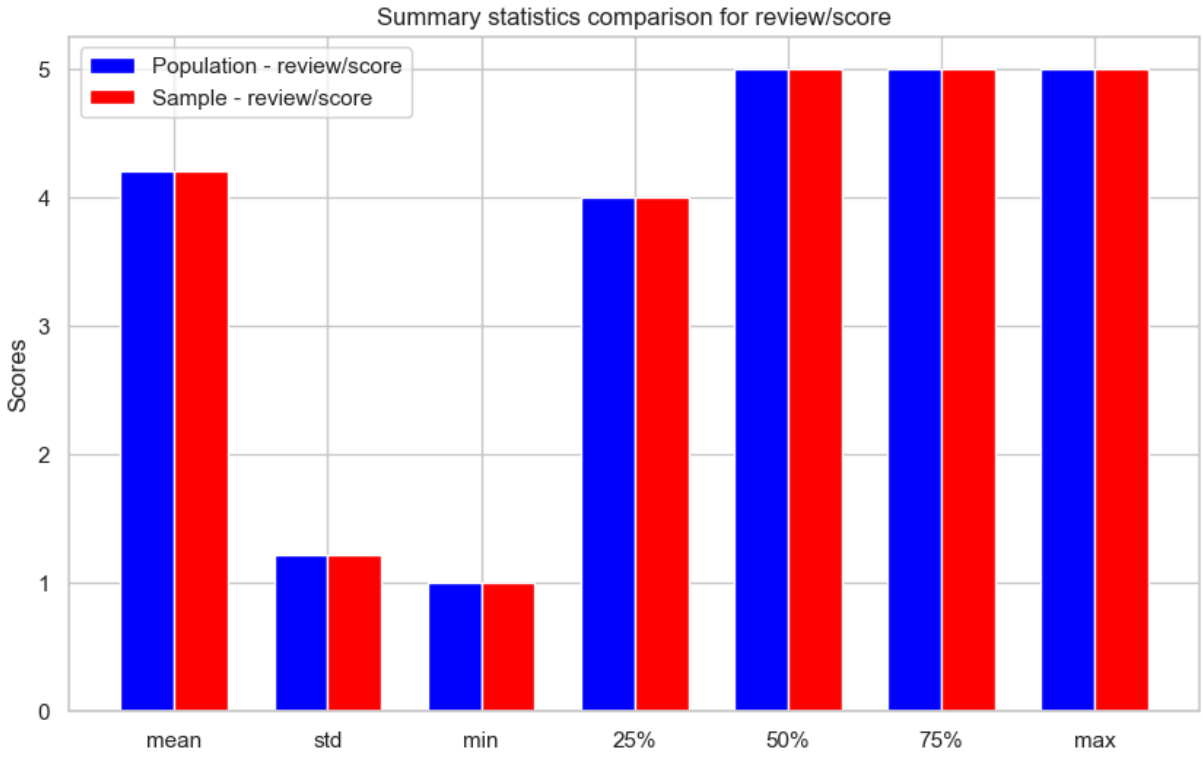
In [27]:
```
population_category_counts = relevant_attributes['categories'].value_counts().head(
sample_category_counts = sampled_df['categories'].value_counts().head(10)

# Create two subplots side by side
fig, axes = plt.subplots(1, 2, figsize=(16, 6))


sns.barplot(x=population_category_counts.index, y=population_category_counts.values
axes[0].set_title('Distribution of Population Categories')
axes[0].set_xlabel('Categories')
```

```
axes[0].set_ylabel('Count')
axes[0].tick_params(axis='x', rotation=45)


sns.barplot(x=sample_category_counts.index, y=sample_category_counts.values, ax=axe
axes[1].set_title('Distribution of Sample Categories')
axes[1].set_xlabel('Categories')
axes[1].set_ylabel('Count')
axes[1].tick_params(axis='x', rotation=45)
```



In [415…

```
# Compute summary statistics 'review/score' for population(relavent_attripute) and

population_summary_stats = relevant_attributes['review/score'].describe()
sample_summary_stats = sampled_df['review/score'].describe()

fig, ax = plt.subplots(figsize=(10, 6))  # Create 1 plot

rects1 = ax.bar(x - width/2, population_vals, width, label='Population - review/sco
rects2 = ax.bar(x + width/2, sample_vals, width, label='Sample - review/score', col

ax.set_ylabel('Scores')
ax.set_title('Summary statistics comparison for review/score')
ax.set_xticks(x)
ax.set_xticklabels(stats)
ax.legend()

plt.show()
```

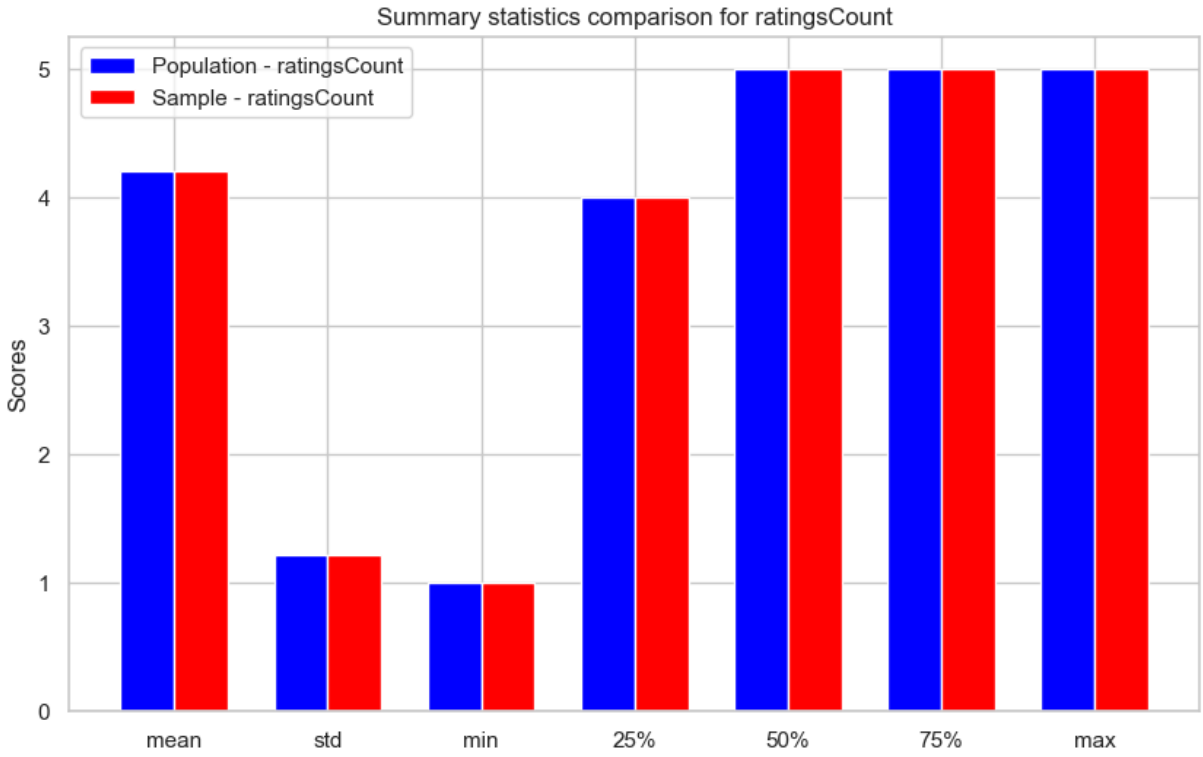


In [416…

```
# Compute summary statistics for 'ratingsCount' for both datasets original and samp
population_summary_stats = relevant_attributes['ratingsCount'].describe()
sample_summary_stats = sampled_df['ratingsCount'].describe()

fig, ax = plt.subplots(figsize=(10, 6))

rects1 = ax.bar(x - width/2, population_vals, width, label='Population - ratingsCou
rects2 = ax.bar(x + width/2, sample_vals, width, label='Sample - ratingsCount', col

ax.set_ylabel('Scores')
ax.set_title('Summary statistics comparison for ratingsCount')
ax.set_xticks(x)
ax.set_xticklabels(stats)
ax.legend()
```

Out[416…

```
<matplotlib.legend.Legend at 0x1a62a67a8c0>
```

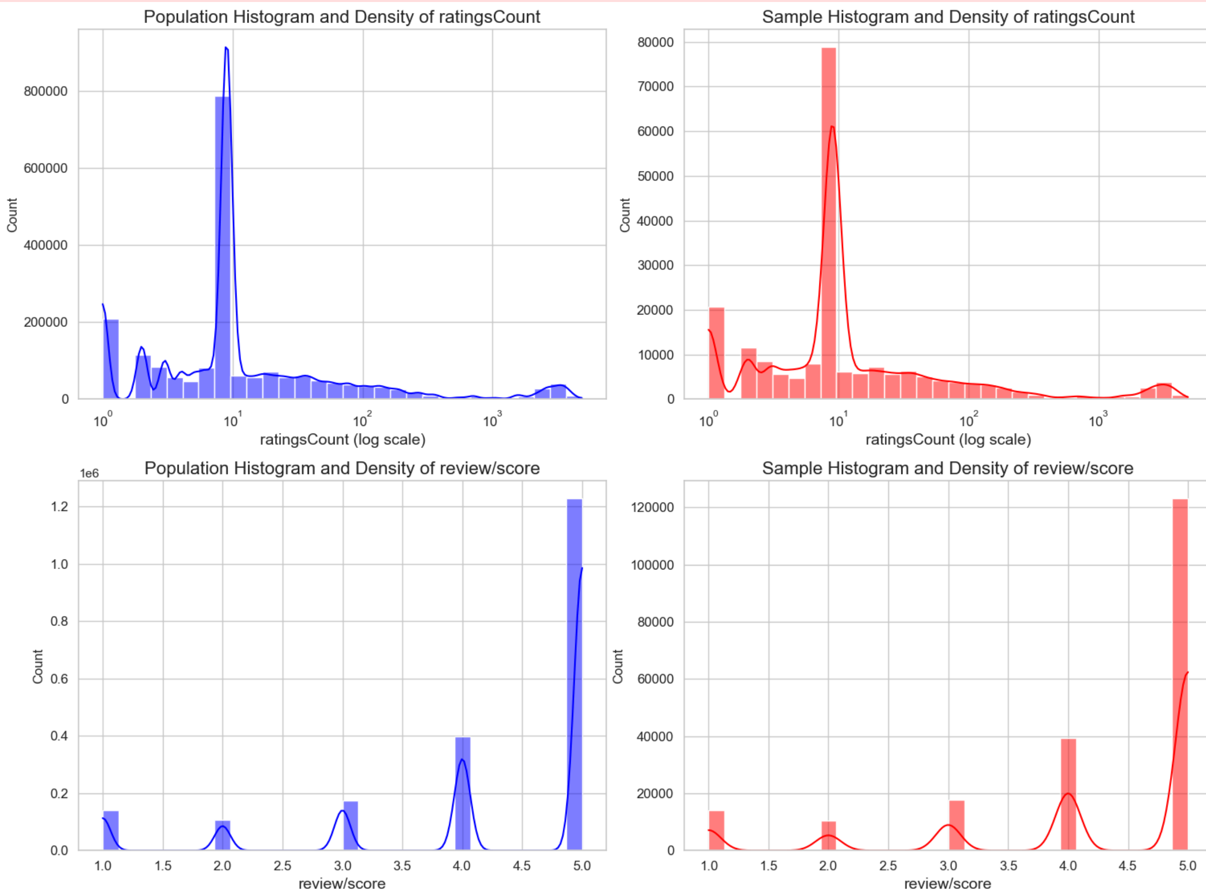


below codes to create histograms to compare between both datas

In [290…

```
import matplotlib.pyplot as plt
import seaborn as sns

fig, axes = plt.subplots(2, 2, figsize=(16, 12))

#  Population
sns.histplot(relevant_attributes['ratingsCount'], bins=30, kde=True, color="blue",
axes[0, 0].set_title('Population Histogram and Density of ratingsCount', fontsize=1
axes[0, 0].set_xlabel('ratingsCount (log scale)', fontsize=14)

#  Sample
sns.histplot(sampled_df['ratingsCount'], bins=30, kde=True, color="red", ax=axes[0,
axes[0, 1].set_title('Sample Histogram and Density of ratingsCount', fontsize=16)
axes[0, 1].set_xlabel('ratingsCount (log scale)', fontsize=14)

# Population
sns.histplot(relevant_attributes['review/score'], bins=30, kde=True, color="blue",
axes[1, 0].set_title('Population Histogram and Density of review/score', fontsize=1
axes[1, 0].set_xlabel('review/score', fontsize=14)

#  Sample
sns.histplot(sampled_df['review/score'], bins=30, kde=True, color="red", ax=axes[1,
axes[1, 1].set_title('Sample Histogram and Density of review/score', fontsize=16)
axes[1, 1].set_xlabel('review/score', fontsize=14)
```

```
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_ol
dcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_ol
dcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_ol
dcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_ol
dcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```



In [199…

```
#some basic Statistics  For ratingsCount in both datas
print("Full dataset 'ratingsCount' statistics:", relevant_attributes['ratingsCount'
print("Sampled dataset 'ratingsCount' statistics:", sampled_df['ratingsCount'].desc

# For review/score
print("Full dataset 'review/score' statistics:", relevant_attributes['review/score'
print("Sampled dataset 'review/score' statistics:", sampled_df['review/score'].desc
```

```
Full dataset 'ratingsCount' statistics: count    2.047264e+06
mean     1.510525e+02
std      6.019904e+02
min      1.000000e+00
25%      5.000000e+00
50%      9.000000e+00
75%      1.900000e+01
max      4.895000e+03
Name: ratingsCount, dtype: float64
Sampled dataset 'ratingsCount' statistics: count    204727.000000
mean        149.965329
std         600.778609
min           1.000000
25%           5.000000
50%           9.000000
75%          19.000000
max        4895.000000
Name: ratingsCount, dtype: float64
Full dataset 'review/score' statistics: count    2.047264e+06
mean     4.204405e+00
std      1.212204e+00
min      1.000000e+00
25%      4.000000e+00
50%      5.000000e+00
75%      5.000000e+00
max      5.000000e+00
Name: review/score, dtype: float64
Sampled dataset 'review/score' statistics: count    204727.000000
mean          4.207071
std           1.211205
min           1.000000
25%           4.000000
50%           5.000000
75%           5.000000
max           5.000000
Name: review/score, dtype: float64
```

In [17]:
```
print(sampled_df.isna())
```

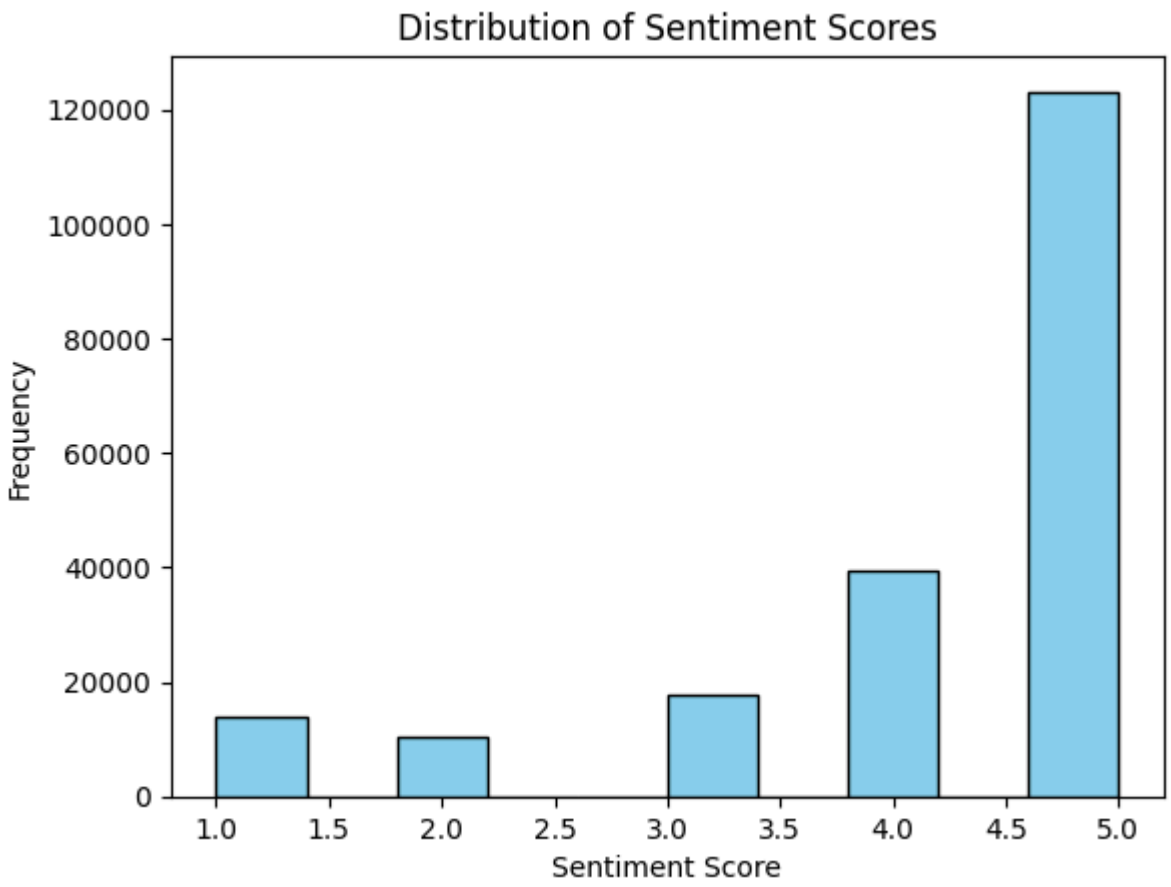
```
        Title  description  authors  ratingsCount  review/score  \
0       False        False    False         False         False
1       False        False    False         False         False
2       False        False    False         False         False
3       False        False    False         False         False
4       False        False    False         False         False
...       ...          ...      ...           ...           ...
204722  False        False    False         False         False
204723  False        False    False         False         False
204724  False        False    False         False         False
204725  False        False    False         False         False
204726  False        False    False         False         False

        review/summary  review/text  categories  tokenized_review  \
0                False        False       False             False
1                False        False       False             False
2                False        False       False             False
3                False        False       False             False
4                False        False       False             False
...                ...          ...         ...               ...
204722           False        False       False             False
204723           False        False       False             False
204724           False        False       False             False
204725           False        False       False             False
204726           False        False       False             False

        sentiment_category
0                    False
1                    False
2                    False
3                    False
4                    False
...                    ...
204722               False
204723               False
204724               False
204725               False
204726               False

[204727 rows x 10 columns]
```

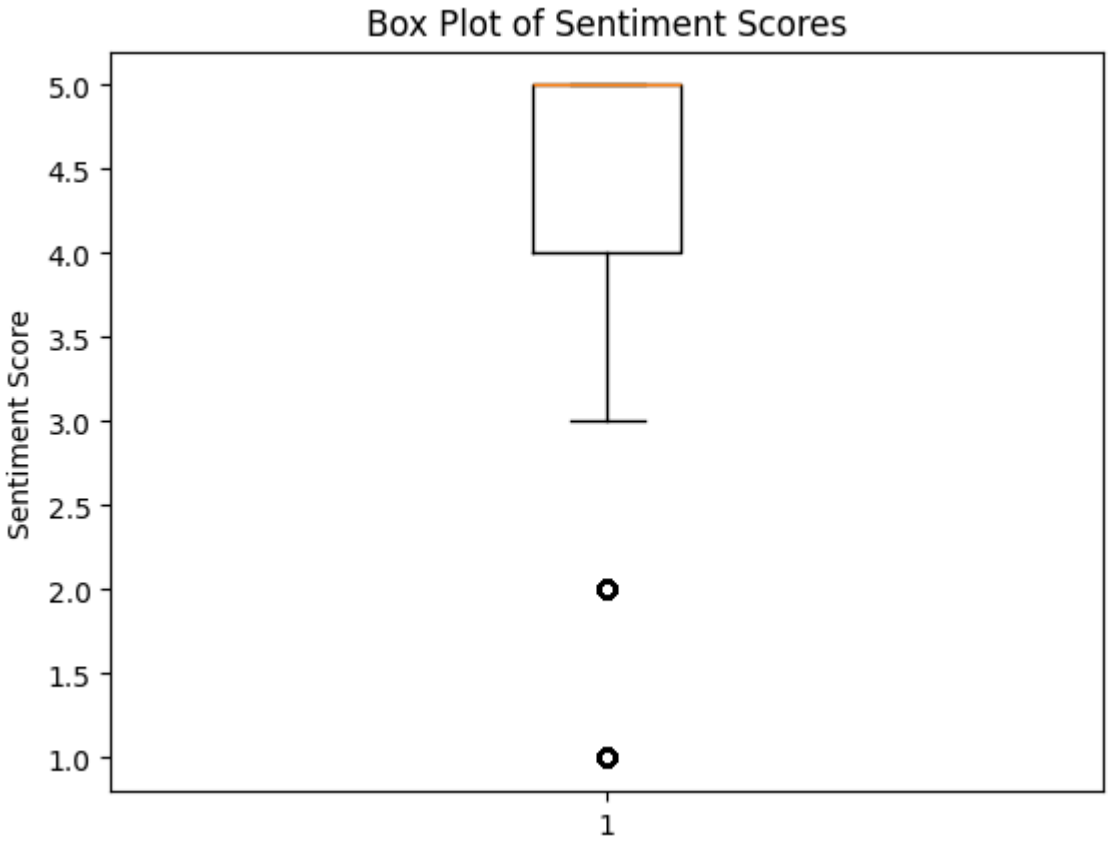
In [65]:
```
# Calculate the distribution of categories
category_distribution = relevant_attributes['categories'].value_counts(normalize=Tr

print("Category Distribution:")
print(category_distribution)
```

```
Category Distribution:
categories
Fiction                                 3.261868e-01
Juvenile Fiction                        8.228087e-02
Biography & Autobiography               4.589433e-02
Religion                                4.046605e-02
Unknown                                 4.000084e-02
                                            ...
Action research in education            4.881544e-07
Vintners                                4.881544e-07
Canon law                               4.881544e-07
Caucasus, Northern (Russia)             4.881544e-07
Flame in the wind (Motion picture)      4.881544e-07
Name: proportion, Length: 5416, dtype: float64
```

In [206…

```python
# Plot histogram of sentiment scores
plt.hist(sampled_df['review/score'], bins=10, color='skyblue', edgecolor='black')
plt.title('Distribution of Sentiment Scores')
plt.xlabel('Sentiment Score')
plt.ylabel('Frequency')
plt.show()

# Plot box plot of sentiment scores
plt.boxplot(sampled_data['review/score'])
plt.title('Box Plot of Sentiment Scores-review/score')
plt.ylabel('Sentiment Score')
plt.show()
```





Part 4 Text preprocessing

Tokenization

In [22]:
```
# here Tokenization and stop word and Punctuation removal

import pandas as pd
import spacy

nlp = spacy.load("en_core_web_sm")

def tokenize_review(review):

    doc = nlp(review)
    tokens = [token.text for token in doc if not token.is_punct and not token.is_st
    return tokens

sampled_df['tokenized_review'] = sampled_df['review/text'].apply(tokenize_review)

print(sampled_df.head())
```

```
                                                    Title  \
2661854                       Eldest (Inheritance, Book 2)
2701459       Hammock: How to Make Your Own and Lie in It
782292                                      The Dogs of War
349600   Year of Wonders (Turtleback School & Library B...
458230                                      Out of the Dust

                                                description  \
2661854  After successfully evading an Urgals ambush, E...
2701459  Information on the history of the hammock prec...
782292   #1 New York Times bestselling author Frederick...
349600   "New Mexico's rich and varied history is easil...
458230   Acclaimed author Karen Hesse's Newbery Medal-w...

                         authors  ratingsCount  review/score  \
2661854       Christopher Paolini         167.0           5.0
2701459           Denison Andrews          10.0           5.0
782292          Frederick Forsyth           8.0           5.0
349600   Arthur Pike & David Pike          10.0           5.0
458230                Karen Hesse         156.0           5.0

                                       review/summary  \
2661854                                         Happy
2701459  I love the SPRANG (pronounced "sprong") hammock!
782292                                Not Free SF Reader
349600                                   Year of Wonders
458230                                      Great Book!!

                                            review/text        categories  \
2661854  I am happy with my purchase. It was in great c...  Juvenile Fiction
2701459  This book is a great introduction to making si...         Hammocks.
782292   People with no reason to worry about continued...           Fiction
349600   This was a extremely enjoyable book which migh...           History
458230   THis is a great book!! It's about a girl named...  Juvenile Fiction

                                       tokenized_review
2661854  [happy, purchase, great, condition, came, quic...
2701459  [book, great, introduction, making, simple, ha...
782292   [People, reason, worry, continued, living, bad...
349600   [extremely, enjoyable, book, strange, book, de...
458230   [great, book, girl, named, Billie, Jo, living,...
```

In [50]:

```
print(sampled_df['tokenized_review'].head(10))
```

```
2661854    [happy, purchase, great, condition, come, quic...
2701459    [book, great, introduction, make, simple, hamm...
782292     [people, reason, worry, continue, live, bad, o...
349600     [extremely, enjoyable, book, strange, book, de...
458230     [great, book, girl, name, billie, jo, living, ...
204721     [book, give, gift, dear, friend, jackie, max, ...
442053     [good, spy, novel, write, good, le, carre, abl...
1897329    [girl, age, read, book, come, read, woman, nov...
1685336    [domine, exaudi, vocem, meum, cslewi, like, th...
1829289    [read, work, basically, focus, hume, famous, t...
Name: tokenized_review, dtype: object
```

In [31]:
```
# here i am Lowercasing the tokens
sampled_df['tokenized_review'] = sampled_df['tokenized_review'].apply(lambda tokens
```

In [9]:
```
# removing numeric characters
sampled_df['tokenized_review'] = sampled_df['tokenized_review'].apply(lambda tokens
```

In [47]:
```
#here i am doing Lemmatization

import spacy

nlp = spacy.load("en_core_web_sm")

def lemmatize_tokens(tokens):
    doc = nlp(" ".join(tokens))
    lemmatized_tokens = [token.lemma_ for token in doc]
    return lemmatized_tokens

# Assuming sampled_df is your DataFrame and 'tokenized_review' is the column contai
sampled_df['tokenized_review'] = sampled_df['tokenized_review'].apply(lemmatize_tok
```

In [8]:
```
# here removing special characters

import re

def remove_special_characters(tokens):
    cleaned_tokens = [re.sub(r'[^a-zA-Z0-9\s]', '', token) for token in tokens]
    return cleaned_tokens

sampled_df['tokenized_review'] = sampled_df['tokenized_review'].apply(remove_specia
```

In [27]:
```
sampled_df.head()
```

Out[27]:

	Title	description	authors	ratingsCount	review/score	review/summary	revie
0	Sacred Path Cards: The Discovery of Self Throu...	This extraordinary tool for self-discovery dra...	Jamie Sams	2.0	4.0	I regularly use the cards and read the book an...	Th a carc de cha
1	Lord of the flies	William Golding's unforgettable classic of boy...	William Golding	2861.0	5.0	Lord of the Flies	Th was excel Gc
2	Lord of the Flies	William Golding's unforgettable classic of boy...	William Golding	2861.0	4.0	Lord of the flies	The t tal re
3	The doomsters	Hired by Carl Hallman, the desperate-eyed junk...	Ross Macdonald	3.0	5.0	Both a good puzzler and good though tragic drama	kn the took
4	The Hobbitt, or there and back again; illustra...	Bilbo Baggins, a respectable, well-to-do hobbi...	J. R. R. Tolkien	9.0	5.0	Classic	This a t clas is a

Part 5: EDA

In [4]:

```
# Check the data type of the tokenized_review column
data_type = type(sampled_df['tokenized_review'].iloc[0])
print("Data type of the tokenized_review column:", data_type)

# to Visual inspection of the first few entries in the tokenized_review column
print("First few entries in the tokenized_review column:")
print(sampled_df['tokenized_review'].head())

# Check if all entries in the tokenized_review column are lists
all_are_lists = all(isinstance(review, list) for review in sampled_df['tokenized_re
print("Are all entries in the tokenized_review column lists?", all_are_lists)

# Check the number of tokens in each entry
token_counts = sampled_df['tokenized_review'].apply(len)
print("Number of tokens in each entry:")
print(token_counts)
```

```
Data type of the tokenized_review column: <class 'list'>
First few entries in the tokenized_review column:
0    [book, card, definately, change, live, life, u...
1    [book, write, excellentally, golde, express, o...
2    [lord, fly, take, realistic, journy, story, st...
3    [know, heck, take, long, discover, ross, macdo...
4    [book, timeless, classic, continue, enjoy, gen...
Name: tokenized_review, dtype: object
Are all entries in the tokenized_review column lists? True
Number of tokens in each entry:
0          19
1          20
2          42
3          78
4          11
         ...
204722     73
204723     13
204724     38
204725     75
204726    122
Name: tokenized_review, Length: 204727, dtype: int64
```

In [5]:
```python
# Find the highest ratingsCount and the lowest ratingsCount
highest_ratings_count = sampled_df['ratingsCount'].max()

lowest_ratings_count = sampled_df['ratingsCount'].min()

print("Highest ratingsCount:", highest_ratings_count)
print("Lowest ratingsCount:", lowest_ratings_count)
```

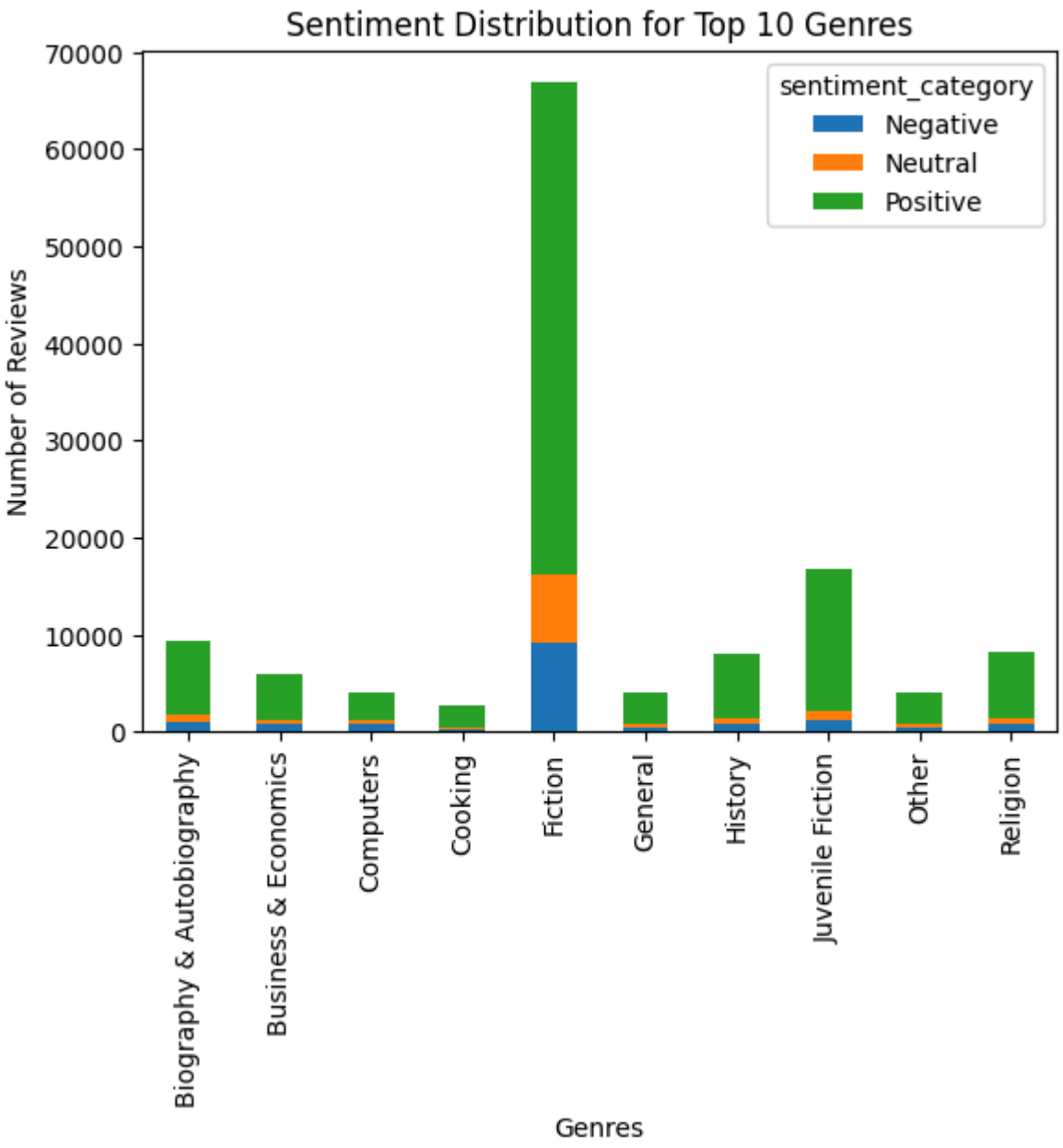
```
Highest ratingsCount: 4895.0
Lowest ratingsCount: 1.0
```

Categorize Sentiment review/Scores Positive Neutral Negative in sentiment_category a new column

In [16]:
```python
def categorize_sentiment(score):
    if score >= 4.0:
        return 'Positive'
    elif score >= 2.5:
        return 'Neutral'
    else:
        return 'Negative'

sampled_df['sentiment_category'] = sampled_df['review/score'].apply(categorize_sent
```

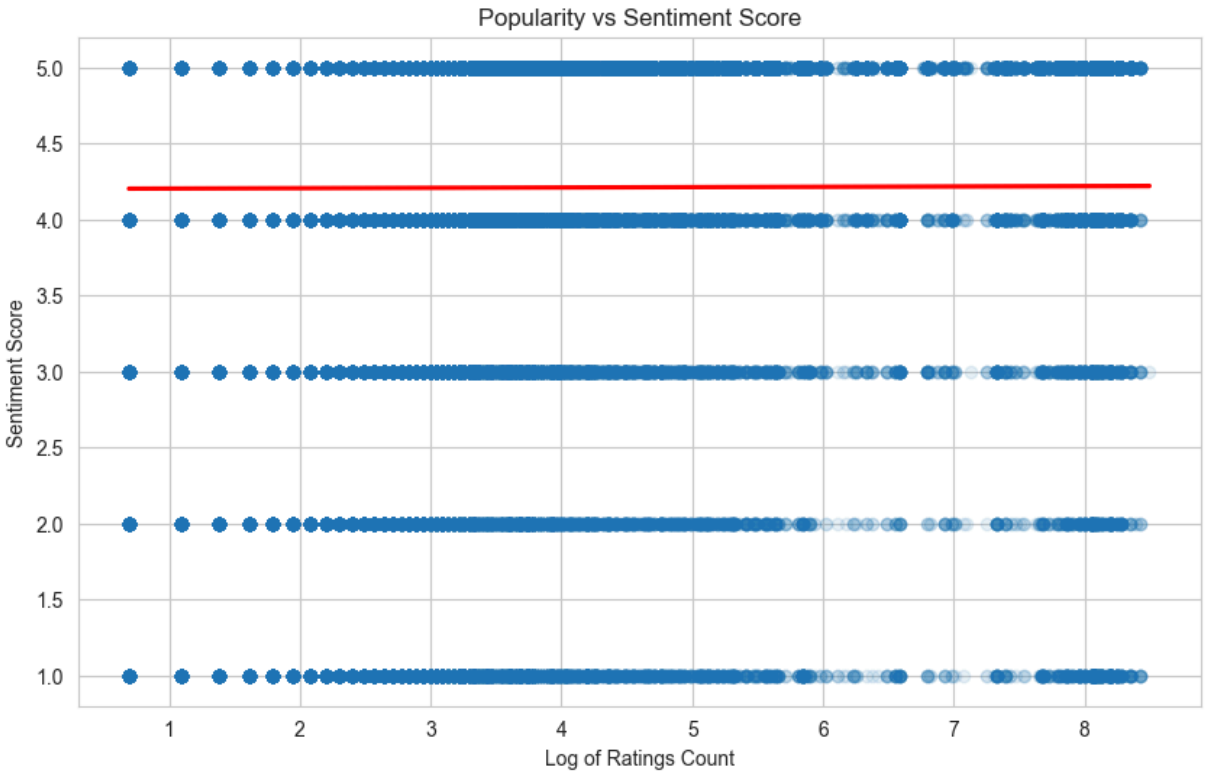
In [11]:
```python
# Find the top 10 most common genres
top_genres = sampled_df['categories'].value_counts().head(10).index

top_genres_df = sampled_df[sampled_df['categories'].isin(top_genres)]

pd.crosstab(top_genres_df['categories'], top_genres_df['sentiment_category']).plot(
plt.title('Sentiment Distribution for Top 10 Genres')
plt.xlabel('Genres')
```

```
plt.ylabel('Number of Reviews')
plt.show()
```



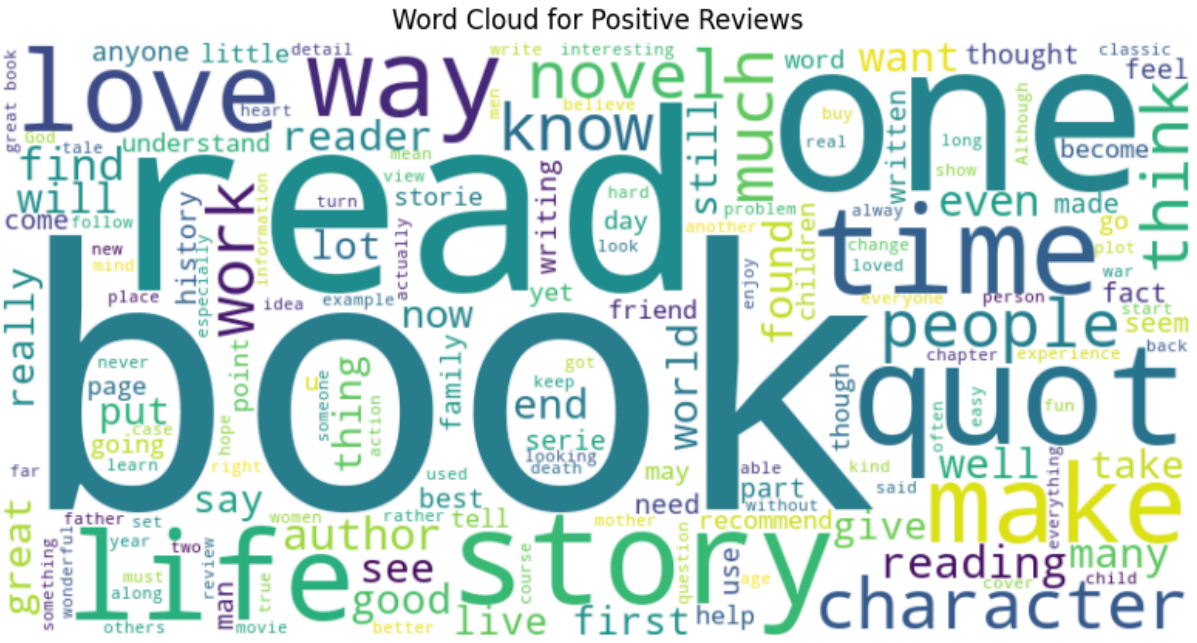
visually explores the relationship between the popularity (measured by ratings count) and the sentiment score of books in the sampled dataset

In [66]:
```
sampled_df['log_ratingsCount'] = np.log(sampled_df['ratingsCount'] + 1)

# Now we create a scatter plot
plt.figure(figsize=(10, 6))
sns.regplot(x='log_ratingsCount', y='review/score', data=sampled_df, scatter_kws={'
plt.title('Popularity vs Sentiment Score')
plt.xlabel('Log of Ratings Count')
plt.ylabel('Sentiment Score')
plt.show()
```



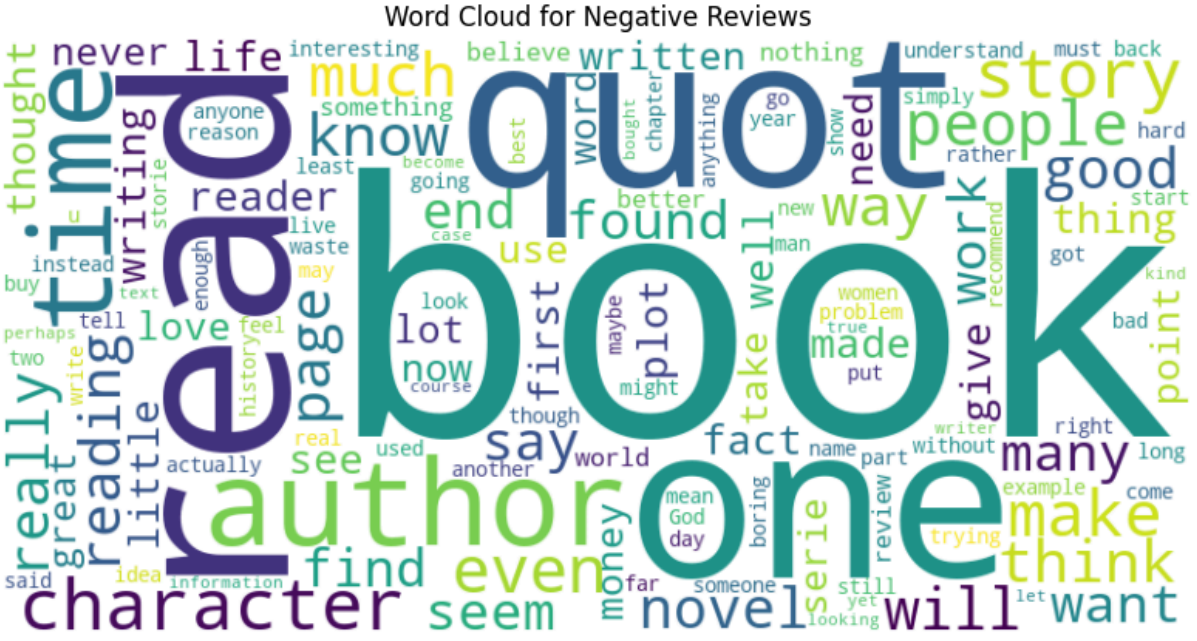
In [17]:
```
# i am creating Positive Reviews Word Cloud:
from wordcloud import WordCloud, STOPWORDS
import matplotlib.pyplot as plt
random.seed(42)
positive_reviews = ' '.join(sampled_df[sampled_df['sentiment_category'] == 'Positiv

wordcloud_pos = WordCloud(width=800, height=400, background_color='white', stopword

plt.figure(figsize=(10, 5))
plt.imshow(wordcloud_pos, interpolation='bilinear')
plt.axis("off")
plt.title('Word Cloud for Positive Reviews')
```

Out[17]:
```
Text(0.5, 1.0, 'Word Cloud for Positive Reviews')
```



In [22]:
```
from wordcloud import WordCloud, STOPWORDS
random.seed(42)
negative_reviews = ' '.join(sampled_df[sampled_df['sentiment_category'] == 'Negativ

wordcloud_neg = WordCloud(width=800, height=400, background_color='white', stopword

plt.figure(figsize=(10, 5))
plt.imshow(wordcloud_neg, interpolation='bilinear')
plt.axis("off")
plt.title('Word Cloud for Negative Reviews')
```

Out[22]:
```
Text(0.5, 1.0, 'Word Cloud for Negative Reviews')
```



In [63]:
```
sampled_df.head()
```

Out[63]:

	Title	description	authors	ratingsCount	review/score	review/summary	revie
0	Sacred Path Cards: The Discovery of Self Throu...	This extraordinary tool for self-discovery dra...	Jamie Sams	2.0	4.0	I regularly use the cards and read the book an...	Th a carc de cha
1	Lord of the flies	William Golding's unforgettable classic of boy...	William Golding	2861.0	5.0	Lord of the Flies	Th was excel Gc
2	Lord of the Flies	William Golding's unforgettable classic of boy...	William Golding	2861.0	4.0	Lord of the flies	The t tal re
3	The doomsters	Hired by Carl Hallman, the desperate-eyed junk...	Ross Macdonald	3.0	5.0	Both a good puzzler and good though tragic drama	kn the took
4	The Hobbitt, or there and back again; illustra...	Bilbo Baggins, a respectable, well-to-do hobbi...	J. R. R. Tolkien	9.0	5.0	Classic	This a t clas is a

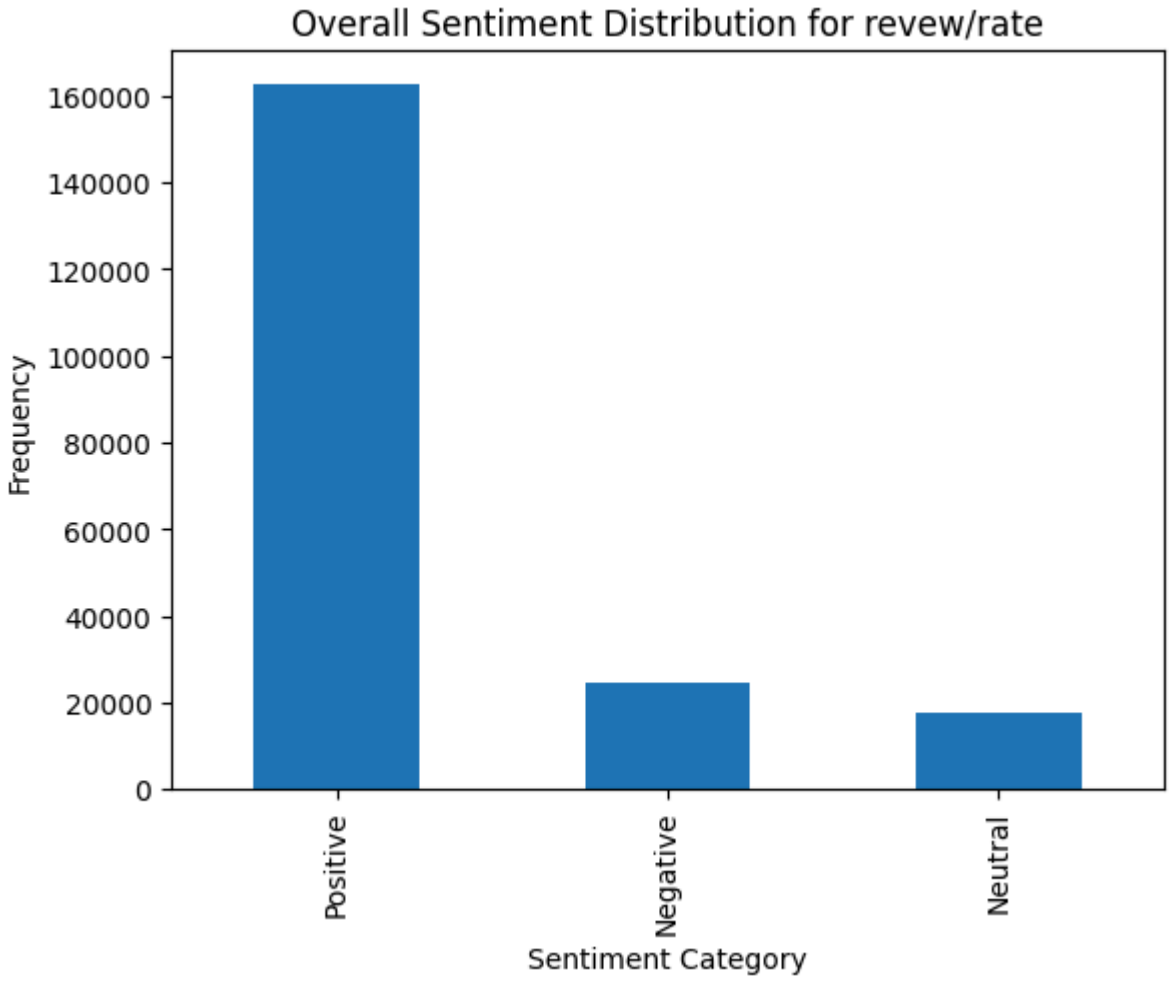
In [328…

```
print(sampled_df[['ratingsCount', 'review/score']].describe())
print(sampled_df[['ratingsCount', 'review/score']].corr())
```

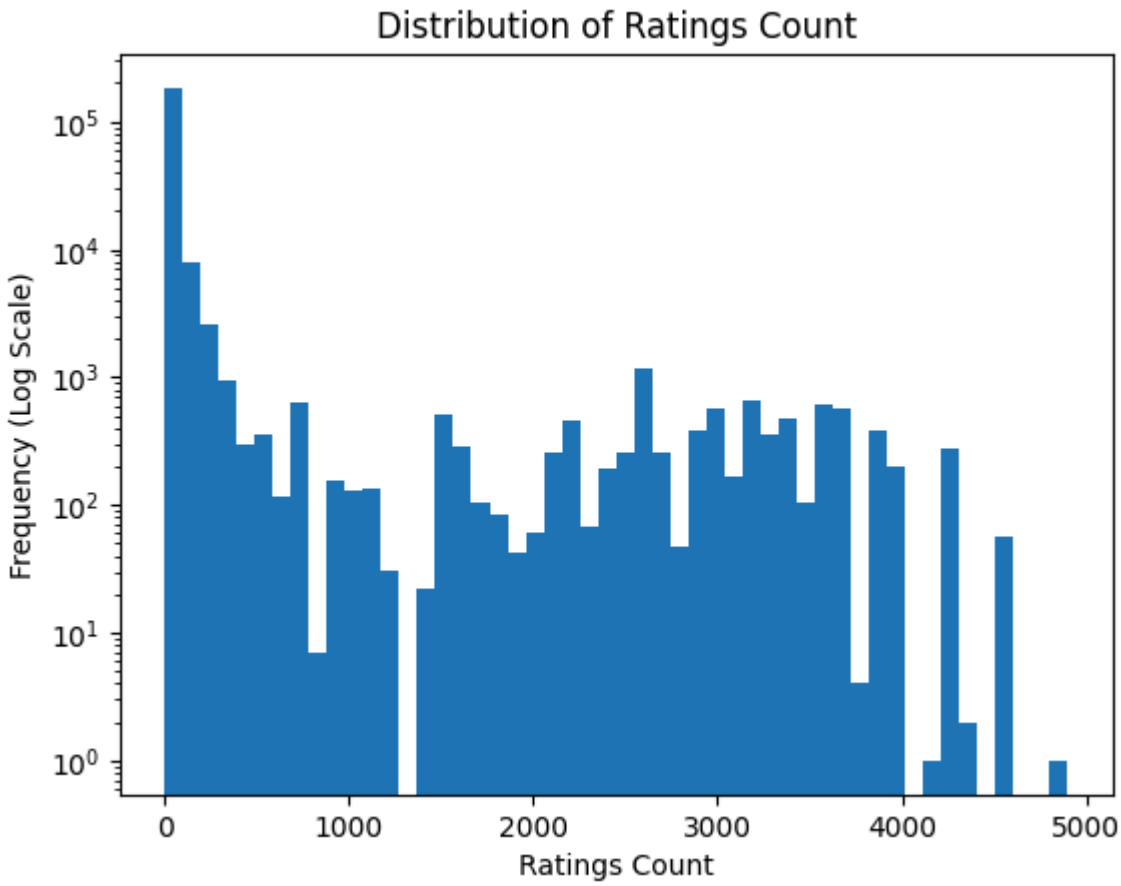
```
        ratingsCount   review/score
count  204727.000000  204727.000000
mean      149.965329       4.207071
std       600.778609       1.211205
min         1.000000       1.000000
25%         5.000000       4.000000
50%         9.000000       5.000000
75%        19.000000       5.000000
max      4895.000000       5.000000
              ratingsCount  review/score
ratingsCount      1.000000      0.000625
review/score      0.000625      1.000000
```

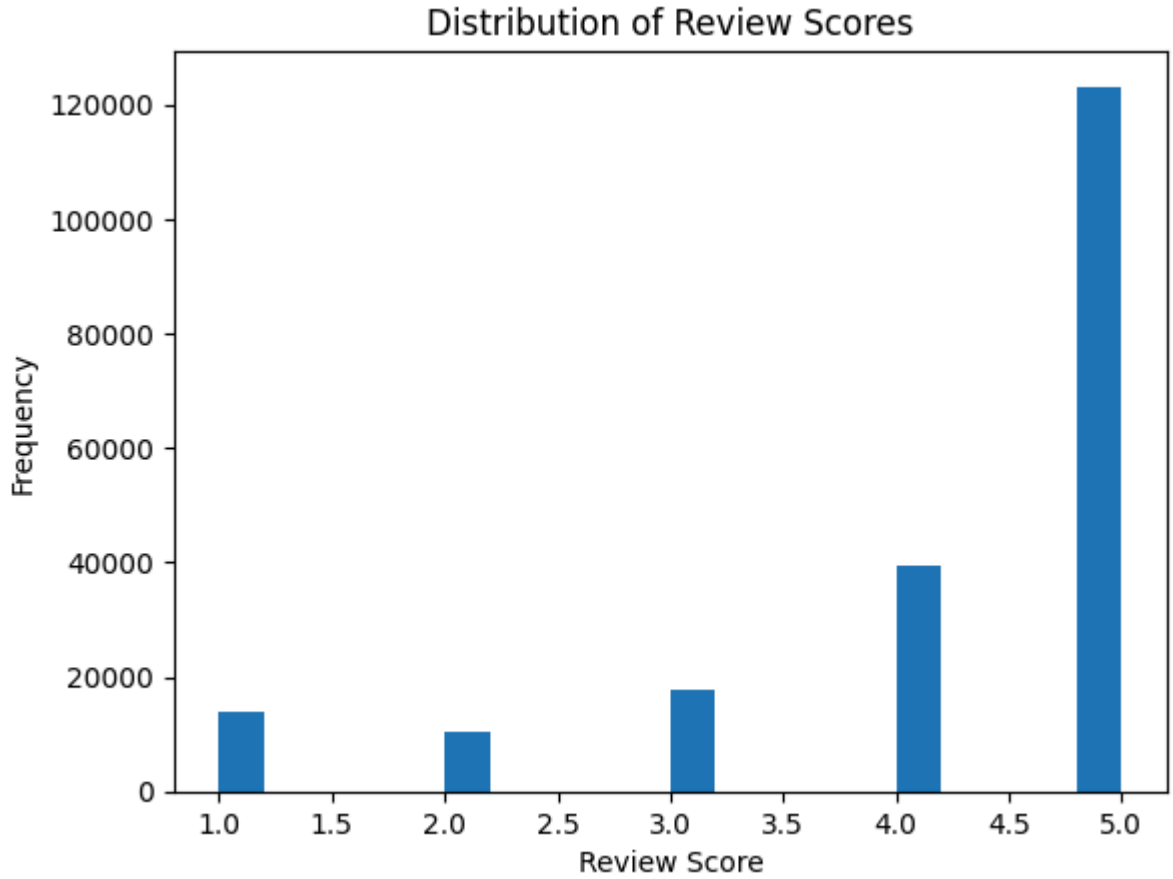
In [23]:

```
sampled_df['sentiment_category'].value_counts().plot(kind='bar')
plt.title('Overall Sentiment Distribution for revew/rate')
plt.xlabel('Sentiment Category')
plt.ylabel('Frequency')
plt.show()
```

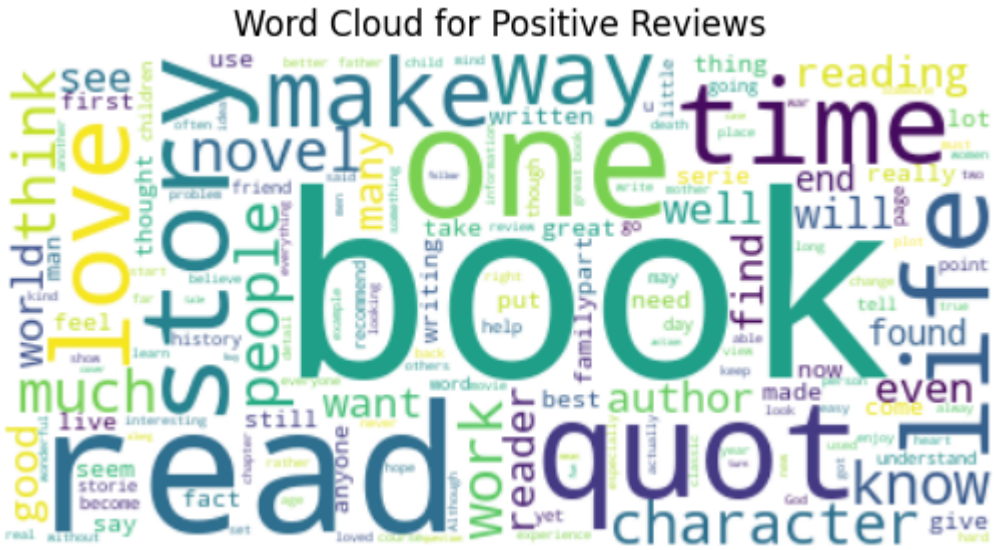


In [24]:
```
sampled_df['ratingsCount'].plot(kind='hist', bins=50, logy=True)
plt.title('Distribution of Ratings Count')
plt.xlabel('Ratings Count')
plt.ylabel('Frequency (Log Scale)')
plt.show()

sampled_df['review/score'].plot(kind='hist', bins=20)
plt.title('Distribution of Review Scores')
plt.xlabel('Review Score')
plt.ylabel('Frequency')
plt.show()
```

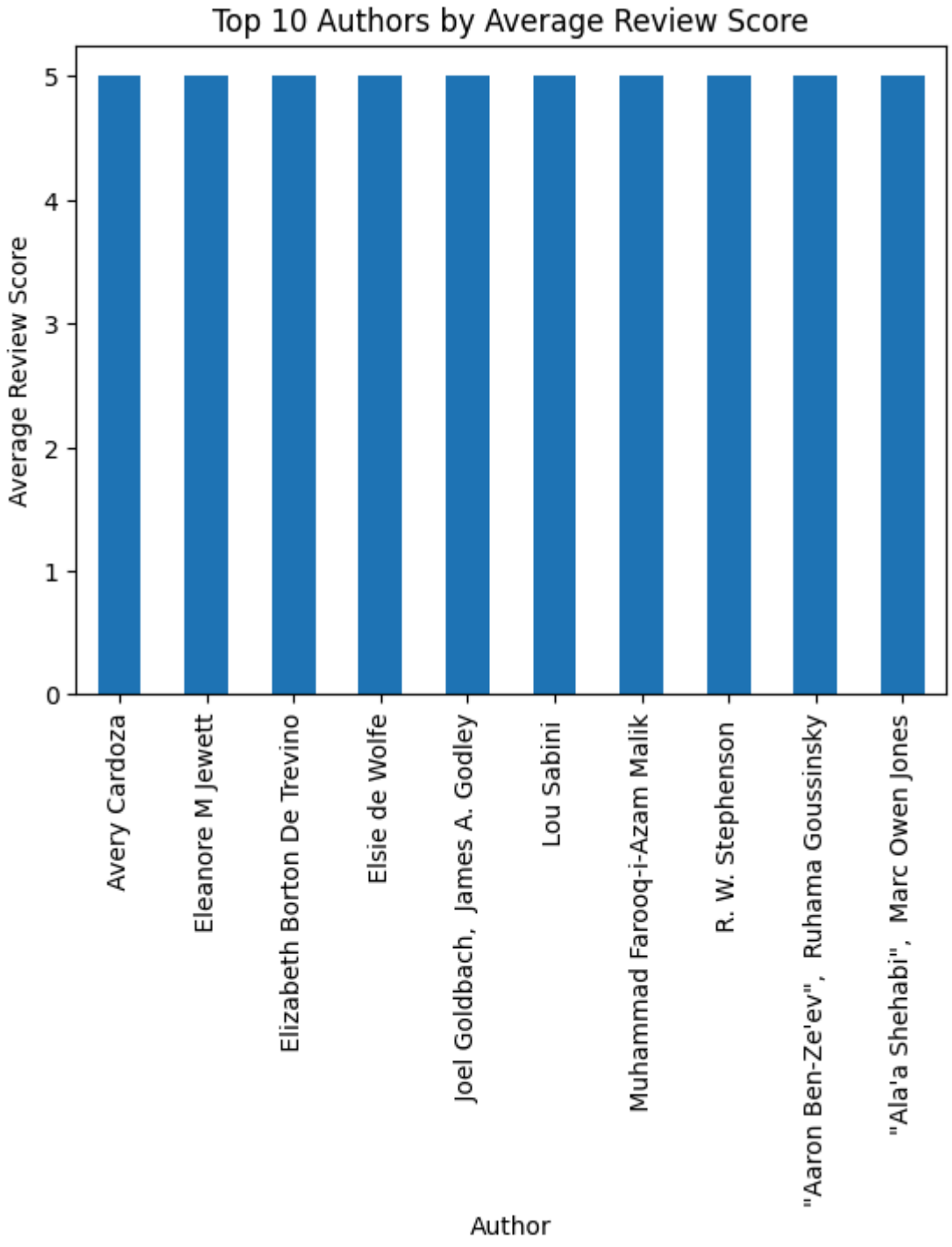

Distribution of Ratings Count
Frequency (Log Scale)
10^5
10^4
10^3
10^2
10^1
10^0
0
1000
2000
3000
4000
5000
Ratings Count


Distribution of Review Scores
Frequency
120000
100000
80000
60000
40000
20000
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Review Score

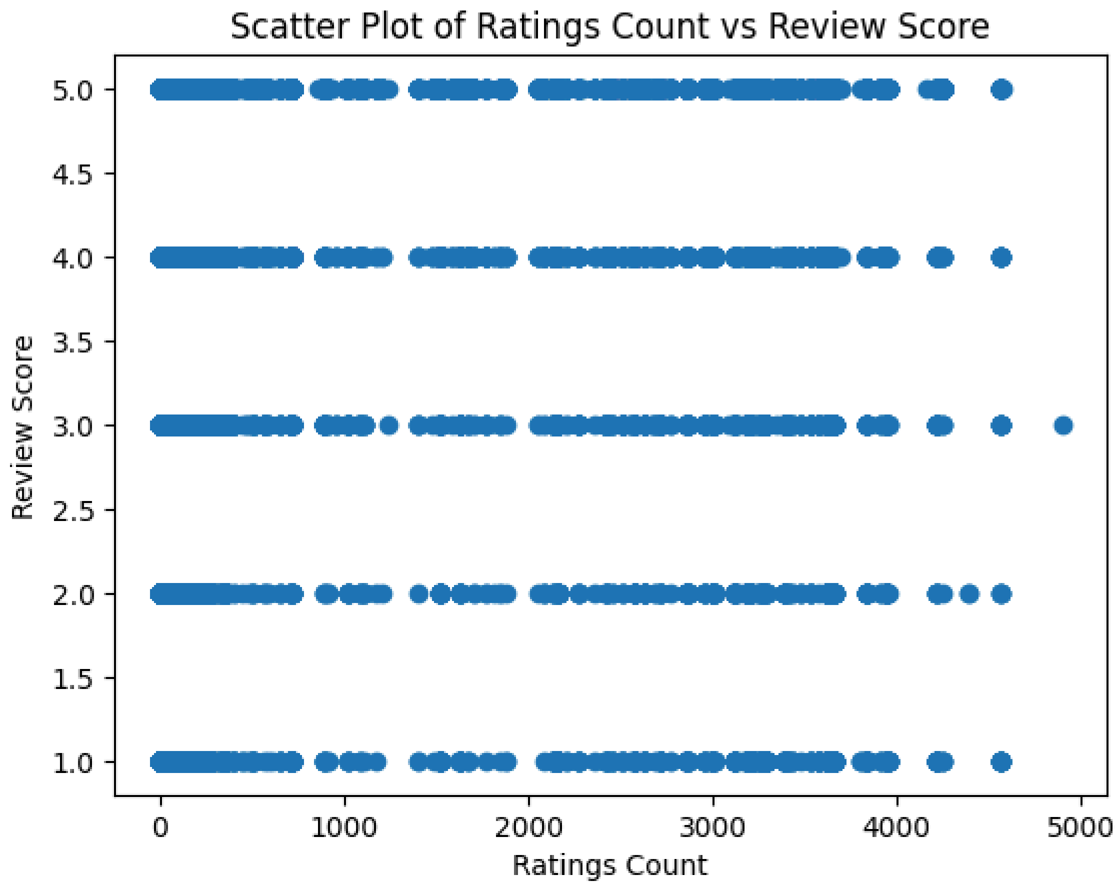
In [25]:
```
from wordcloud import WordCloud

# Generate a word cloud image for positive sentiment reviews
positive_reviews = ' '.join(sampled_df[sampled_df['sentiment_category'] == 'Positiv
wordcloud_pos = WordCloud(background_color="white").generate(positive_reviews)
random.seed(42)

plt.imshow(wordcloud_pos, interpolation='bilinear')
plt.axis("off")
plt.title('Word Cloud for Positive Reviews')
plt.show()
```



In [26]:
```
authors_sentiment = sampled_df.groupby('authors')['review/score'].mean().nlargest(1
authors_sentiment.plot(kind='bar')
plt.title('Top 10 Authors by Average Review Score')
plt.xlabel('Author')
plt.ylabel('Average Review Score')
plt.show()
```

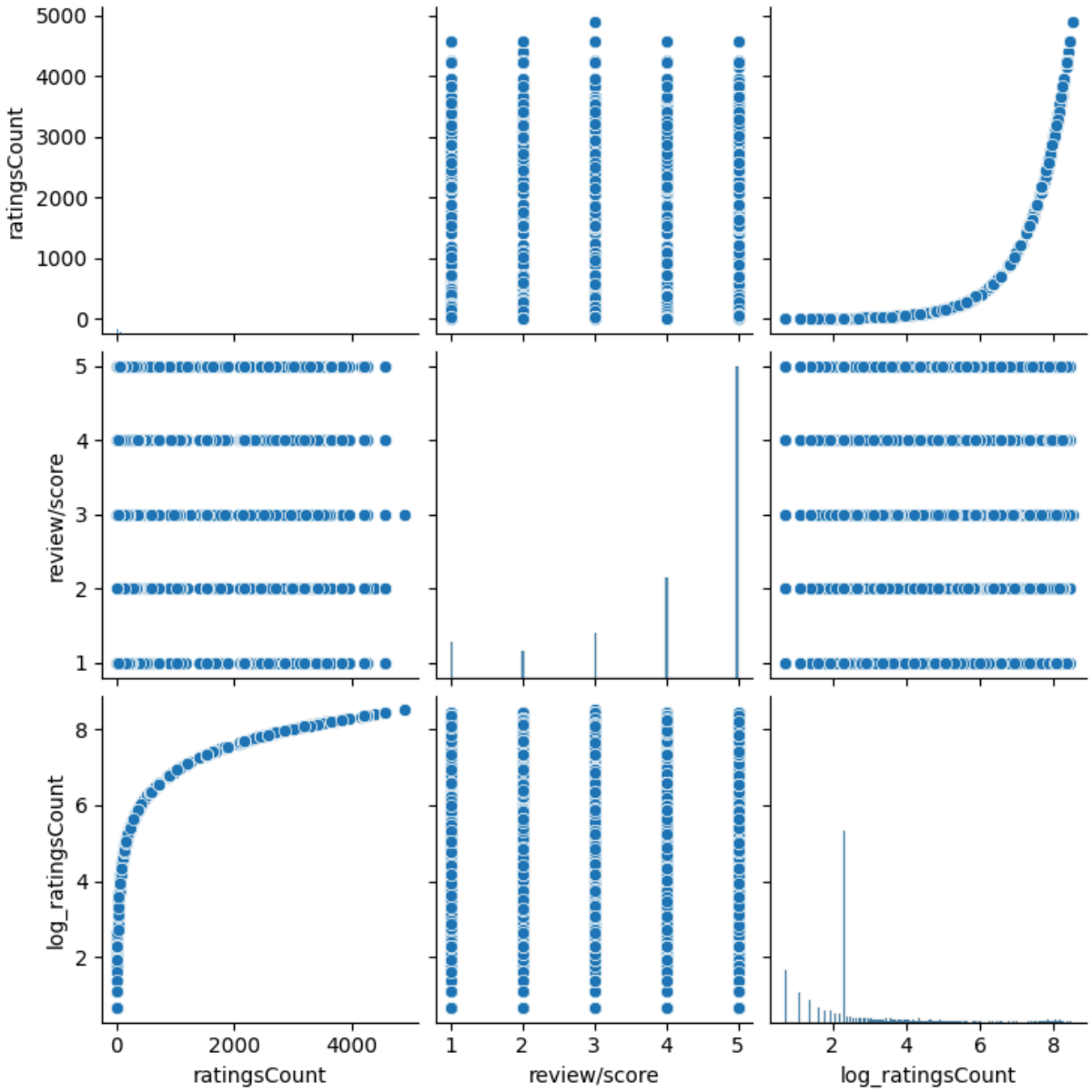


In [27]:
```
import matplotlib.pyplot as plt

plt.scatter(sampled_df['ratingsCount'], sampled_df['review/score'])
plt.xlabel('Ratings Count')
plt.ylabel('Review Score')
plt.title('Scatter Plot of Ratings Count vs Review Score')
plt.show()
```



In [15]:
```
#scatterplot matrix Visualization for Exploring Relationship between snumerical var
sns.pairplot(sampled_df)
plt.show()
```

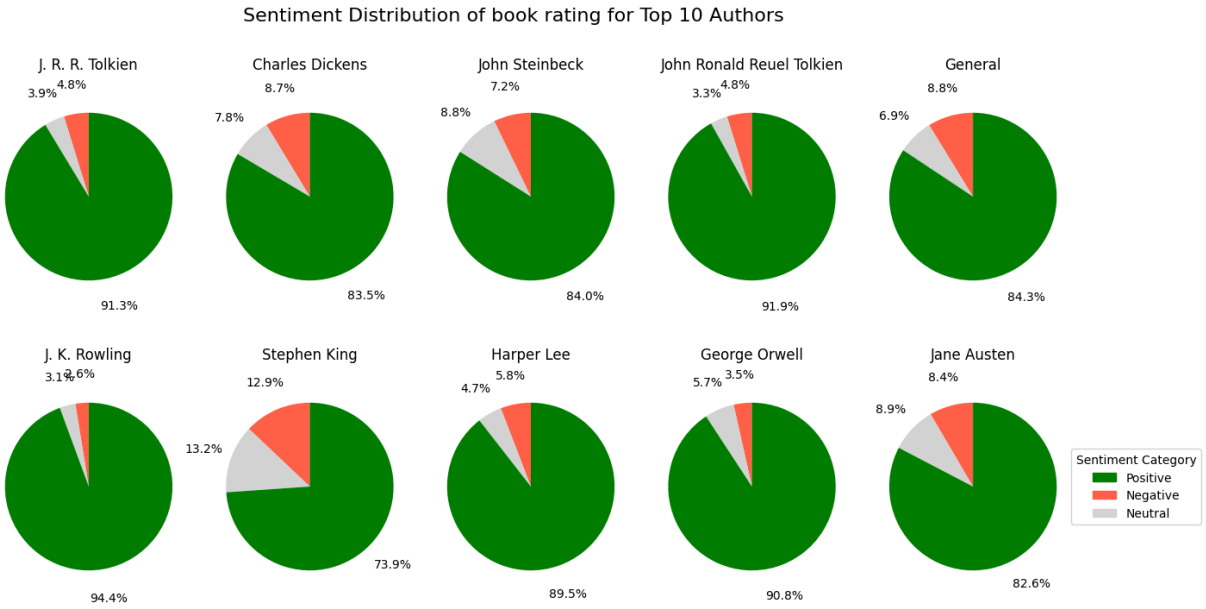
```
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_ol
dcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_ol
dcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\seaborn\_ol
dcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```



In [28]:
```
#Sentiment Distribution of book rating for Top 10 Authors

author_sentiment_counts = sampled_df.groupby(['authors', 'sentiment_category']).siz

top_10_authors = author_sentiment_counts.sum(axis=1).nlargest(10).index

colors = {'Positive': 'green', 'Negative': 'tomato', 'Neutral': 'lightgray'}

fig, axs = plt.subplots(2, 5, figsize=(16, 8), squeeze=False)
axs = axs.flatten()
random.seed(42)
for i, author in enumerate(top_10_authors):
    sentiment_counts = author_sentiment_counts.loc[author]
    pie = axs[i].pie(sentiment_counts, colors=[colors.get(label, 'black') for label
    axs[i].set_title(author)
    axs[i].axis('equal')

legend_handles = [plt.Rectangle((0,0),1,1, color=color) for color in colors.values(
plt.legend(legend_handles, colors.keys(), loc='center left', bbox_to_anchor=(1, 0.5
```

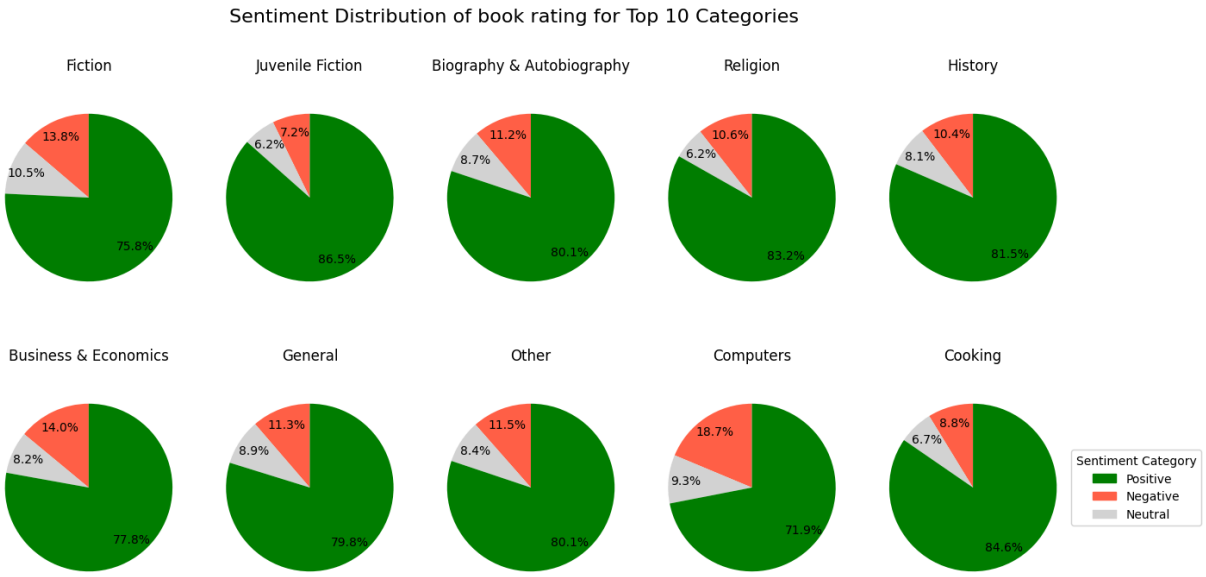
```
plt.suptitle('Sentiment Distribution of book rating for Top 10 Authors', fontsize=1
```

Out[28]: Text(0.5, 0.98, 'Sentiment Distribution of book rating for Top 10 Authors')



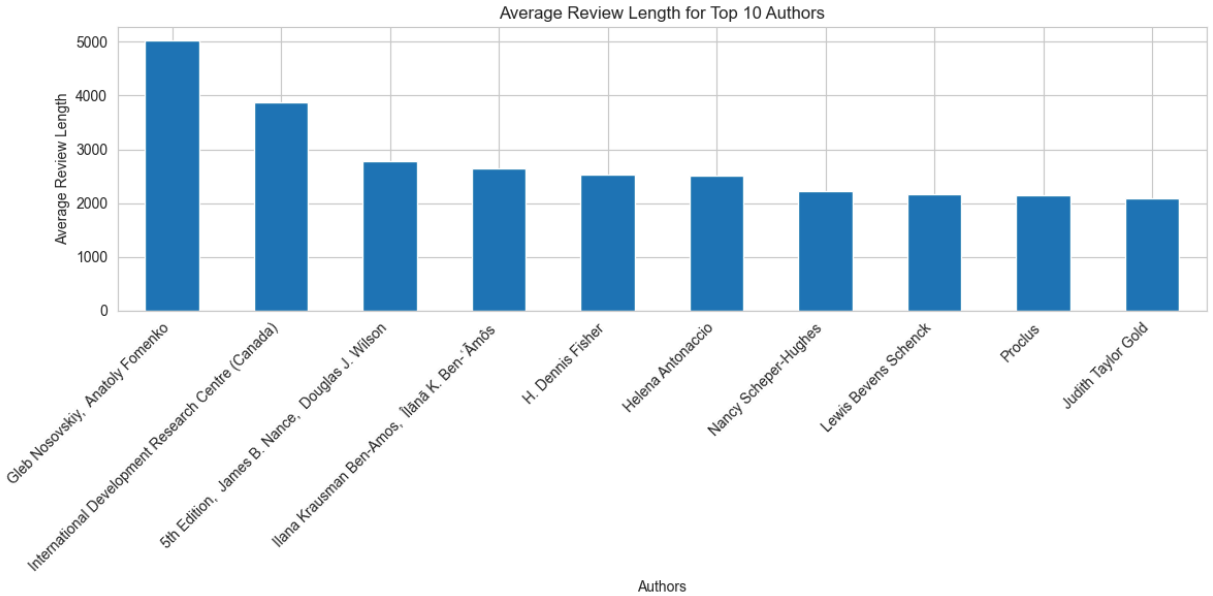
In [29]:
```
#Sentiment Distribution of book rating for Top 10 Categories
category_sentiment_counts = sampled_df.groupby(['categories', 'sentiment_category']
top_10_categories = category_sentiment_counts.sum(axis=1).nlargest(10).index

colors = {'Positive': 'green', 'Negative': 'tomato', 'Neutral': 'lightgray'}

fig, axs = plt.subplots(2, 5, figsize=(16, 8), squeeze=False)
axs = axs.flatten()


for i, category in enumerate(top_10_categories):
    sentiment_counts = category_sentiment_counts.loc[category]
    pie = axs[i].pie(sentiment_counts, colors=[colors.get(label, 'black') for label
    axs[i].set_title(category)
    axs[i].axis('equal')

legend_handles = [plt.Rectangle((0,0),1,1, color=color) for color in colors.values(
plt.legend(legend_handles, colors.keys(), loc='center left', bbox_to_anchor=(1, 0.5

plt.suptitle('Sentiment Distribution of book rating for Top 10 Categories', fontsiz
```

Out[29]: Text(0.5, 0.98, 'Sentiment Distribution of book rating for Top 10 Categories')



creating new column review_length for calculated average review/textlength of each review and visualize the Average Review Length for Top 10 Authors

In [64]:
```
sampled_df['review_length'] = sampled_df['review/text'].apply(lambda x: len(x.split

author_avg_review_length = sampled_df.groupby('authors')['review_length'].mean().so

top_10_authors = author_avg_review_length.head(10)

top_10_authors.plot(kind='bar', figsize=(12, 6))
plt.title('Average Review Length for Top 10 Authors')
plt.xlabel('Authors')
plt.ylabel('Average Review Length')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
```



In [67]:
```
sampled_df.head()
```

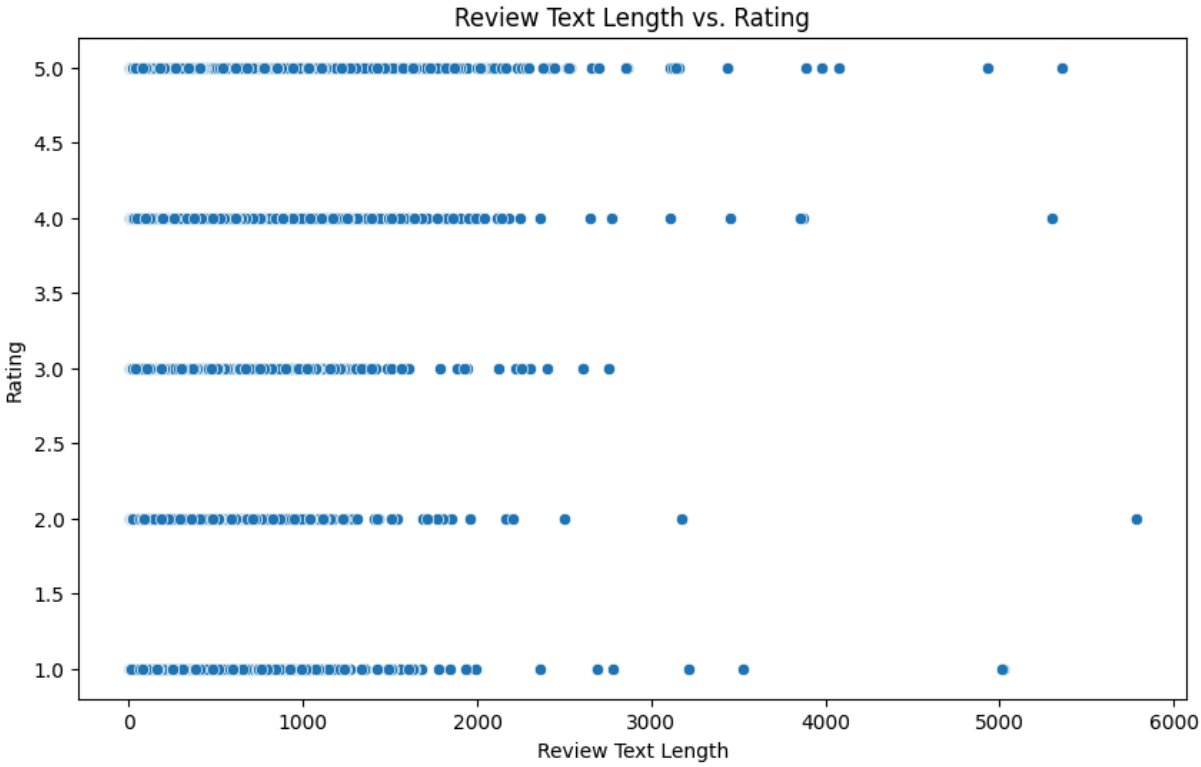
Out[67]:

	Title	description	authors	ratingsCount	review/score	review/summary	revie
0	Sacred Path Cards: The Discovery of Self Throu...	This extraordinary tool for self-discovery dra...	Jamie Sams	2.0	4.0	I regularly use the cards and read the book an...	Th a carc de cha
1	Lord of the flies	William Golding's unforgettable classic of boy...	William Golding	2861.0	5.0	Lord of the Flies	Th was excel Gc
2	Lord of the Flies	William Golding's unforgettable classic of boy...	William Golding	2861.0	4.0	Lord of the flies	The t tal re
3	The doomsters	Hired by Carl Hallman, the desperate-eyed junk...	Ross Macdonald	3.0	5.0	Both a good puzzler and good though tragic drama	kn the took
4	The Hobbitt, or there and back again; illustra...	Bilbo Baggins, a respectable, well-to-do hobbi...	J. R. R. Tolkien	9.0	5.0	Classic	This a t clas is a

This code generates a scatter plot of review text length against review rating and calculates the correlation coefficient between these two variables

In [32]:

```
import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(10, 6))
sns.scatterplot(x='review_length', y='review/score', data=sampled_df)
plt.title('Review Text Length vs. Rating')
plt.xlabel('Review Text Length')
plt.ylabel('Rating')
plt.show()

correlation = sampled_df[['review_length', 'review/score']].corr().iloc[0, 1]
print(f"Correlation coefficient: {correlation}")
```



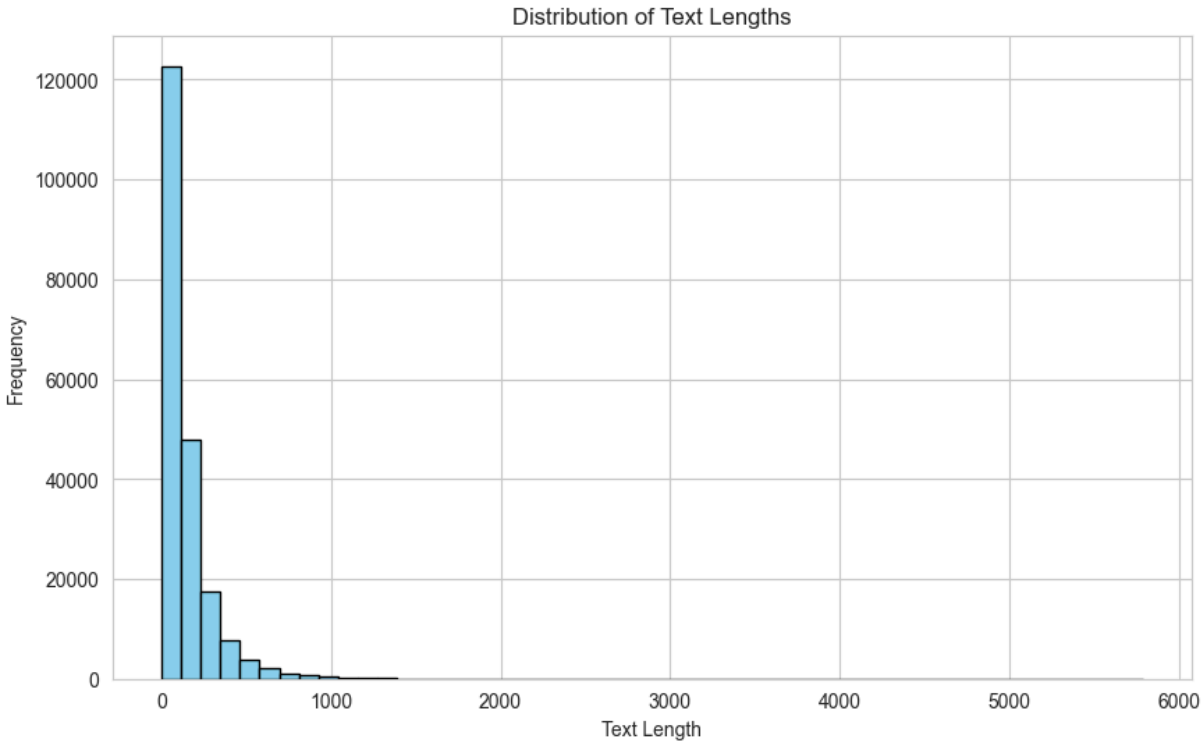

```
Correlation coefficient: -0.055603010745443764
```

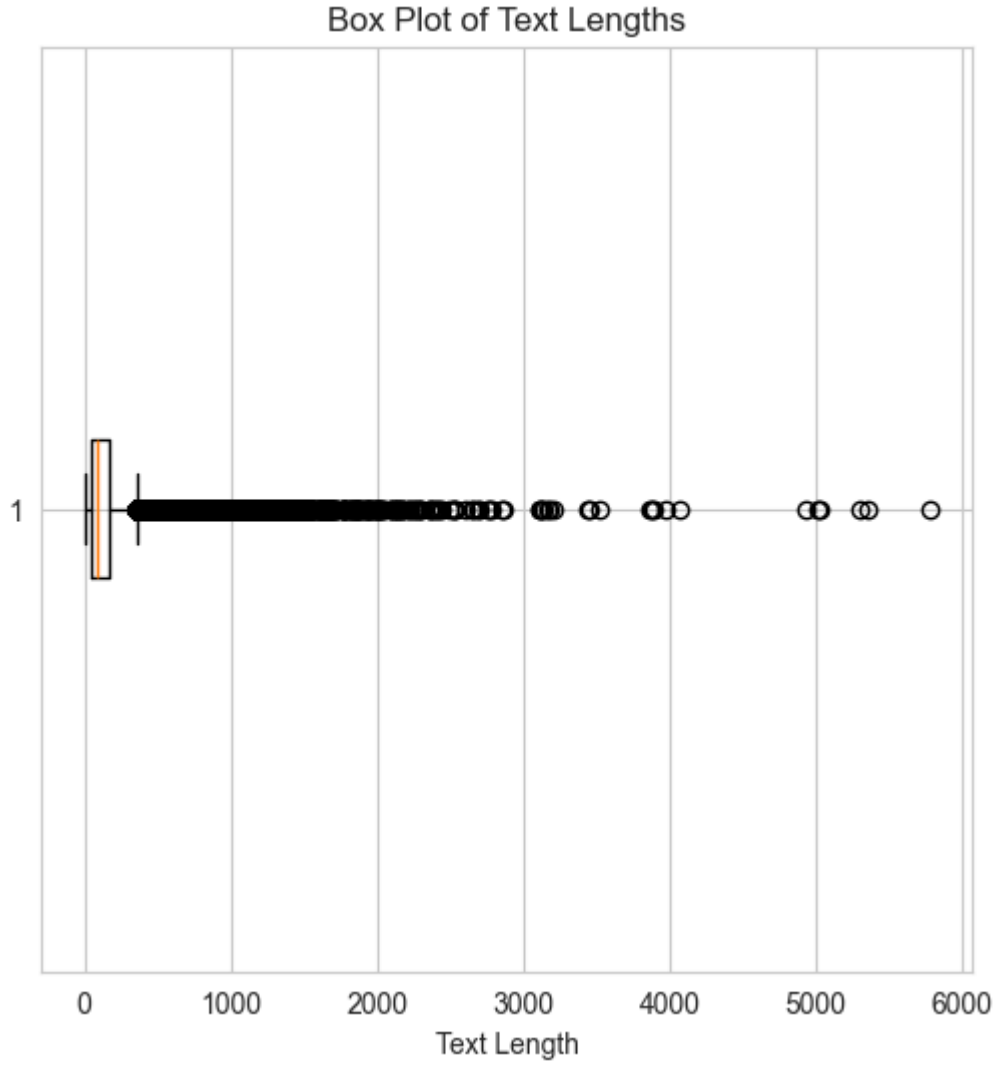
Part 6:

text preprocessing 2

In [57]:
```
import spacy
```

In [75]:
```
import pandas as pd
import matplotlib.pyplot as plt

# Plot histogram of text lengths
plt.figure(figsize=(10, 6))
plt.hist(sampled_df['review_length'], bins=50, color='skyblue', edgecolor='black')
plt.title('Distribution of Text Lengths')
plt.xlabel('Text Length')
plt.ylabel('Frequency')
plt.grid(True)
plt.show()

# Plot box plot of text lengths
plt.figure(figsize=(6, 6))
plt.boxplot(sampled_df['review_length'], vert=False)
plt.title('Box Plot of Text Lengths')
plt.xlabel('Text Length')
plt.grid(True)
plt.show()
```


Distribution of Text Lengths
Frequency
Text Length
0
20000
40000
60000
80000
100000
120000
0
1000
2000
3000
4000
5000
6000


Box Plot of Text Lengths
1
0
1000
2000
3000
4000
5000
6000
Text Length

In [6]:
```
# Calculate the length of each review
sampled_df['review_length'] = sampled_df['tokenized_review'].apply(len)

print(sampled_df[['tokenized_review', 'review_length']].head())
```

```
                                     tokenized_review  review_length
0  [book, card, definately, change, live, life, u...              19
1  [book, write, excellentally, golde, express, o...              20
2  [lord, fly, take, realistic, journy, story, st...              42
3  [know, heck, take, long, discover, ross, macdo...              78
4  [book, timeless, classic, continue, enjoy, gen...              11
```

In [7]:
```
import pandas as pd

# Calculate the length of each review
sampled_df['review_length'] = sampled_df['tokenized_review'].apply(len)

# Find the length of the longest and shortest reviews
longest_length = sampled_df['review_length'].max()
shortest_length = sampled_df['review_length'].min()

# Print the number of words in the longest and shortest reviews
print("Number of words in the longest review:", longest_length)
print("Number of words in the shortest review:", shortest_length)
```

```
Number of words in the longest review: 2695
Number of words in the shortest review: 0
```

In [8]:
```
import pandas as pd
# Count the number of reviews with 0 to 50 words
reviews_0_to_50 = sampled_df[(sampled_df['review_length'] >= 0) & (sampled_df['revi

print("Number of reviews with 0 to 50 words:", reviews_0_to_50)
```

```
Number of reviews with 0 to 50 words: 121261
```

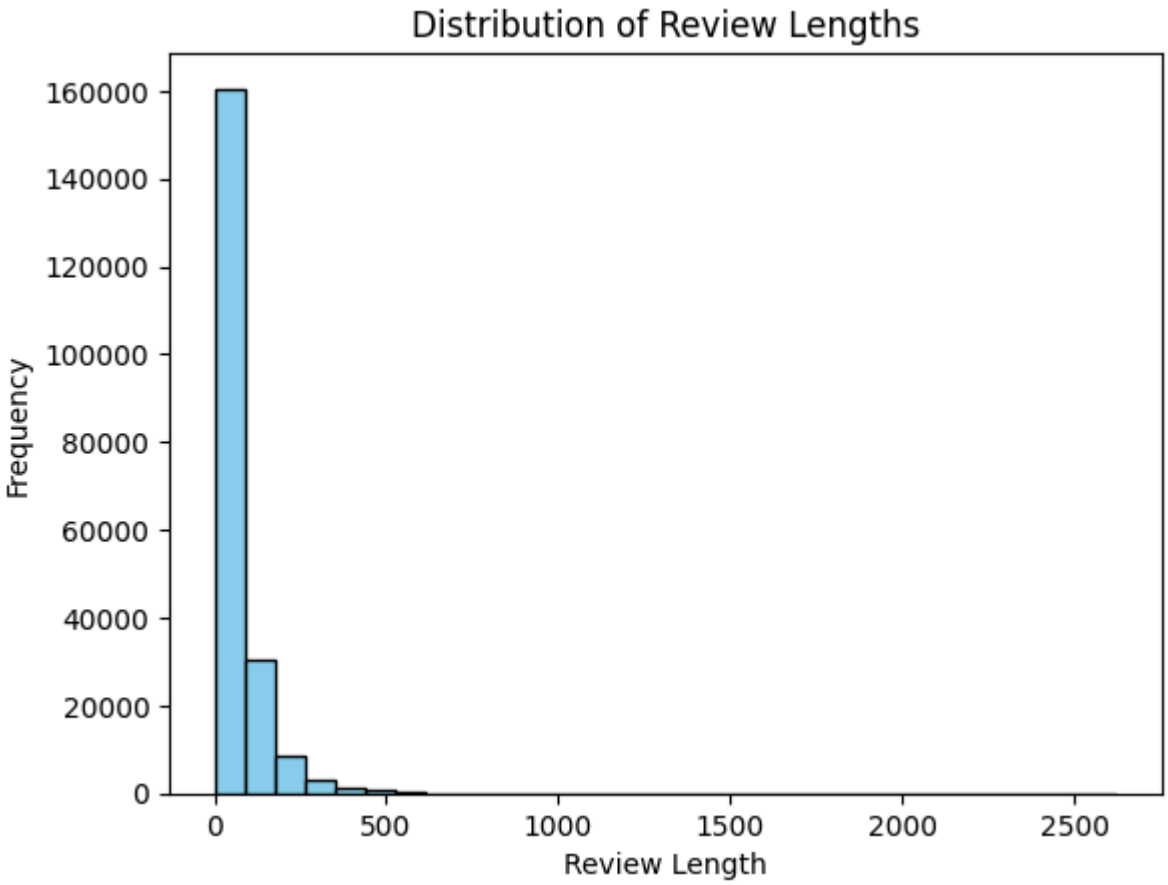
In [112…
```
sampled_df.describe()
```

Out[112…

	ratingsCount	review/score	review_length	log_ratingsCount	review_length1
count	204727.000000	204727.000000	204727.000000	204727.000000	204727.000000
mean	149.965329	4.207071	142.413521	2.648609	64.317809
std	600.778609	1.211205	161.989461	1.598294	76.008330
min	1.000000	1.000000	1.000000	0.693147	0.000000
25%	5.000000	4.000000	48.000000	1.791759	21.000000
50%	9.000000	5.000000	92.000000	2.302585	40.000000
75%	19.000000	5.000000	175.000000	2.995732	78.000000
max	4895.000000	5.000000	5785.000000	8.496174	2695.000000

Part 7: Feature Extraction and Modeling Preparation

In [57]:
```
import matplotlib.pyplot as plt

# Plotting the distribution of review lengths
plt.hist(sampled_df['review_length'], bins=30, color='skyblue', edgecolor='black')
plt.xlabel('Review Length')
plt.ylabel('Frequency')
plt.title('Distribution of Review Lengths')
plt.show()
```



In [8]:
```
sentiment_df = sampled_df[['Title', 'authors', 'ratingsCount', 'review/score', 'rev
sentiment_df.rename(columns={'categories': 'genre'}, inplace=True)
```

- Vectorization with TF-IDF (Term Frequency-Inverse Document Frequency)

This code converts tokenized reviews into TF-IDF scores using the TfidfVectorizer from scikit-learn. First, it converts the lists of tokens back into strings to meet the input requirements of the vectorizer. Then, it initializes the vectorizer, fits it to the processed reviews, and transforms them into TF-IDF matrices. The resulting TF-IDF matrices contain the TF-IDF scores for each review.

In [28]:
```
from sklearn.feature_extraction.text import TfidfVectorizer

# Initialize TfidfVectorizer with parameters similar to the Word2Vec setup
tfidf_vectorizer = TfidfVectorizer(min_df=3, max_df=0.8, max_features=100)

# Fit and transform the data
tfidf_matrix = tfidf_vectorizer.fit_transform(sentiment_df['processed_reviews'])

print(tfidf_matrix.shape)
```

```
(204727, 100)
```

-Document Embedding with Word2Vec:

Create document representations using Word2Vec embeddings through averaging of word vectors

In [10]:
```
#https://spotintelligence.com/2023/02/15/word2vec-for-text-classification/
#Word2Vec Text Classification Vectorization
from gensim.models import Word2Vec
import numpy as np

model = Word2Vec(sentences=sentiment_df['tokenized_review'], vector_size=100, windo
model_vocab_set = set(model.wv.index_to_key)

def document_vector(word_list):
    word_list = [word for word in word_list if word in model_vocab_set]
    if not word_list:
        return np.zeros(model.vector_size)
    else:
        return np.mean(model.wv[word_list], axis=0)

sentiment_df['doc_vector'] = sentiment_df['tokenized_review'].apply(document_vector
```

In [33]:
```
# here checking the shape of the feature matrix
print("Shape of training data:", X_train_smote_word2vec.shape)
```

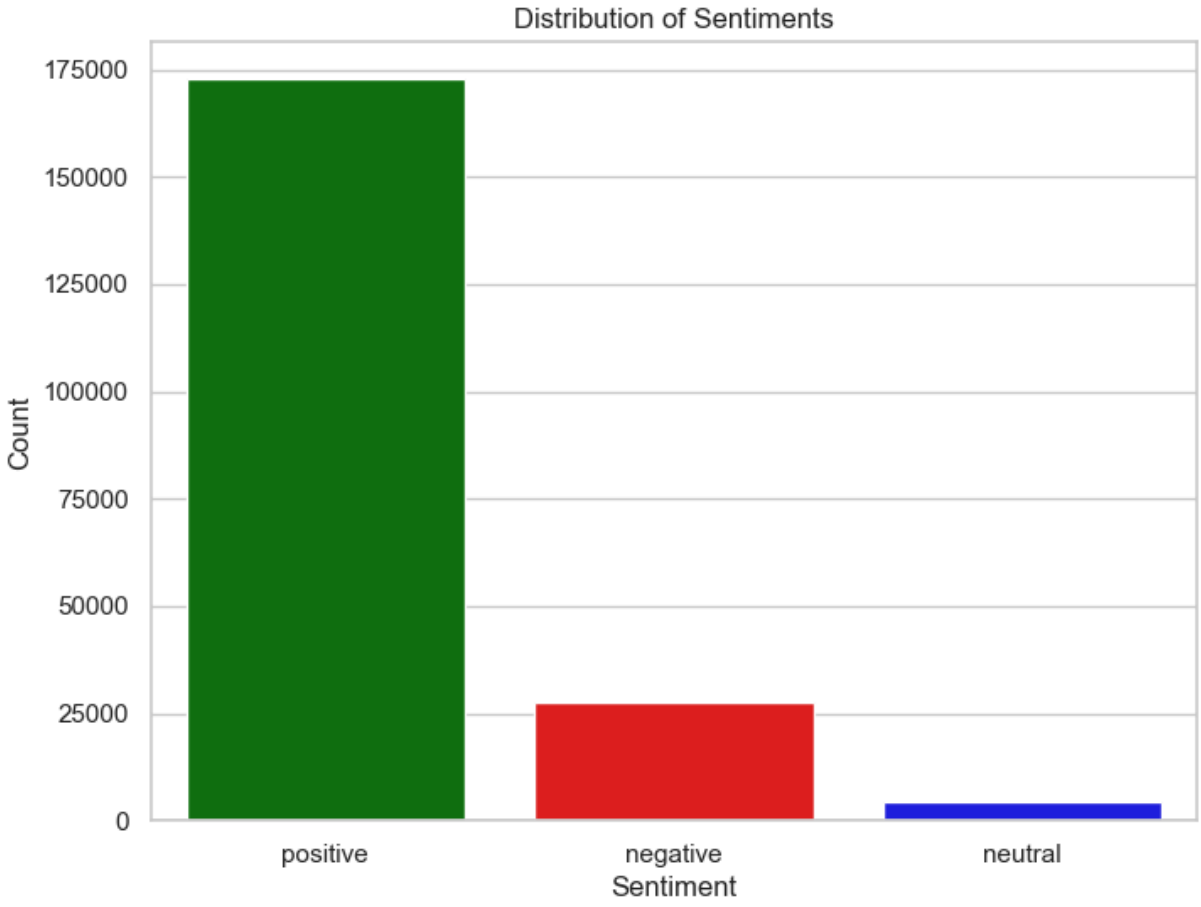
```
Shape of training data: (414762, 100)
```

In [34]:
```
#Generate Sentiment Labels
#https://www.geeksforgeeks.org/python-sentiment-analysis-using-vader/
import nltk
nltk.download('vader_lexicon')

from nltk.sentiment import SentimentIntensityAnalyzer

sia = SentimentIntensityAnalyzer()

def get_sentiment_category(review):
    scores = sia.polarity_scores(review)
    if scores['compound'] > 0.05:
        return 'positive'
    elif scores['compound'] < -0.05:
        return 'negative'
```

```
    else:
        return 'neutral'

sentiment_df['sentiment'] = sentiment_df['processed_reviews'].apply(get_sentiment_c
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     C:\Users\Tareq\AppData\Roaming\nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
```

In [35]:
```
import seaborn as sns

sns.set(style="whitegrid")
plt.figure(figsize=(8, 6))
sns.countplot(data=sentiment_df, x='sentiment', palette=["green", "red", "blue"])
plt.title('Distribution of Sentiments')
plt.xlabel('Sentiment')
plt.ylabel('Count')
plt.show()
```



-Class Balancing with SMOTE for TF-IDF Features

This code applies the Synthetic Minority Over-sampling Technique (SMOTE) to address class imbalance in TF-IDF features. It splits the dataset into training and testing sets and then applies SMOTE to the training data to create a more balanced distribution of classes. This ensures better performance of machine learning models trained on TF-IDF features.

In [36]:
```
#Apply SMOTE to the TF-IDF training set to address class imbalance
from sklearn.model_selection import train_test_split
from imblearn.over_sampling import SMOTE

y = sentiment_df['sentiment'].values

X_train_tfidf, X_test_tfidf, y_train_tfidf, y_test_tfidf = train_test_split(tfidf_m

# Applying SMOTE for Class Balancing in TF-IDF
smote_tfidf = SMOTE(random_state=42, n_jobs=-1)
X_train_smote_tfidf, y_train_smote_tfidf = smote_tfidf.fit_resample(X_train_tfidf,
```

```
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\imblearn\ov
er_sampling\_smote\base.py:363: FutureWarning: The parameter `n_jobs` has been depre
cated in 0.10 and will be removed in 0.12. You can pass an nearest neighbors estimat
or where `n_jobs` is already set instead.
  warnings.warn(
```

In [37]:
```
#Class Distribution after SMOTE
y_train_smote_df = pd.DataFrame(y_train_smote_tfidf, columns=['sentiment'])

class_distribution = y_train_smote_df['sentiment'].value_counts()
print("Class Distribution after SMOTE:\n", class_distribution)
```

```
Class Distribution after SMOTE:
 sentiment
positive    138254
neutral     138254
negative    138254
Name: count, dtype: int64
```

- next cell Word2Vec Feature Preparation and SMOTE Class Balancing

This following code prepares Word2Vec features for machine learning and applies SMOTE to balance class distribution. It converts Word2Vec document vectors into a feature matrix, splits the dataset for training and testing, and addresses class imbalance using SMOTE.

In [38]:
```
#Word2Vec Feature Preparation and Class Balancing with SMOTE

from sklearn.model_selection import train_test_split
from imblearn.over_sampling import SMOTE
import numpy as np

word2vec_features = np.array(sentiment_df['doc_vector'].tolist())

y = sentiment_df['sentiment'].values

X_train_word2vec, X_test_word2vec, y_train_word2vec, y_test_word2vec = train_test_s
    word2vec_features, y, test_size=0.2, random_state=42)

smote_word2vec = SMOTE(random_state=42, n_jobs=-1)
X_train_smote_word2vec, y_train_smote_word2vec = smote_word2vec.fit_resample(X_trai
```

```
C:\Users\Tareq\AppData\Local\Programs\Python\Python310\lib\site-packages\imblearn\over_sampling\_smote\base.py:363: FutureWarning: The parameter `n_jobs` has been deprecated in 0.10 and will be removed in 0.12. You can pass an nearest neighbors estimator where `n_jobs` is already set instead.
  warnings.warn(
```

XGBoost and TF-IDF

Objective: Train an XGBoost classifier on TF-IDF features for sentiment analysis. Steps: Initialize XGBoost classifier, train the classifier, predict sentiment labels, evaluate performance. Input Data: Training and test data with TF-IDF features and labels. Output: Classification report and accuracy score.

-Label Encoding

This part involves converting target variables (sentiment labels) into a format suitable for machine learning models, which require numerical input.

In [42]:
```
from sklearn.preprocessing import LabelEncoder

label_encoder = LabelEncoder()
y_train_encoded = label_encoder.fit_transform(y_train_smote_tfidf)
y_test_encoded = label_encoder.transform(y_test_tfidf)
```

-XGBoost Classifier Training

Here, we initialize and fit the XGBoost classifier using the TF-IDF vectorized training data and the encoded labels from code above

In [132…
```
from xgboost import XGBClassifier

xgb_classifier = XGBClassifier(random_state=42, eval_metric='mlogloss')
xgb_classifier.fit(X_train_smote_tfidf, y_train_encoded)
```

Out[132…
```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric='mlogloss',
              feature_types=None, gamma=None, grow_policy=None,
              importance_type=None, interaction_constraints=None,
              learning_rate=None, max_bin=None, max_cat_threshold=None,
              max_cat_to_onehot=None, max_delta_step=None, max_depth=None,
```

-Model Prediction & Evaluation

In this final part, we use the trained model to make predictions on the test set. Then, we decode these predictions back to their original labels for interpretability and evaluate the model's performance using classification metrics

In [133…
```
from sklearn.metrics import classification_report, accuracy_score

y_pred_encoded = xgb_classifier.predict(X_test_tfidf)

y_pred_f = label_encoder.inverse_transform(y_pred_encoded)

print(classification_report(y_test_tfidf, y_pred_f))
print("Accuracy:", accuracy_score(y_test_tfidf, y_pred_f))
```

```
              precision    recall  f1-score   support

    negative       0.37      0.36      0.37      5528
     neutral       0.13      0.64      0.22       901
    positive       0.91      0.82      0.86     34517

    accuracy                           0.75     40946
   macro avg       0.47      0.61      0.48     40946
weighted avg       0.82      0.75      0.78     40946

Accuracy: 0.7548722707956821
```

XGBoost (Extreme Gradient Boosting) and Word2Vec

Objective: Train an XGBoost classifier on Word2Vec features for sentiment analysis. Steps: Initialize XGBoost classifier, train using SMOTE-adjusted data, predict sentiment labels, evaluate performance. Input Data: Training and test data with Word2Vec features and labels. Output: Classification report and accuracy score.

In [22]:
```
# Check the dimensionality of X_train_smote_word2vec and y_train_smote_word2vec
print("Shape of X_train_smote_word2vec:", X_train_smote_word2vec.shape)
```

```
Shape of X_train_smote_word2vec: (414762, 100)
```

Encode Target Classes The target classes in `y_train_smote_word2vec` and `y_test_word2vec` are in string format ('negative', 'neutral', 'positive'). XGBoost requires the target classes to be encoded as integers for training. Therefore, we use `LabelEncoder` to transform the string labels into integer labels. This step ensures that the target classes are in the correct format for model training and evaluation.

In [59]:
```
from sklearn.preprocessing import LabelEncoder
label_encoder = LabelEncoder()
y_train_encoded = label_encoder.fit_transform(y_train_smote_word2vec)
y_test_encoded = label_encoder.transform(y_test_word2vec)
```

In [60]:
```
#Initialize and Fit XGBoost Classifier
xgb_classifier = xgb.XGBClassifier(random_state=42, eval_metric='mlogloss')
xgb_classifier.fit(X_train_smote_word2vec, y_train_encoded)
```

Out[60]:

XGBClassifier

```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=No
ne,
              enable_categorical=False, eval_metric='mlogloss',
              feature_types=None, gamma=None, grow_policy=None,
              importance_type=None, interaction_constraints=None,
              learning_rate=None, max_bin=None, max_cat_threshold=None,
              max_cat_to_onehot=None, max_delta_step=None, max_depth=None,
```

In [83]:

```
#Predict and Evaluate Model Performance
from sklearn.metrics import classification_report, accuracy_score

# Predict sentiments on the test set
y_pred_encoded = xgb_classifier.predict(X_test_word2vec)

y_pred = label_encoder.inverse_transform()

print(classification_report(y_test_word2vec, y_pred))
print("Accuracy:", accuracy_score(y_test_word2vec, y_pred))
```

```
              precision    recall  f1-score   support

    negative       0.47      0.73      0.57      5528
     neutral       0.14      0.46      0.21       901
    positive       0.95      0.81      0.88     34517

    accuracy                           0.79     40946
   macro avg       0.52      0.66      0.55     40946
weighted avg       0.87      0.79      0.82     40946

Accuracy: 0.7921164460508963
```

In [99]:

```
#cross validation Word2Vec
from sklearn.model_selection import cross_val_score
from xgboost import XGBClassifier

model_word2vec = XGBClassifier()
scores_word2vec = cross_val_score(model_word2vec, X_test_word2vec, y_pred_encoded,
print("Average accuracy of CV with Word2Vec: ", scores_word2vec.mean())
```

```
Average accuracy of CV with Word2Vec:  0.8949591868898257
```

In [98]:

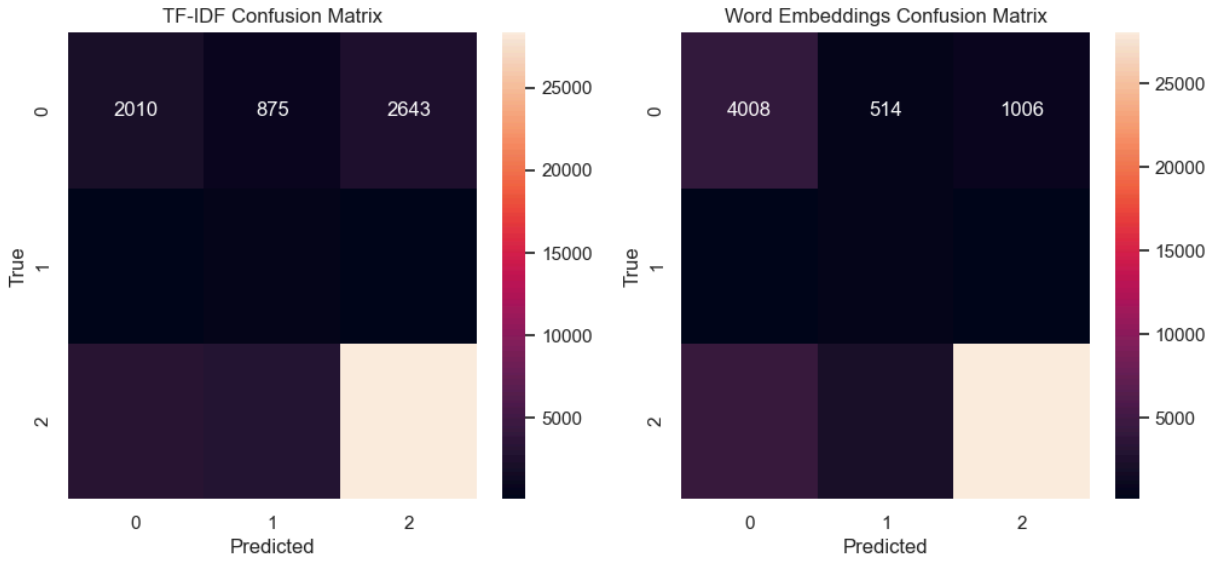
```
#cross validation TF_IDF
from sklearn.model_selection import cross_val_score
from xgboost import XGBClassifier

model_tfidf = XGBClassifier()
scores_tfidf = cross_val_score(model_tfidf, X_test_tfidf, y_pred_encoded, cv=5, sco
print("Average accuracy of CV with TF-IDF: ", scores_tfidf.mean())
```

```
Average accuracy of CV with TF-IDF:  0.751550939935358
```

visualization

In [134…

```
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.metrics import confusion_matrix

cm_tfidf = confusion_matrix(y_test_tfidf, y_pred_f)
cm_embeddings = confusion_matrix(y_test_word2vec, y_pred)

fig, ax = plt.subplots(1, 2, figsize=(12, 5))

sns.heatmap(cm_tfidf, annot=True, fmt='d', ax=ax[0])
ax[0].set_title('TF-IDF Confusion Matrix')
ax[0].set_xlabel('Predicted')
ax[0].set_ylabel('True')

sns.heatmap(cm_embeddings, annot=True, fmt='d', ax=ax[1])
ax[1].set_title('Word Embeddings Confusion Matrix')
ax[1].set_xlabel('Predicted')
ax[1].set_ylabel('True')

plt.show()
```

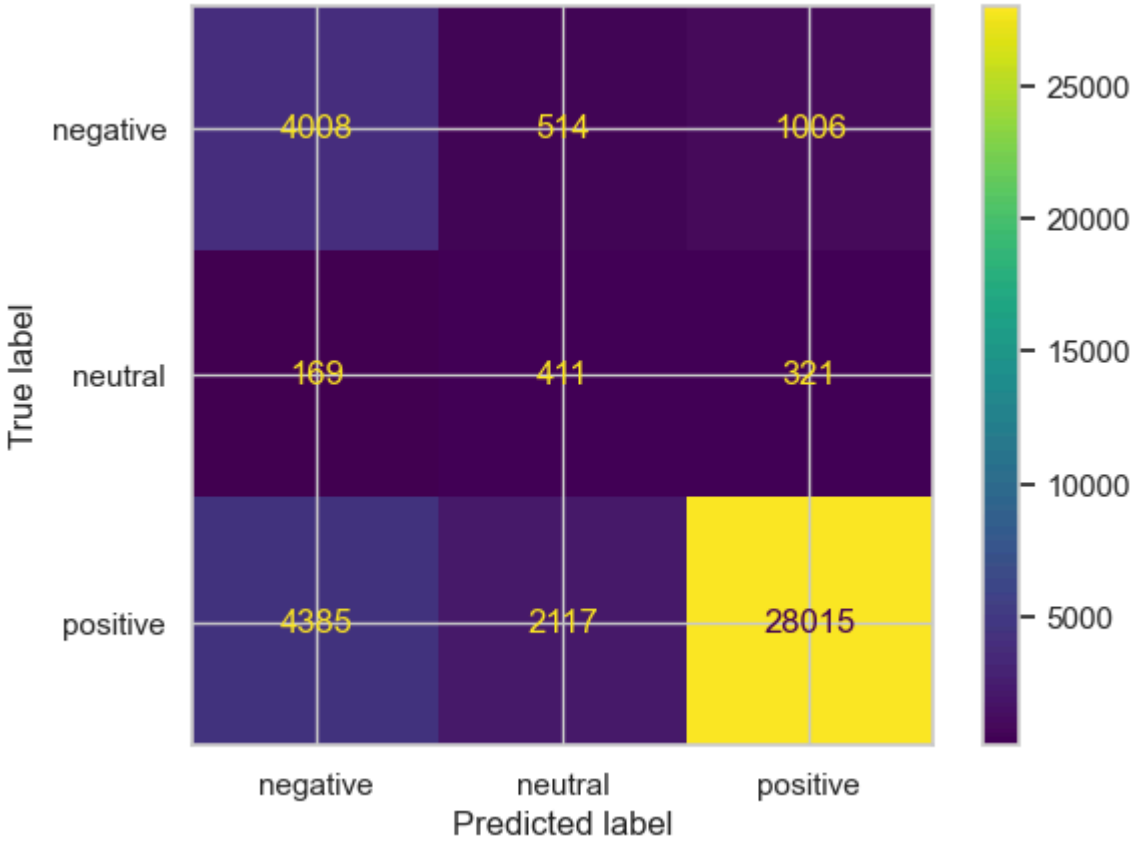


In [136…

```
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay

cm_embeddings = confusion_matrix(y_test_word2vec, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm_embeddings, display_labels=label_
disp.plot()
```

Out[136…

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x11d22219a80>
```

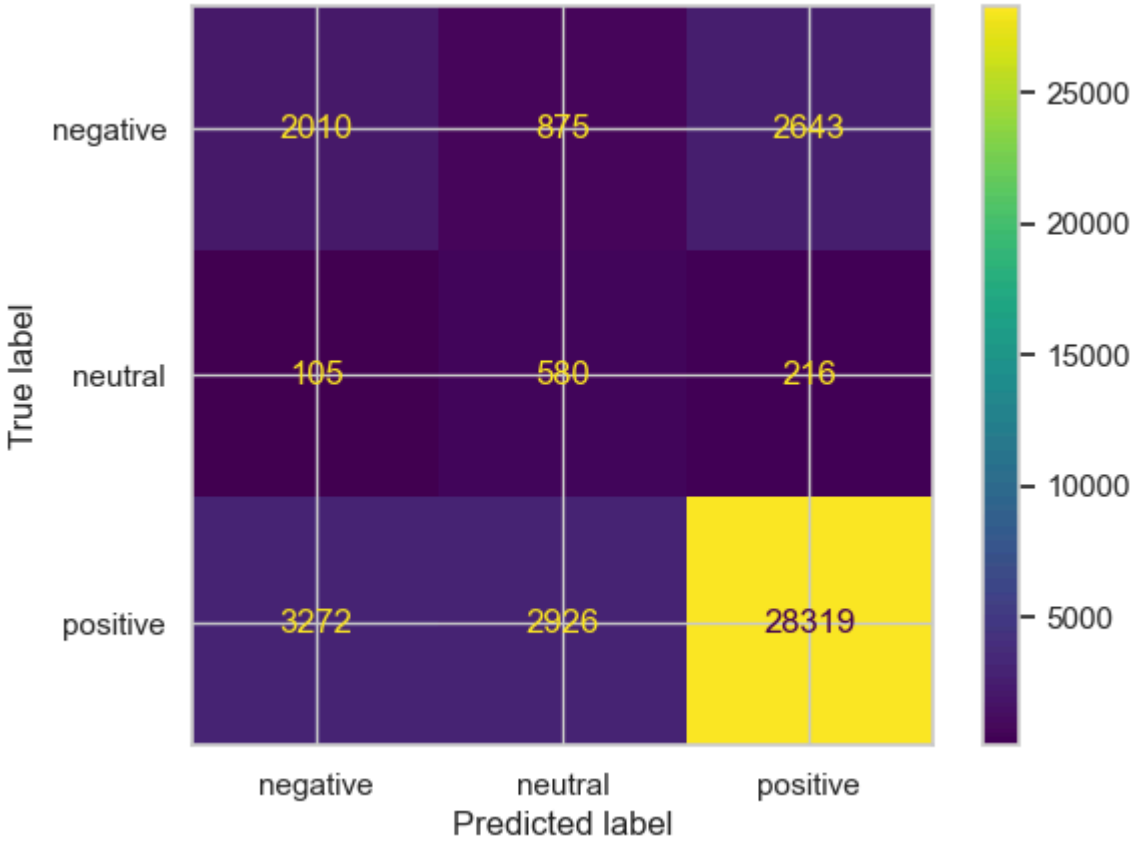


In [137…

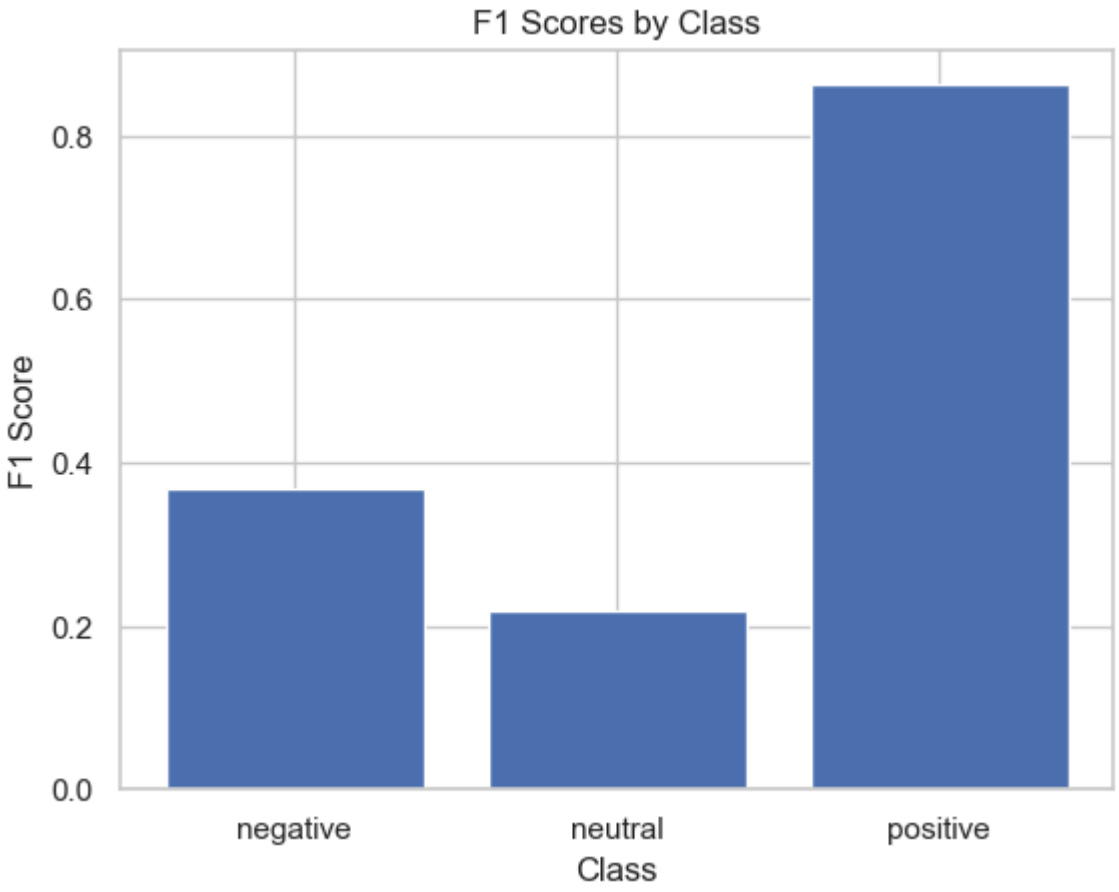
```
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay

cm_tfidf = confusion_matrix(y_test_tfidf, y_pred_f)
disp = ConfusionMatrixDisplay(confusion_matrix=cm_tfidf, display_labels=label_encod
disp.plot()
```

Out[137…

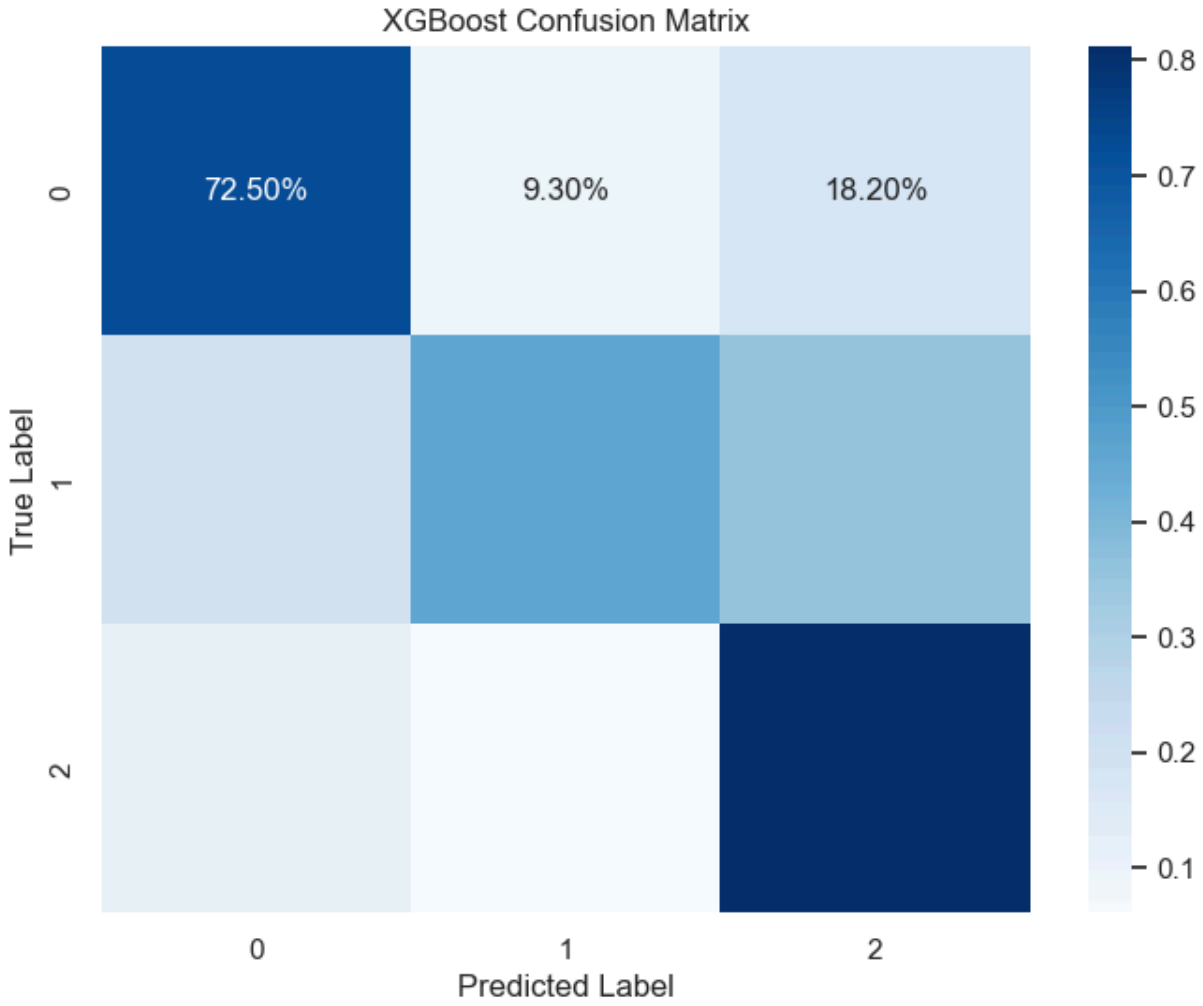
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x11d237cc2e0>
```



In [48]:
```
from sklearn.metrics import f1_score
import matplotlib.pyplot as plt
import numpy as np

f1_scores = f1_score(y_test_word2vec, y_pred, labels=["negative", "neutral", "posit

plt.bar(["negative", "neutral", "positive"], f1_scores)
plt.xlabel('Class')
plt.ylabel('F1 Score')
plt.title('F1 Scores by Class')
plt.show()
```

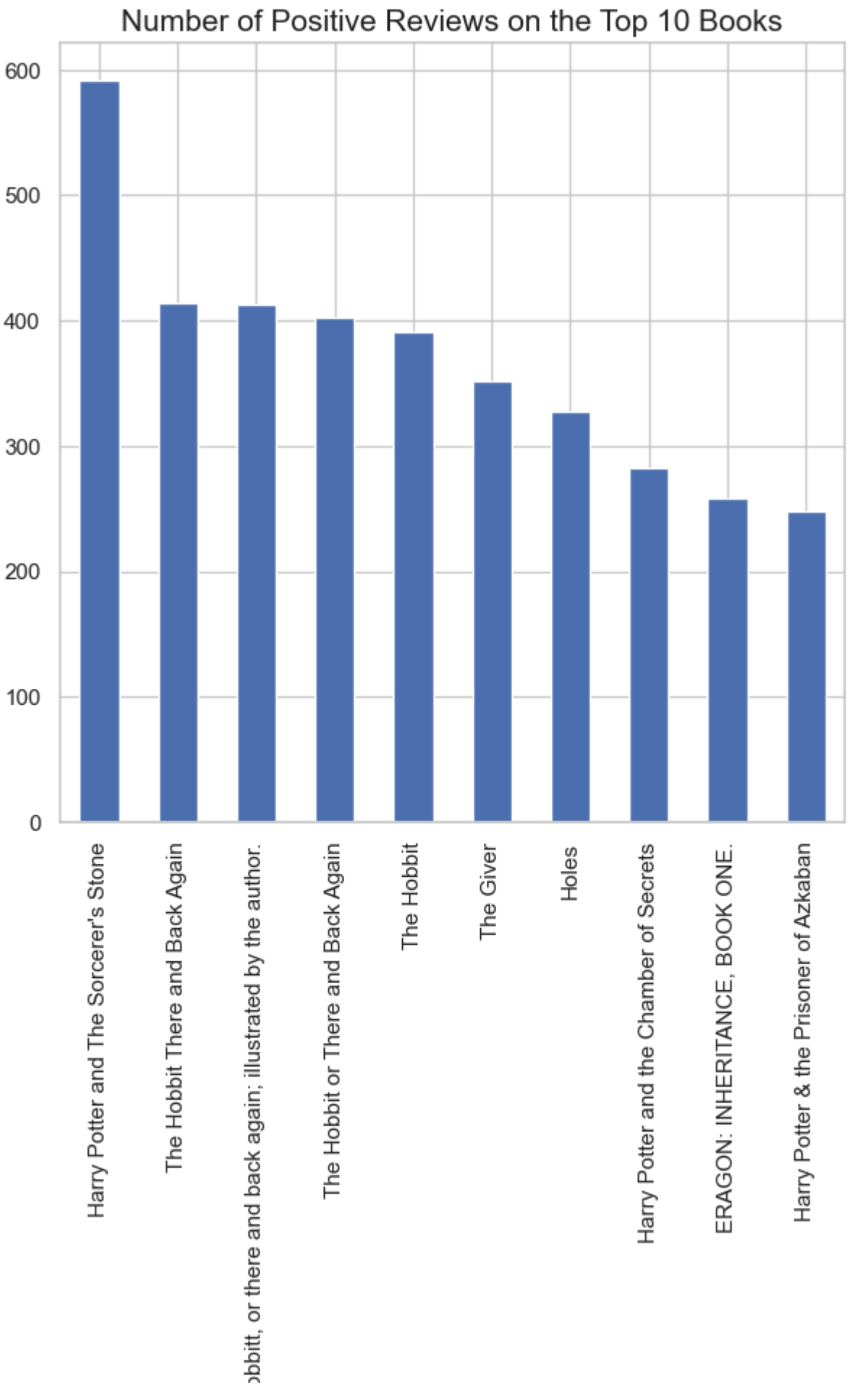


In [62]:
```
XGB2_cm = confusion_matrix(y_test_word2vec, y_pred)


XGB2_cm_normalized = XGB2_cm / XGB2_cm.sum(axis=1)[:, np.newaxis]

# Plotting the normalized confusion matrix
plt.figure(figsize=(8, 6))
sns.heatmap(XGB2_cm_normalized, annot=True, fmt=".2%", cmap="Blues")
plt.title("XGBoost Confusion Matrix")
plt.xlabel("Predicted Label")
plt.ylabel("True Label")
plt.show()
```



In [103…

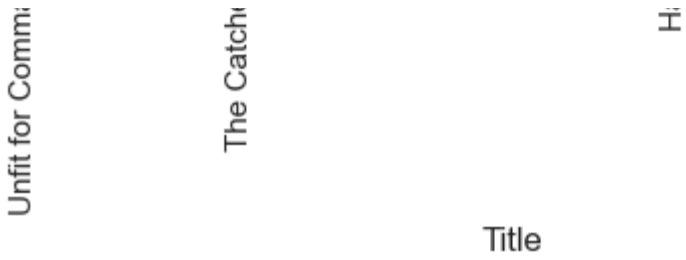
```
# Visualization for the most number of Positive Reviews on the top 10 Books
positive_reviews = sentiment_df[sentiment_df['sentiment'] == 'positive']['Title'].v
positive_reviews.plot(kind='bar', figsize=(7, 7))
plt.title('Number of Positive Reviews on the Top 10 Books', fontsize=15)
plt.xticks(rotation=90)
plt.show()
```


Number of Positive Reviews on the Top 10 Books
600
500
400
300
200
100
0
Harry Potter and The Sorcerer's Stone
The Hobbit There and Back Again
obbitt, or there and back again; illustrated by the author.
The Hobbit or There and Back Again
The Hobbit
The Giver
Holes
Harry Potter and the Chamber of Secrets
ERAGON: INHERITANCE, BOOK ONE.
Harry Potter & the Prisoner of Azkaban

In [104…

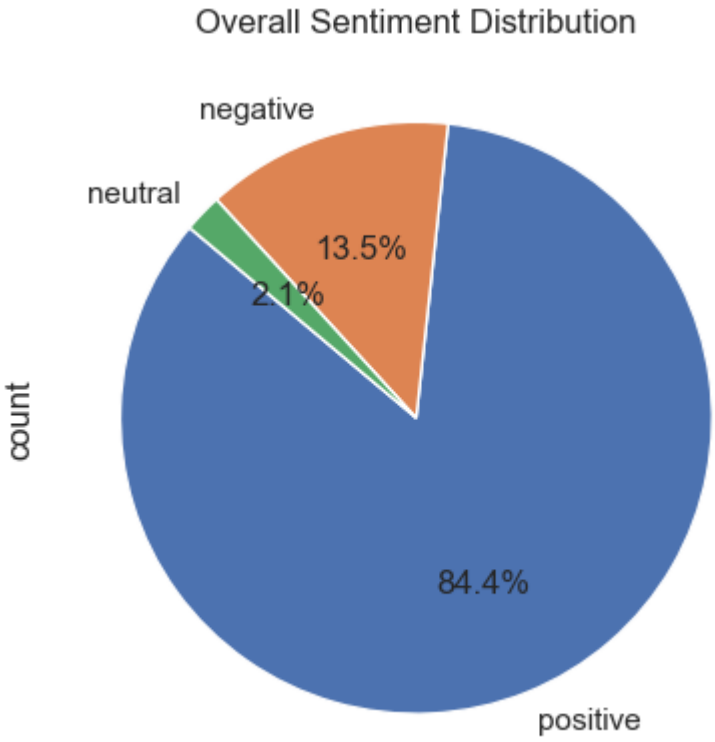
```
# Visualization for the most number of Negative Reviews on the top 10 Books
negative_reviews = sentiment_df[sentiment_df['sentiment'] == 'negative']['Title'].v
negative_reviews.plot(kind='bar', figsize=(7, 7))
plt.title('Number of Negative Reviews on the Top 10 Books', fontsize=15)
plt.xticks(rotation=90)
plt.show()
```

Number of Negative Reviews on the Top 10 Books
120
100
80
60
40
20
0
and: Swift Boat Veterans Speak Out Against John Kerry
Hannibal
er in the Rye [Audiobook] [Cd] [Unabridged] (Audio CD)
THE CATCHER IN THE RYE
Hannibal (Hannibal Lecter)
Night
arper Lee's To Kill a Mockingbird (Barron's Book Notes)
To Kill a Mocking Bird
Crossroads of Twilight (The Wheel of Time, Book 10)
Lord of the flies: A novel



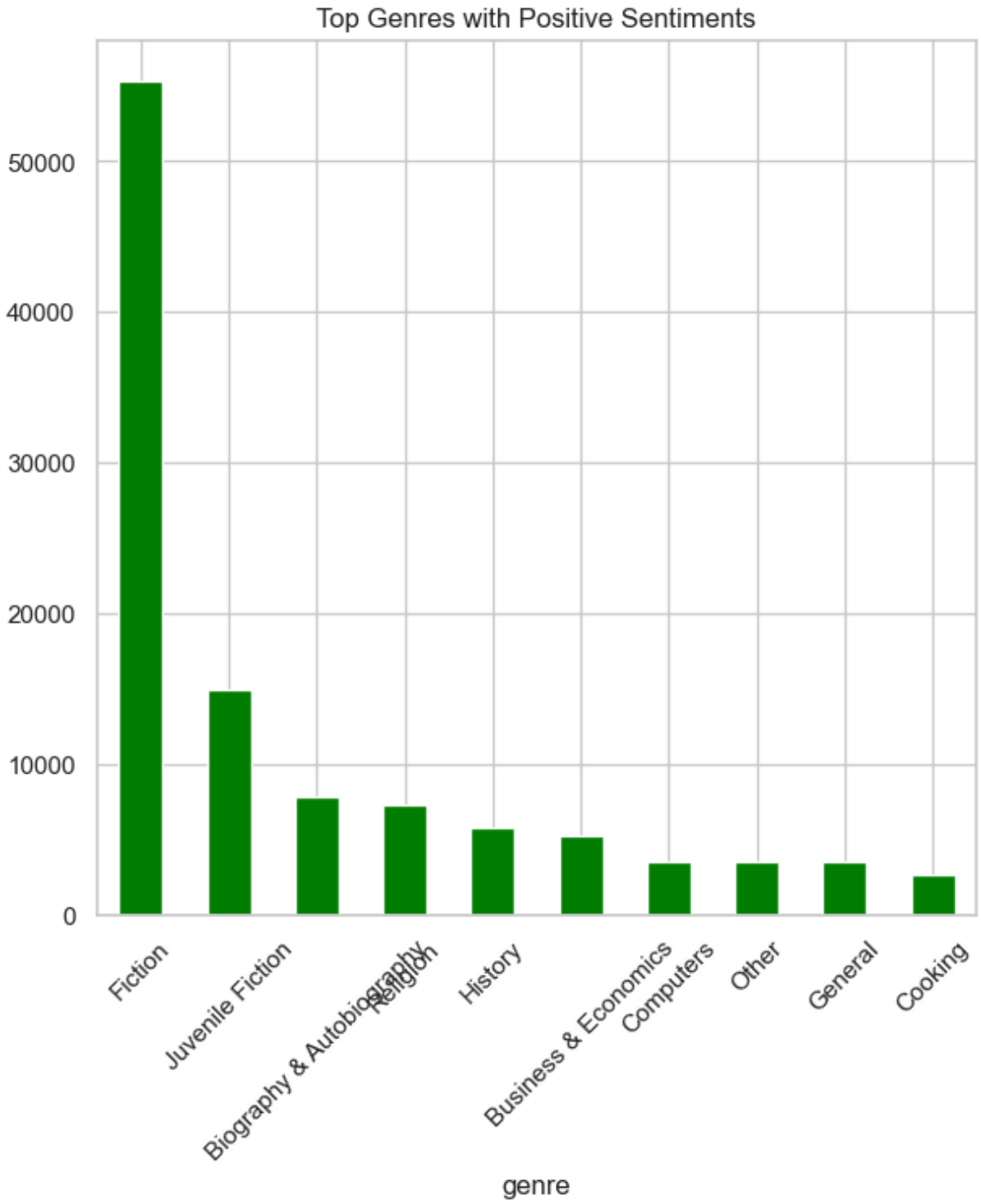
In [105…

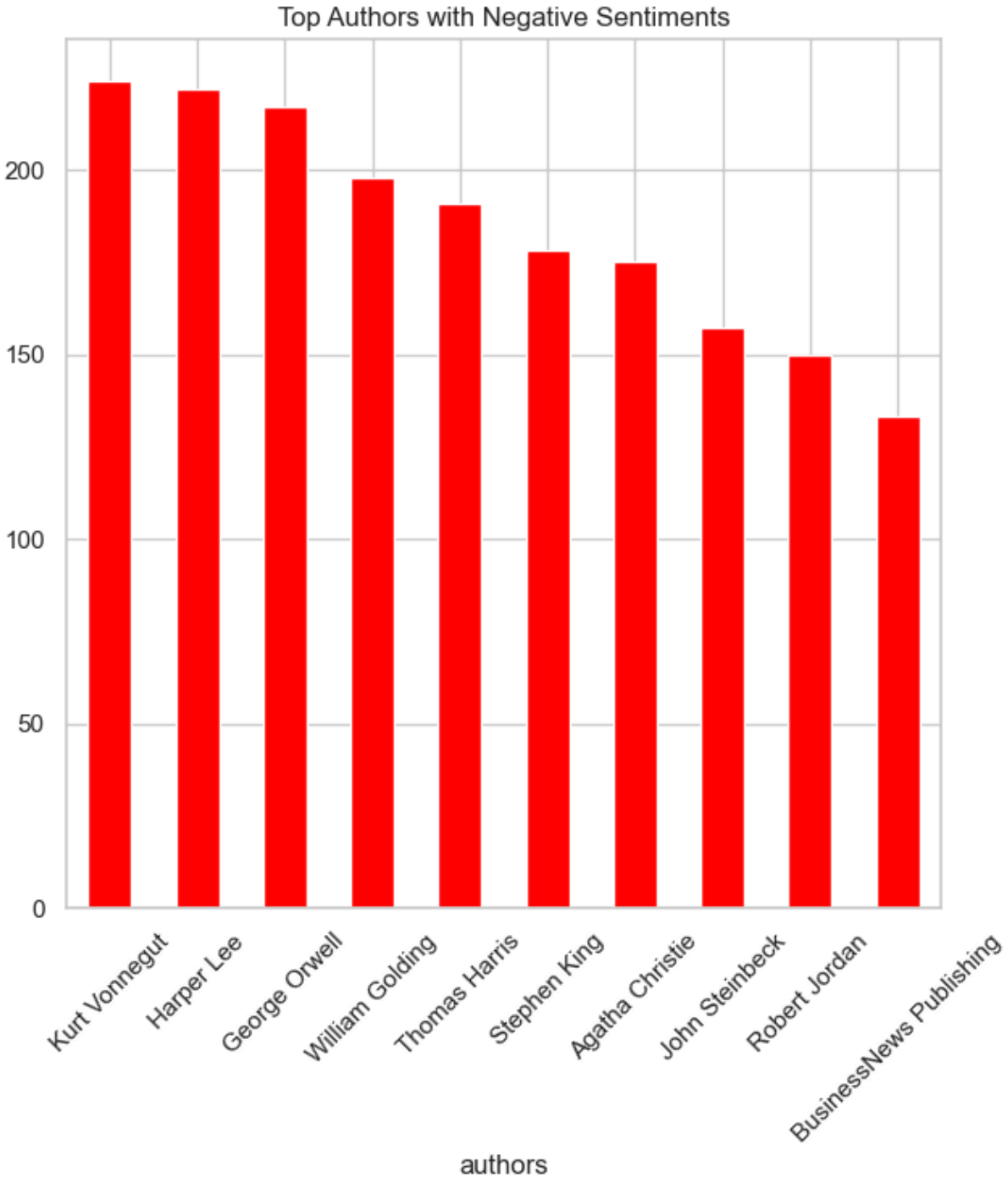
```
#positive, negative, and neutral
sentiment_df['sentiment'].value_counts().plot(kind='pie', autopct='%1.1f%%', starta
plt.title('Overall Sentiment Distribution')
plt.show()
```



In [108…

```
# Top Genres with the Most Positive Sentiments
sentiment_df[sentiment_df['sentiment'] == 'positive']['genre'].value_counts().head(
plt.title('Top Genres with Positive Sentiments')
plt.xticks(rotation=45)
plt.show()

# Top Authors with the Most Negative Sentiments
sentiment_df[sentiment_df['sentiment'] == 'negative']['authors'].value_counts().hea
plt.title('Top Authors with Negative Sentiments')
plt.xticks(rotation=45)
plt.show()
```


Top Genres with Positive Sentiments
50000
40000
30000
20000
10000
0
Fiction
Juvenile Fiction
Biography & Autobiography
Religion
History
Business & Economics
Computers
Other
General
Cooking
genre


Top Authors with Negative Sentiments
200
150
100
50
0
Kurt Vonnegut
Harper Lee
George Orwell
William Golding
Thomas Harris
Stephen King
Agatha Christie
John Steinbeck
Robert Jordan
BusinessNews Publishing
authors

In [ ]: