In [ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [3]:
```
books = pd.read_csv('books.csv')
ratings = pd.read_csv('ratings.csv')
users = pd.read_csv('users.csv')
```

```
/var/folders/zt/12s0mgps6hl_1c1k2_r1f9n00000gp/T/ipykernel_17813/835
546400.py:1: DtypeWarning: Columns (3) have mixed types. Specify dty
pe option on import or set low_memory=False.
  books = pd.read_csv('books.csv')
```

In [4]:
```
books['Image-URL-M'][1]
```

Out[4]:
```
'http://images.amazon.com/images/P/0002005018.01.MZZZZZZZ.jpg'
```

In [5]:
```
users.head()
```

Out[5]:

	User-ID	Location	Age
0	1	nyc, new york, usa	NaN
1	2	stockton, california, usa	18.0
2	3	moscow, yukon territory, russia	NaN
3	4	porto, v.n.gaia, portugal	17.0
4	5	farnborough, hants, united kingdom	NaN

In [6]:
```
ratings.head()
```

Out[6]:

	User-ID	ISBN	Book-Rating
0	276725	034545104X	0
1	276726	155061224	5
2	276727	446520802	0
3	276729	052165615X	3
4	276729	521795028	6

In [7]:
```
#dimension of dataset
print(books.shape)
print(ratings.shape)
print(users.shape)
```

```
(271360, 8)
(1048575, 3)
(278858, 3)
```

In [8]:
```
books.isnull().sum()
```

Out[8]:
```
ISBN                   0
Book-Title             0
Book-Author            1
Year-Of-Publication    0
Publisher              2
Image-URL-S            0
Image-URL-M            0
Image-URL-L            3
dtype: int64
```

In [9]:
```
users.isnull().sum()
```

Out[9]:
```
User-ID          0
Location         0
Age         110762
dtype: int64
```

In [10]:
```
ratings.isnull().sum()
```

Out[10]:
```
User-ID        0
ISBN           0
Book-Rating    0
dtype: int64
```

In [11]:
```
books.duplicated().sum()
```

Out[11]:
```
0
```

In [12]:
```
ratings.duplicated().sum()
```

Out[12]:
```
72
```

In [13]:
```
users.duplicated().sum()
```

Out[13]:
```
0
```

Popularity Based Recommender System

In [14]:
```
ratings_with_name = ratings.merge(books,on='ISBN')
```

In [15]:
```
num_rating_df = ratings_with_name.groupby('Book-Title').count()['Book-
num_rating_df.rename(columns={'Book-Rating':'num_ratings'},inplace=Tru
num_rating_df
```

Out[15]:

	Book-Title	num_ratings
0	A Light in the Storm: The Civil War Diary of ...	4
1	Always Have Popsicles	1
2	Apple Magic (The Collector's series)	1
3	Beyond IBM: Leadership Marketing and Finance ...	1
4	Clifford Visita El Hospital (Clifford El Gran...	1
...	...	...
230215	Ã?Â?l- Connection.	1
230216	Ã?Â?lpiraten.	2
230217	Ã?Â?rger mit Produkt X. Roman.	4
230218	Ã?Â?stlich der Berge.	2
230219	Ã?Â?thique en toc	2

230220 rows × 2 columns

In [16]:
```
avg_rating_df = ratings_with_name.groupby('Book-Title').mean()['Book-F
avg_rating_df.rename(columns={'Book-Rating':'avg_rating'},inplace=True
avg_rating_df
```

Out[16]:

	Book-Title	avg_rating
0	A Light in the Storm: The Civil War Diary of ...	2.25
1	Always Have Popsicles	0.00
2	Apple Magic (The Collector's series)	0.00
3	Beyond IBM: Leadership Marketing and Finance ...	0.00
4	Clifford Visita El Hospital (Clifford El Gran...	0.00
...	...	...
230215	Ã?Â?l- Connection.	0.00
230216	Ã?Â?lpiraten.	0.00
230217	Ã?Â?rger mit Produkt X. Roman.	5.25
230218	Ã?Â?stlich der Berge.	4.00
230219	Ã?Â?thique en toc	4.00

230220 rows × 2 columns

In [17]:
```
popular_df = num_rating_df.merge(avg_rating_df,on='Book-Title')
popular_df
```

Out[17]:

	Book-Title	num_ratings	avg_rating
0	A Light in the Storm: The Civil War Diary of ...	4	2.25
1	Always Have Popsicles	1	0.00
2	Apple Magic (The Collector's series)	1	0.00
3	Beyond IBM: Leadership Marketing and Finance ...	1	0.00
4	Clifford Visita El Hospital (Clifford El Gran...	1	0.00
...	...	...	...
230215	Ã?Â?l- Connection.	1	0.00
230216	Ã?Â?lpiraten.	2	0.00
230217	Ã?Â?rger mit Produkt X. Roman.	4	5.25
230218	Ã?Â?stlich der Berge.	2	4.00
230219	Ã?Â?thique en toc	2	4.00

230220 rows × 3 columns

In [18]:
```
popular_df = popular_df[popular_df['num_ratings'] >= 250].sort_values(
```

In [19]:
```
popular_df = popular_df.merge(books,on='Book-Title').drop_duplicates(
```

In [20]:
```
popular_df
```

Out[20]:

	Book-Title	Book-Author	Image-URL-M	num_ratin
0	Harry Potter and the Goblet of Fire (Book 4)	J. K. Rowling	http://images.amazon.com/images/P/0439139597.0...	3
2	Harry Potter and the Prisoner of Azkaban (Book 3)	J. K. Rowling	http://images.amazon.com/images/P/0439136350.0...	3
5	Harry Potter and the Order of the Phoenix (Boo...	J. K. Rowling	http://images.amazon.com/images/P/043935806X.0...	3
9	Harry Potter and the Chamber of	J. K. Rowling	http://images.amazon.com/images/P/0439064872.0	5

Collaborative Filtering Based Recommender System

In [21]:
```
x = ratings_with_name.groupby('User-ID').count()['Book-Rating'] > 200
padhe_likhe_users = x[x].index
```

In [22]:
```
filtered_rating = ratings_with_name[ratings_with_name['User-ID'].isin
```

In [23]:
```
y = filtered_rating.groupby('Book-Title').count()['Book-Rating']>=50
famous_books = y[y].index
```

In [24]:
```
final_ratings = filtered_rating[filtered_rating['Book-Title'].isin(fa
```

In [25]:
```
pt = final_ratings.pivot_table(index='Book-Title',columns='User-ID',v
```

In [26]:
```
pt.fillna(0,inplace=True)
```

In [27]:
```
pt
```

Out[27]:

User-ID	254	2276	2766	2977	3363	4017	4385	6251	6323	6543	...	249111	24962
Book-Title													
1984	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
1st to Die: A Novel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	...	0.0	0.
2nd Chance	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
4 Blondes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
A Bend in the Road	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
...	...	...	...	...	...	...	...	...	...	...	...	...	..
Year of Wonders	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
You Belong To Me	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
Zen and the Art of Motorcycle Maintenance: An Inquiry into Values	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
Zoya	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.
\O\" Is for Outlaw"	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.

603 rows × 735 columns

In [28]:
```
from sklearn.metrics.pairwise import cosine_similarity
```

In [29]:
```
similarity_scores = cosine_similarity(pt)
```

In [30]:
```
similarity_scores.shape
```

Out[30]:
```
(603, 603)
```

In [31]:
```
def recommend(book_name):
    # index fetch
    index = np.where(pt.index==book_name)[0][0]
    similar_items = sorted(list(enumerate(similarity_scores[index])),k

    data = []
    for i in similar_items:
        item = []
        temp_df = books[books['Book-Title'] == pt.index[i[0]]]
        item.extend(list(temp_df.drop_duplicates('Book-Title')['Book-T
        item.extend(list(temp_df.drop_duplicates('Book-Title')['Book-A
        item.extend(list(temp_df.drop_duplicates('Book-Title')['Image-

        data.append(item)

    return data
```

In [32]:
```
recommend('1984')
```

Out[32]:
```
[['Animal Farm',
  'George Orwell',
  'http://images.amazon.com/images/P/0451526341.01.MZZZZZZZ.jpg'],
 ['Brave New World',
  'Aldous Huxley',
  'http://images.amazon.com/images/P/0060809833.01.MZZZZZZZ.jpg'],
 ['The Vampire Lestat (Vampire Chronicles, Book II)',
  'ANNE RICE',
  'http://images.amazon.com/images/P/0345313860.01.MZZZZZZZ.jpg'],
 ["The Handmaid's Tale",
  'Margaret Atwood',
  'http://images.amazon.com/images/P/0449212602.01.MZZZZZZZ.jpg']]
```

In [33]:
```
pt.index[545]
```

Out[33]:
```
'The Winner'
```

In [34]:
```
import pickle
pickle.dump(popular_df,open('popular.pkl','wb'))
```

In [35]:
```
books.drop_duplicates('Book-Title')
```

Out[35]:

	ISBN	Book-Title	Book-Author	Year-Of-Publication	Publisher	
0	195153448	Classical Mythology	Mark P. O. Morford	2002	Oxford University Press	http://images.ama
1	2005018	Clara Callan	Richard Bruce Wright	2001	HarperFlamingo Canada	http://images.ama
2	60973129	Decision in Normandy	Carlo D'Este	1991	HarperPerennial	http://images.ama
3	374157065	Flu: The Story of the Great Influenza Pandemic...	Gina Bari Kolata	1999	Farrar Straus Giroux	http://images.ama
4	393045218	The Mummies of Urumchi	E. J. W. Barber	1999	W. W. Norton &amp; Company	http://images.ama
...	...	...	...	...	...	
271354	449906736	Flashpoints: Promise and Peril in a New World	Robin Wright	1993	Ballantine Books	http://images.ama
271356	525447644	From One to One Hundred	Teri Sloat	1991	Dutton Books	http://images.ama
271357	006008667X	Lily Dale : The True Story of the Town that Ta...	Christine Wicker	2004	HarperSanFrancisco	http://images.ama
271358	192126040	Republic (World's Classics)	Plato	1996	Oxford University Press	http://images.ama
271359	767409752	A Guided Tour of Rene Descartes' Meditations o...	Christopher Biffle	2000	McGraw-Hill Humanities/Social Sciences/Languages	http://images.ama

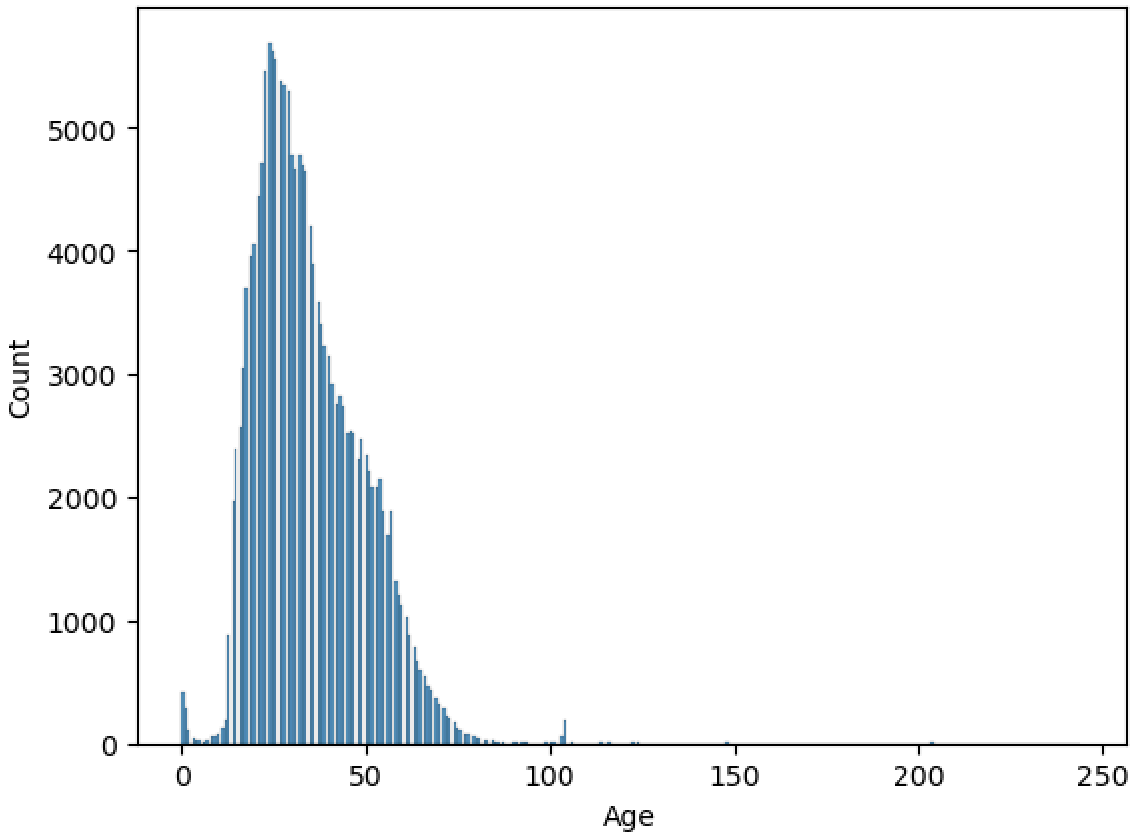
242131 rows × 8 columns

In [36]:
```
pickle.dump(pt,open('pt.pkl','wb'))
pickle.dump(books,open('books.pkl','wb'))
pickle.dump(similarity_scores,open('similarity_scores.pkl','wb'))
```

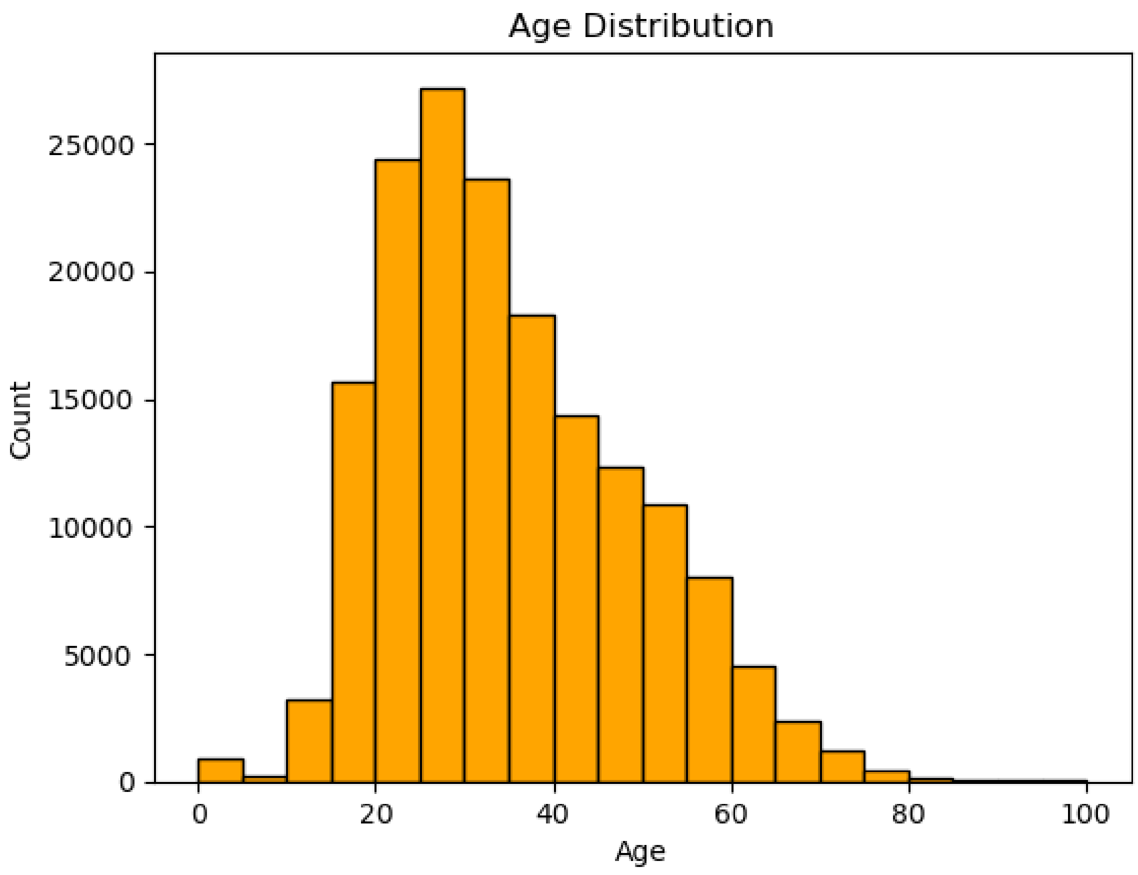
In [37]:
```
import seaborn as sns
```

In [38]:
```
sns.histplot(users.Age)
```

Out[38]:
```
<AxesSubplot:xlabel='Age', ylabel='Count'>
```

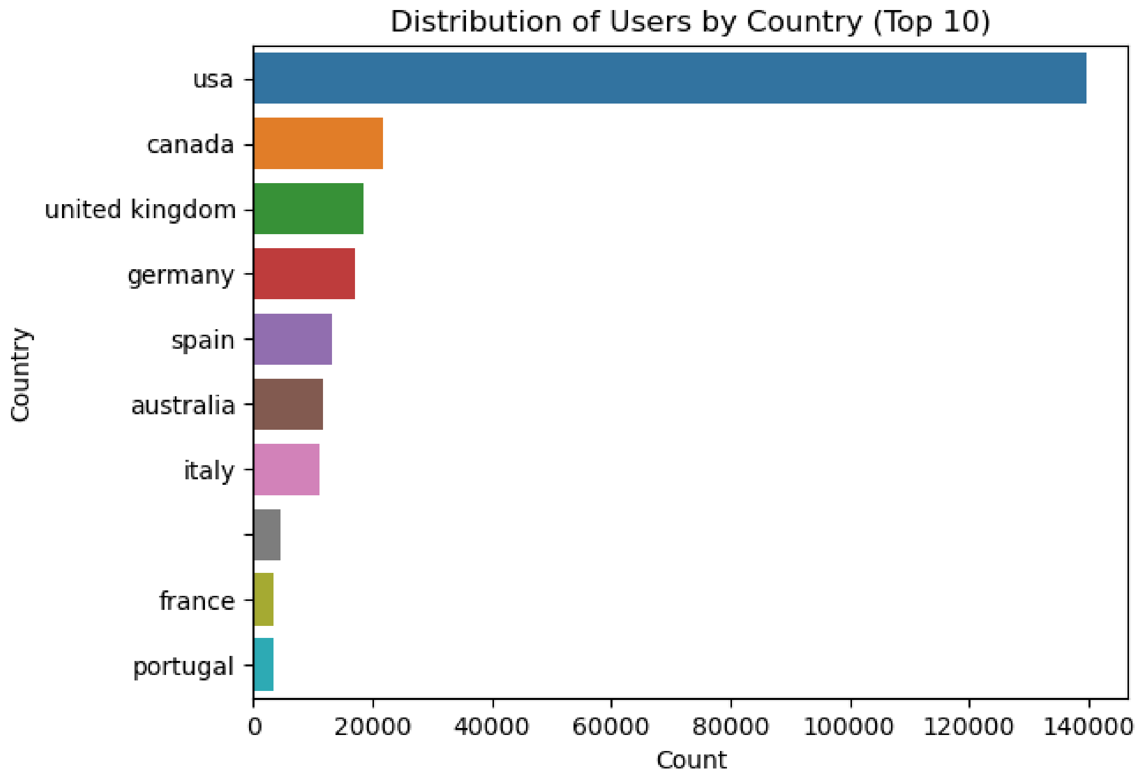


```
In [39]: # Plotting the histogram
         df = pd.DataFrame(users)
         plt.hist(df['Age'], bins=20, range=(0, 100), edgecolor='black', color=

         # Adding labels and title
         plt.xlabel('Age')
         plt.ylabel('Count')
         plt.title('Age Distribution')

         # Display the plot
         plt.show()
```

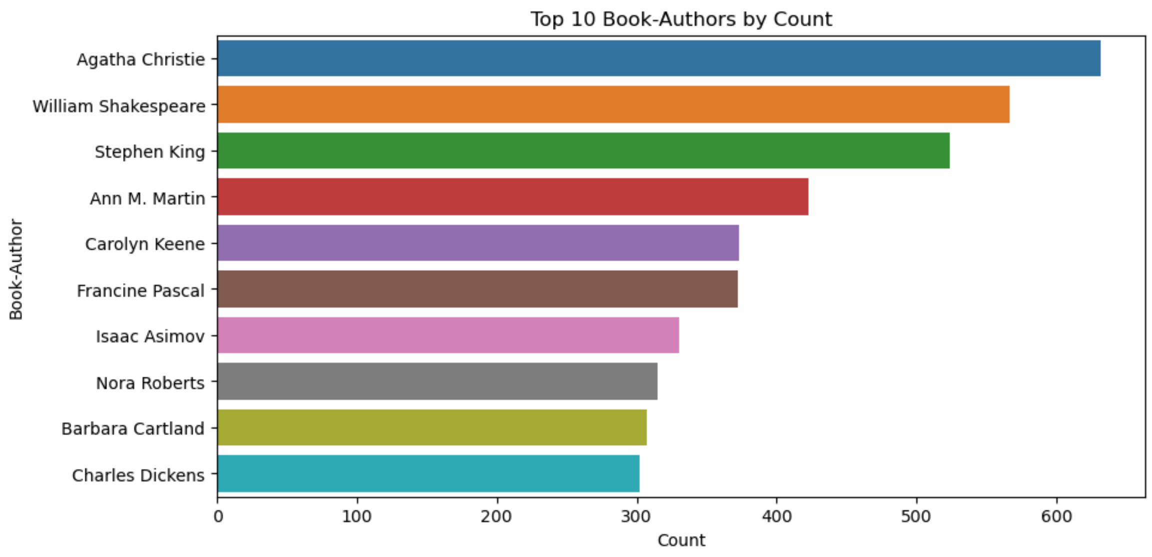


In [40]:
```
df['Country'] = df['Location'].str.split(',').str[-1].str.strip()

# Display the updated DataFrame
print(df)

# Get the top 10 countries by count in descending order
top_countries = df['Country'].value_counts().sort_values(ascending=Fal

# Filter the DataFrame to include only the top 10 countries
df_top_countries = df[df['Country'].isin(top_countries)]

# Plotting the horizontal countplot
sns.countplot(data=df_top_countries, y='Country', order=top_countries)

# Adding labels and title
plt.xlabel('Count')
plt.ylabel('Country')
plt.title('Distribution of Users by Country (Top 10)')

# Display the plot
plt.show()
```

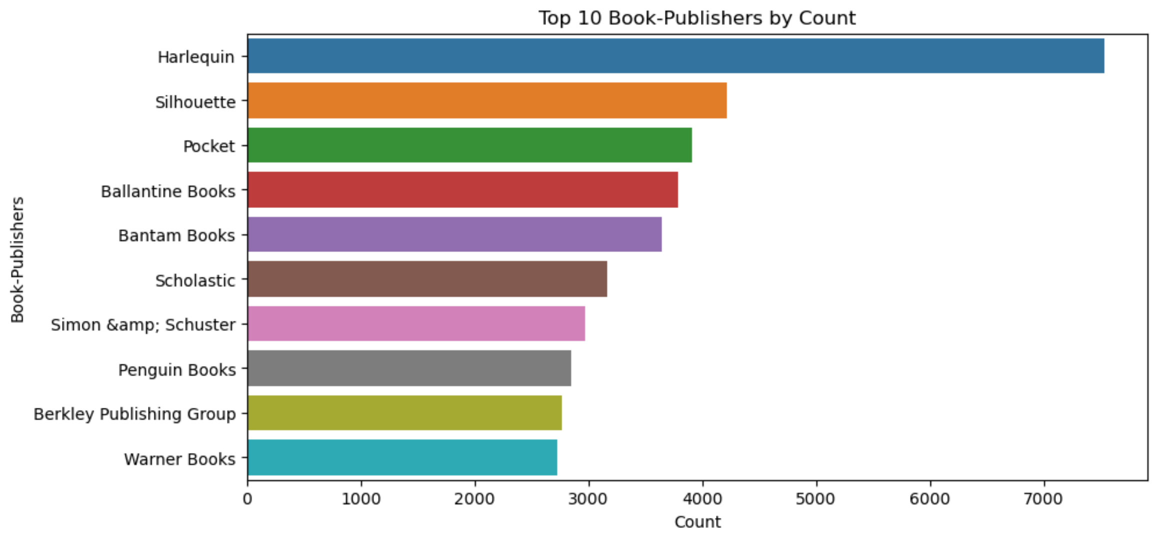
```
        User-ID                            Location   Age         Co
untry
0             1                  nyc, new york, usa   NaN
usa
1             2           stockton, california, usa  18.0
usa
2             3     moscow, yukon territory, russia   NaN          r
ussia
3             4           porto, v.n.gaia, portugal  17.0        por
tugal
4             5  farnborough, hants, united kingdom   NaN  united ki
ngdom
...         ...                                 ...   ...
...
278853   278854                portland, oregon, usa   NaN
usa
278854   278855  tacoma, washington, united kingdom  50.0  united ki
ngdom
278855   278856           brampton, ontario, canada   NaN          c
anada
278856   278857           knoxville, tennessee, usa   NaN
usa
278857   278858                dublin, n/a, ireland   NaN         ir
eland

[278858 rows x 4 columns]
```



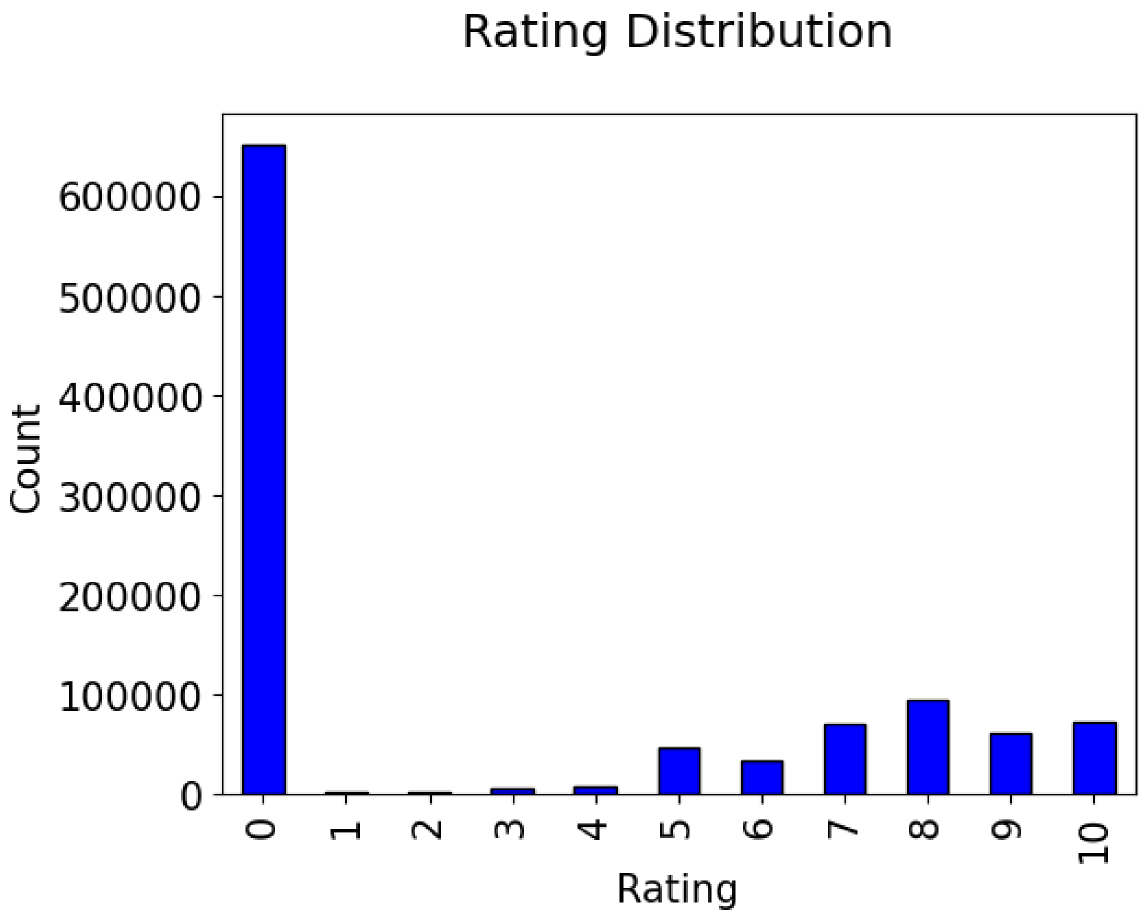
In [41]:
```
df = pd.DataFrame(books)
top_authors = df['Book-Author'].value_counts().head(10)

# Plotting the top 10 Book-Authors
plt.figure(figsize=(10, 5))
sns.barplot(x=top_authors.values, y=top_authors.index)
plt.xlabel('Count')
plt.ylabel('Book-Author')
plt.title('Top 10 Book-Authors by Count')
plt.show()
```



In [42]:
```
df = pd.DataFrame(books)
top_publishers = df['Publisher'].value_counts().head(10)

# Plotting the top 10 publisher
plt.figure(figsize=(10, 5))
sns.barplot(x=top_publishers.values, y=top_publishers.index)
plt.xlabel('Count')
plt.ylabel('Book-Publishers')
plt.title('Top 10 Book-Publishers by Count')
plt.show()
```

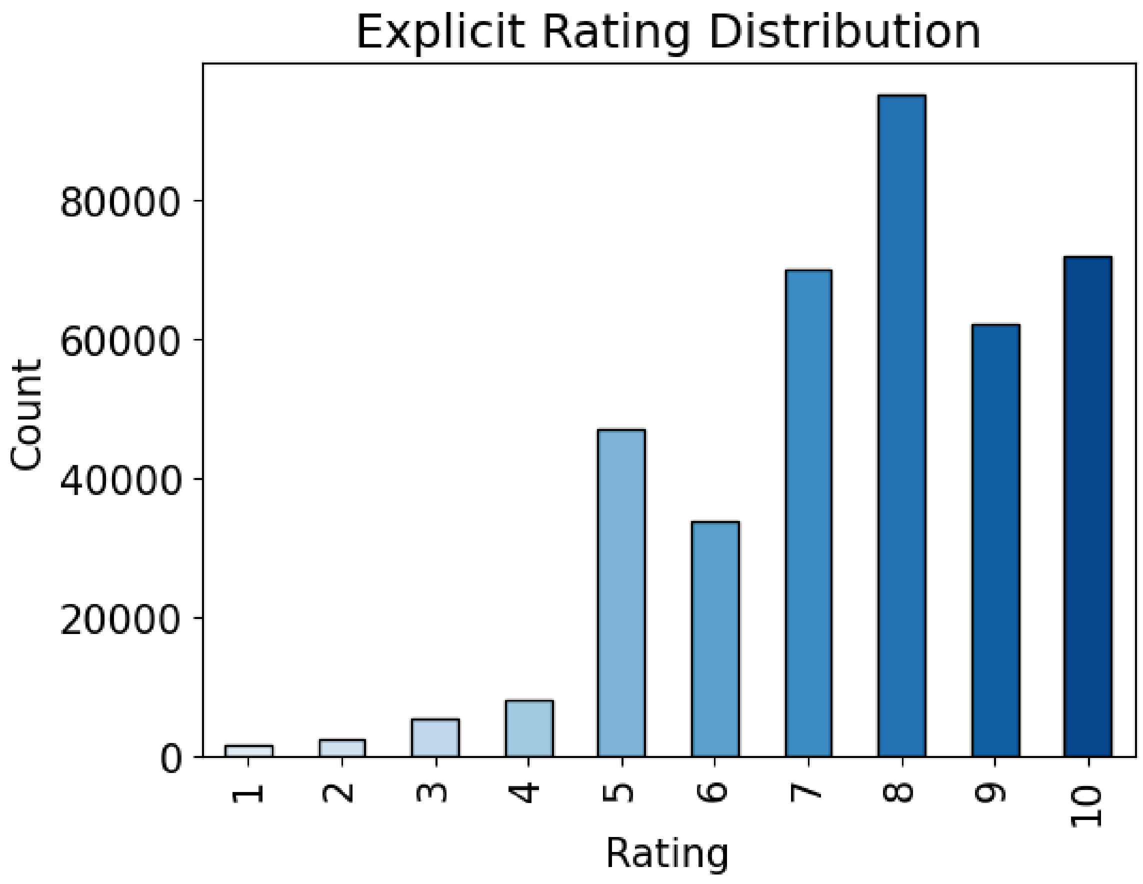


In [43]:
```
plt.rc("font", size=15)

# Plotting the bar chart in ascending order
ratings['Book-Rating'].value_counts(sort=False).sort_index().plot(kinc

# Adding title and labels
plt.title('Rating Distribution\n')
plt.xlabel('Rating')
plt.ylabel('Count')

# Display the plot
plt.show()
```



In [44]:
```
# Assuming you have a DataFrame named 'ratings' with a 'Book-Rating' c

# Segregating implicit and explicit ratings datasets
implicit_ratings = ratings[ratings['Book-Rating'] == 0]
explicit_ratings = ratings[ratings['Book-Rating'] != 0]

# Define a color palette
color_palette = sns.color_palette("Blues", len(explicit_ratings['Book-

# Plotting the bar chart for the rating distribution in ascending orde
plt.rc("font", size=15)
explicit_ratings['Book-Rating'].value_counts(sort=False).sort_index().
    kind='bar', edgecolor='black', color=color_palette)

# Adding title and labels
plt.title('Explicit Rating Distribution')
plt.xlabel('Rating')
plt.ylabel('Count')
```

Out[44]:
```
Text(0, 0.5, 'Count')
```



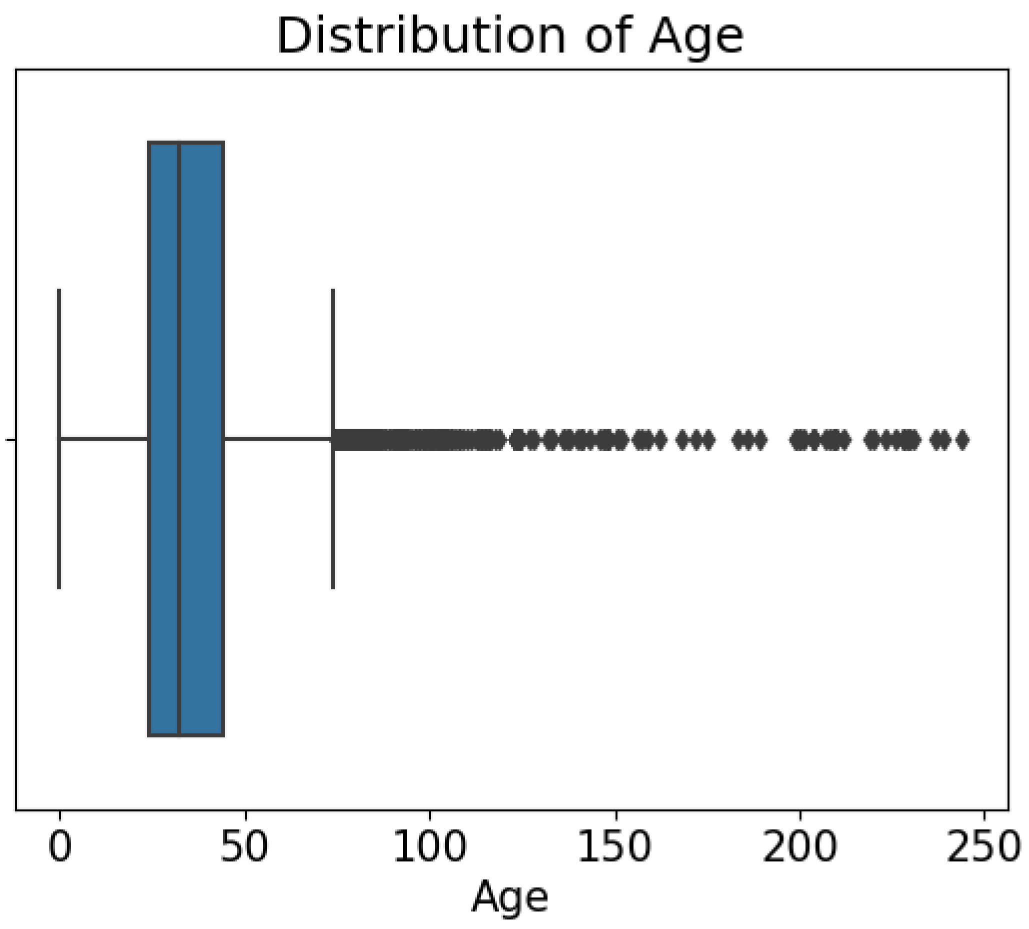
In [45]:
```
def missing_values(df):
    # Calculate the total number of values in each column
    total_values = df.shape[0]

    # Calculate the number of missing values in each column
    missing = df.isnull().sum()

    # Calculate the percentage of missing values in each column
    missing_percentage = (missing / total_values) * 100

    # Return the missing value percentages
    return missing_percentage

# Create a DataFrame
df = pd.DataFrame(users)  # Replace ... with your actual data

# Call the missing_values function
result = missing_values(df)

# Print the result
print(result)
```

```
User-ID      0.000000
Location     0.000000
Age         39.719857
Country      0.000000
dtype: float64
```

In [46]:
```
books.isna().sum()
```

Out[46]:
```
ISBN                   0
Book-Title             0
Book-Author            1
Year-Of-Publication    0
Publisher              2
Image-URL-S            0
Image-URL-M            0
Image-URL-L            3
dtype: int64
```

```
In [47]: Users_df = pd.DataFrame(users)
         sns.boxplot(data=Users_df, x='Age')

         # Add a title to the plot
         plt.title('Distribution of Age')

         # Display the plot
         plt.show()
```



```
In [48]: #users.loc[(users.Age > 100) | (users.Age < 5), 'Age'] = np.nan

In [49]: #users['Age'] = users['Age'].fillna(users.groupby('Country')['Age'].tı

In [50]: # Assuming you have a DataFrame named 'Users_df' with 'Age' and 'Coun

         # Calculate the median age by country
         median_age_by_country = Users_df.groupby('Country')['Age'].median()

         # Impute the missing values in 'Age' column with the median age of the
         Users_df['Age'] = Users_df.apply(
             lambda row: median_age_by_country[row['Country']] if pd.isnull(rov
             axis=1
         )
```

In [51]:
```
C= popular_df['avg_rating'].mean()
m= popular_df['num_ratings'].quantile(0.90)
Top_Books = popular_df.loc[popular_df['num_ratings'] >= m]
print(f'C={C} , m={m}')
Top_Books.shape
```

```
C=4.224302025049491 , m=598.9
```

Out[51]:
```
(5, 5)
```