Notebook

January 28, 2025

1 Amazon Review Analysis

1.0.1 Data Loading

[1]:
```
import pandas as pd



adata=pd.read_csv('Reviews.csv')
adata.head()
```

[1]:

	Id	ProductId	UserId	ProfileName	\
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	

	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	\
0	1	1	5	1303862400	
1	0	0	1	1346976000	
2	1	1	4	1219017600	
3	3	3	2	1307923200	
4	0	0	5	1350777600	

	Summary	Text
0	Good Quality Dog Food	I have bought several of the Vitality canned d…
1	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut…
2	"Delight" says it all	This is a confection that has been around a fe…
3	Cough Medicine	If you are looking for the secret ingredient i…
4	Great taffy	Great taffy at a great price. There was a wid…

1.0.2 Data Cleaning

[2]:
```
adata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 568454 entries, 0 to 568453
```

```
Data columns (total 10 columns):
 #   Column                  Non-Null Count   Dtype
---  ------                  --------------   -----
 0   Id                      568454 non-null  int64
 1   ProductId               568454 non-null  object
 2   UserId                  568454 non-null  object
 3   ProfileName             568428 non-null  object
 4   HelpfulnessNumerator    568454 non-null  int64
 5   HelpfulnessDenominator  568454 non-null  int64
 6   Score                   568454 non-null  int64
 7   Time                    568454 non-null  int64
 8   Summary                 568427 non-null  object
 9   Text                    568454 non-null  object
dtypes: int64(5), object(5)
memory usage: 43.4+ MB
```

[3]:
```
#column to be cleaned is ProfileName,Time,Summary date conversion
#Time=date conversion

adata['ProfileName']=adata['ProfileName'].fillna('NoData')
adata['Summary']=adata['Summary'].fillna('NoData')
adata['Time']=pd.to_datetime(adata['Time'], unit='s')
adata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 568454 entries, 0 to 568453
Data columns (total 10 columns):
 #   Column                  Non-Null Count   Dtype
---  ------                  --------------   -----
 0   Id                      568454 non-null  int64
 1   ProductId               568454 non-null  object
 2   UserId                  568454 non-null  object
 3   ProfileName             568454 non-null  object
 4   HelpfulnessNumerator    568454 non-null  int64
 5   HelpfulnessDenominator  568454 non-null  int64
 6   Score                   568454 non-null  int64
 7   Time                    568454 non-null  datetime64[ns]
 8   Summary                 568454 non-null  object
 9   Text                    568454 non-null  object
dtypes: datetime64[ns](1), int64(4), object(5)
memory usage: 43.4+ MB
```

[4]:
```
adata.head()
```

[4]:

	Id	ProductId	UserId	ProfileName	\
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	

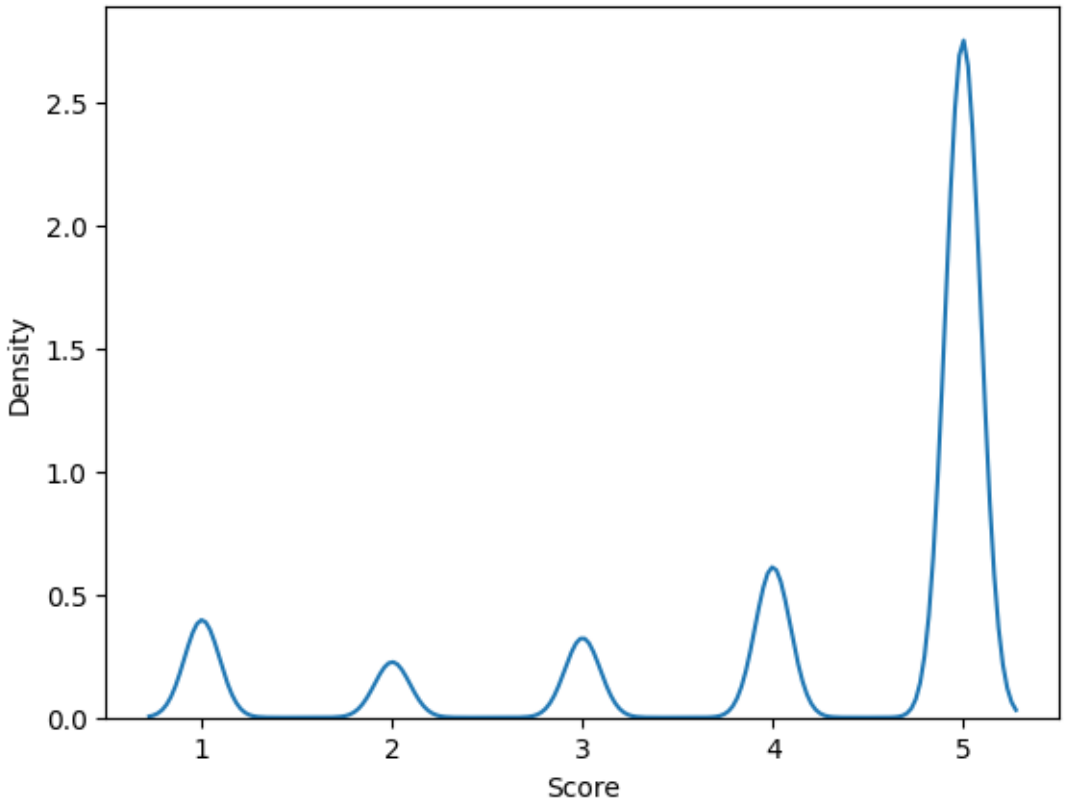
```
3   4  B000UA0QIQ  A395BORC6FGVXV                              Karl
4   5  B006K2ZZ7K  A1UQRSCLF8GW1T    Michael D. Bigham "M. Wassir"

   HelpfulnessNumerator  HelpfulnessDenominator  Score       Time  \
0                     1                       1      5 2011-04-27
1                     0                       0      1 2012-09-07
2                     1                       1      4 2008-08-18
3                     3                       3      2 2011-06-13
4                     0                       0      5 2012-10-21

                Summary                                                Text
0  Good Quality Dog Food  I have bought several of the Vitality canned d…
1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut…
2  "Delight" says it all  This is a confection that has been around a fe…
3         Cough Medicine  If you are looking for the secret ingredient i…
4            Great taffy  Great taffy at a great price.  There was a wid…
```

[5]:
```
adata.drop_duplicates(inplace=True)
```

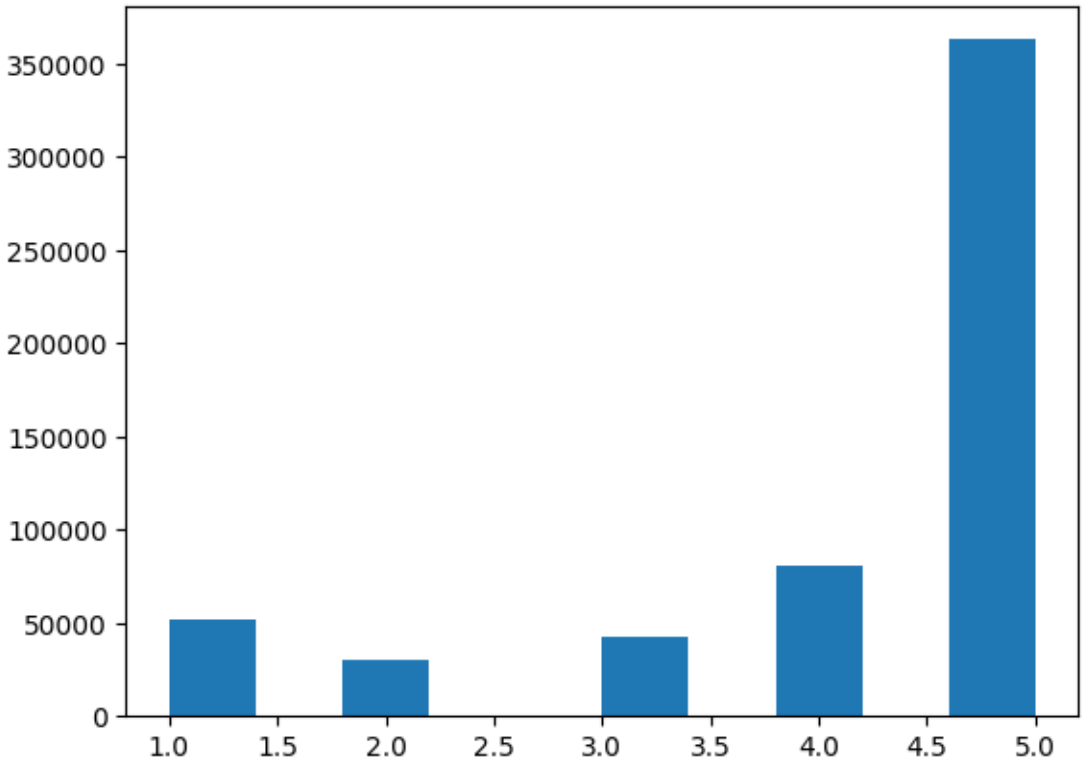
2 Answering Hypothesis

2.0.1 Review scores are generally positive:What is the distribution of review scores? Analyze the data using Pandas.

[6]:
```
import matplotlib.pyplot as plt
import seaborn as sns
sns.kdeplot(adata['Score'])
plt.show()
```



[7]:
```
plt.hist(adata['Score'])
plt.show()
```



[8]:
```
adata['Score'].value_counts()
```

[8]:
```
Score
5    363122
4     80655
1     52268
3     42640
2     29769
Name: count, dtype: int64
```

[9]:
```
adata.describe()
```

[9]:

	Id	HelpfulnessNumerator	HelpfulnessDenominator	\
count	568454.000000	568454.000000	568454.00000	
mean	284227.500000	1.743817	2.22881	
min	1.000000	0.000000	0.00000	
25%	142114.250000	0.000000	0.00000	
50%	284227.500000	0.000000	1.00000	
75%	426340.750000	2.000000	2.00000	
max	568454.000000	866.000000	923.00000	
std	164098.679298	7.636513	8.28974	

```
               Score                           Time
count  568454.000000                         568454
mean        4.183199  2011-01-28 23:16:44.902419712
min         1.000000            1999-10-08 00:00:00
25%         4.000000            2010-04-15 00:00:00
50%         5.000000            2011-07-20 00:00:00
75%         5.000000            2012-03-26 00:00:00
max         5.000000            2012-10-26 00:00:00
std         1.310436                            NaN
```

Hypothesis Analysis Report

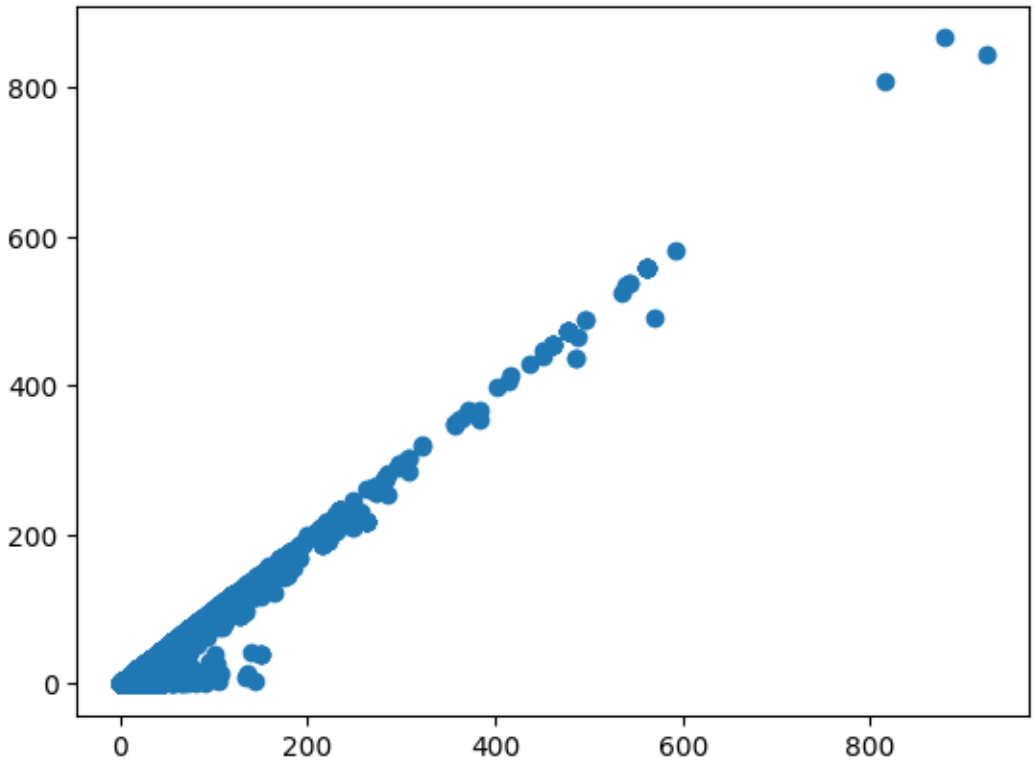
[10]:
```
""" According to the Line plot and Histogram plot distribution of majority data␣
 ↪of scores column  lies in 5th score which is the maximum value
the 5th score has frequency of 363122 out of 568454
so 5th score contributes to 63.87% of review score
this concludes that the hypothesis is correct that Review scores are generally␣
 ↪positive"""
```

[10]:
```
' According to the Line plot and Histogram plot distribution of majority data of
scores column  lies in 5th score which is the maximum value  \nthe 5th score has
frequency of 363122 out of 568454 \nso 5th score contributes to 63.87% of review
score \nthis concludes that the hypothesis is correct that Review scores are
generally positive'
```

2.0.2 Helpful reviews are often marked as such by many users: How does the helpfulness numerator compare to the helpfulness denominator across reviews? Perform a statistical analysis using NumPy

helpfulness numerator and denominator relationship

[11]:
```
import matplotlib.pyplot as plt
import numpy as np
plt.scatter(adata['HelpfulnessDenominator'],adata['HelpfulnessNumerator'])
plt.show()
```



[12]:
```
adata['helpfulness_ratio']=adata['HelpfulnessNumerator']/
↪adata['HelpfulnessDenominator']
```

[13]:
```
adata.head()
```

[13]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	2011-04-27	Good Quality Dog Food	I have bought several of the Vitality canned d…
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	2012-09-07	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut…
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	4	2008-08-18		
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	2011-06-13		
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	0	0	5	2012-10-21		

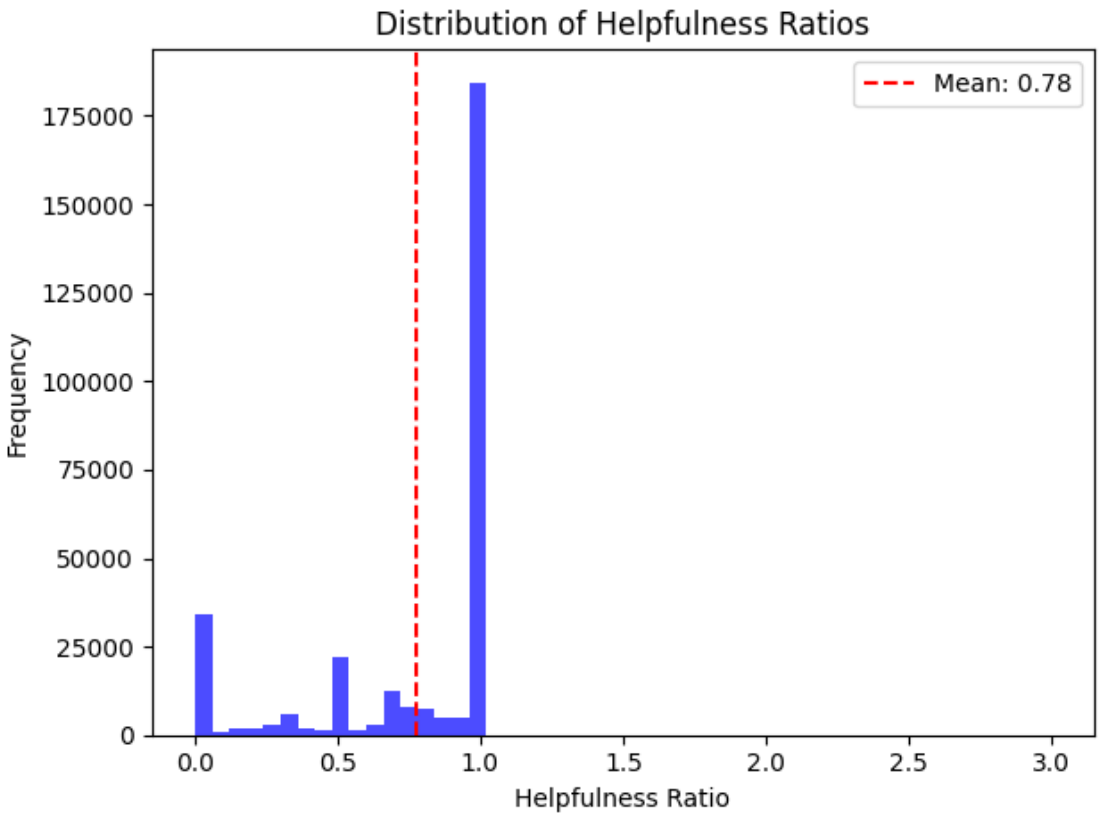
```
2  "Delight" says it all  This is a confection that has been around a fe…
3         Cough Medicine  If you are looking for the secret ingredient i…
4            Great taffy  Great taffy at a great price.  There was a wid…

   helpfulness_ratio
0                1.0
1                NaN
2                1.0
3                1.0
4                NaN
```

[14]:
```
    stats_dict = {
        'mean_ratio': np.mean(adata['helpfulness_ratio']),
        'median_ratio': np.median(adata['helpfulness_ratio']),
        'std_ratio': np.std(adata['helpfulness_ratio']),
        'correlation': np.corrcoef(adata['HelpfulnessNumerator'],␣
↪adata['HelpfulnessDenominator'])[0,1],
        'total_reviews': len(adata)
    }
```

[15]:
```
stats_dict
```

[15]:
```
{'mean_ratio': 0.7769745358714405,
 'median_ratio': nan,
 'std_ratio': 0.34632082585956464,
 'correlation': 0.9746893287742138,
 'total_reviews': 568454}
```

[16]:
```
plt.hist(adata['helpfulness_ratio'], bins=50, color='blue', alpha=0.7)
plt.axvline(stats_dict['mean_ratio'], color='red',
                linestyle='--', label=f"Mean: {stats_dict['mean_ratio']:.2f}")
plt.xlabel('Helpfulness Ratio')
plt.ylabel('Frequency')
plt.title('Distribution of Helpfulness Ratios')
plt.legend()

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



[17]:
```
adata['helpfulness_ratio'].value_counts()
```

[17]:
```
helpfulness_ratio
1.000000    183309
0.000000     33774
0.500000     21623
0.666667     10514
0.750000      6364
             ...
0.946237         1
0.232558         1
0.704545         1
0.161290         1
0.991411         1
Name: count, Length: 951, dtype: int64
```

Hypothesis Analysis Report

[18]:
```
""" According to the scatter plot There is a strong positive linear correlation␣
 ↪between the two variables.
```

```
As the Helpfulness Denominator increases, the Helpfulness Numerator also␣
 ↪increases.
This suggests that reviews with more total votes (denominator) tend to have␣
 ↪more helpful votes (numerator)

The red dashed line represents the mean helpfulness ratio (approximately 0.78).
This indicates that, on average, about 78% of the votes cast for reviews are␣
 ↪marked as helpful.

The histogram shows that most reviews have a helpfulness ratio close to 1,␣
 ↪indicating that most of the votes for these reviews were marked as helpful.
So above analysis shows Hypothesis :Helpful reviews are often marked as such by␣
 ↪many usersb is True"""
```

[18]:
```
' According to the scatter plot There is a strong positive linear correlation
between the two variables. \nAs the Helpfulness Denominator increases, the
Helpfulness Numerator also increases. \nThis suggests that reviews with more
total votes (denominator) tend to have more helpful votes (numerator)\n\nThe red
dashed line represents the mean helpfulness ratio (approximately 0.78). \nThis
indicates that, on average, about 78% of the votes cast for reviews are marked
as helpful.\n\nThe histogram shows that most reviews have a helpfulness ratio
close to 1, indicating that most of the votes for these reviews were marked as
helpful.\nSo above analysis shows Hypothesis :Helpful reviews are often marked
as such by many usersb is True'
```

2.0.3 There are differences in review scores among different products:What are the average review scores for different products? Analyze the data using Pandas

[19]:
```
prorev=adata.groupby('ProductId')['Score'].mean().reset_index()
prorev.head()
```

[19]:

	ProductId	Score
0	0006641040	4.351351
1	141278509X	5.000000
2	2734888454	3.500000
3	2841233731	5.000000
4	7310172001	4.751445

[20]:
```
prorev.tail()
```

[20]:

	ProductId	Score
74253	B009UOFTUI	1.0
74254	B009UOFU20	1.0
74255	B009UUS05I	5.0
74256	B009WSNWC4	5.0
74257	B009WVB40S	5.0

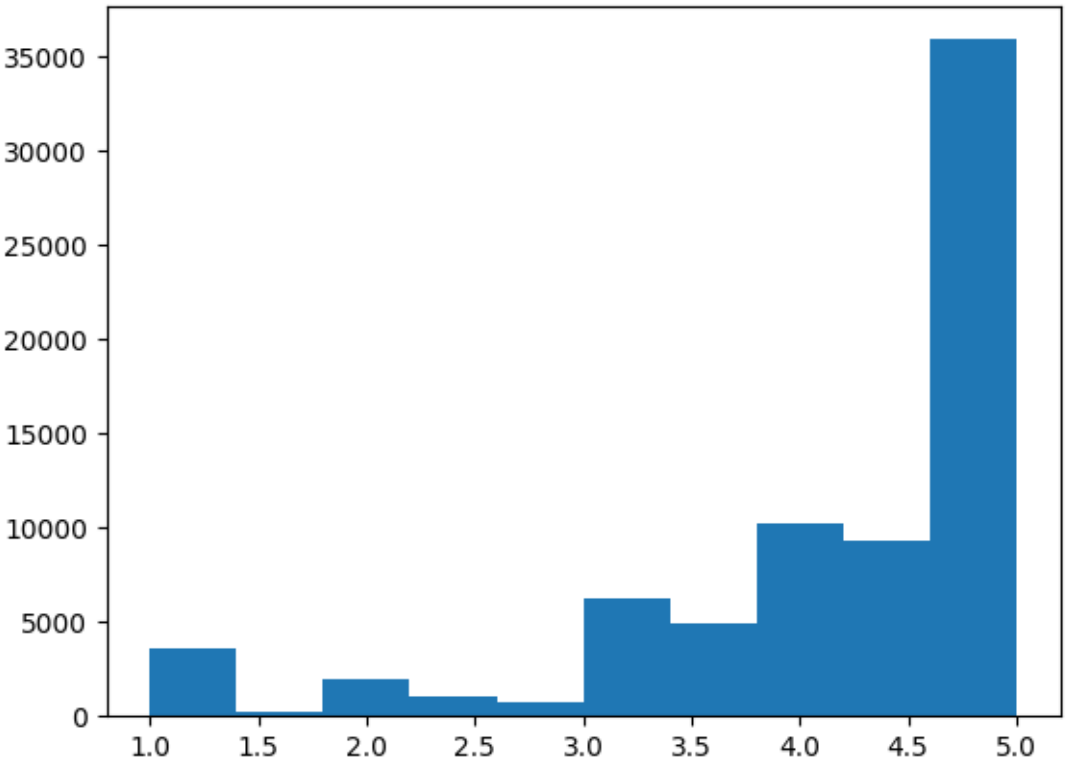
[21]:
```
prorev['Score'].value_counts()
```

[21]:
```
Score
5.000000    29904
4.000000     7320
3.000000     4614
1.000000     3601
4.500000     2862
            …
4.245283        1
4.373134        1
4.087719        1
4.174242        1
2.117647        1
Name: count, Length: 1685, dtype: int64
```

[22]:
```
prorev['Score'].describe()
```

[22]:
```
count    74258.000000
mean         4.166189
std          1.070182
min          1.000000
25%          3.783784
50%          4.500000
75%          5.000000
max          5.000000
Name: Score, dtype: float64
```

[23]:
```
plt.hist(prorev['Score'])
plt.show()
```



Hypothesis Analysis Report

[24]:
```
""" As shown below

Score
5.000000    29904
4.000000     7320
3.000000     4614
1.000000     3601
4.500000     2862
            ...
4.245283        1
4.373134        1
4.087719        1
4.174242        1
2.117647        1

and by analyzing  the histogram it shows even though majority score resides in␣
 ↪5 the data is spread among various scores
so we can tell that the hypothesis :
There are differences in review scores among different products is true"""
```

[24]:
```
' As shown below\n\nScore\n5.000000    29904\n4.000000     7320\n3.000000
4614\n1.000000     3601\n4.500000     2862\n            …  \n4.245283
1\n4.373134        1\n4.087719        1\n4.174242        1\n2.117647
1\n\nand by analyzing  the histogram it shows even though majority score resides
in 5 the data is spread among various scores \nso we can tell that the
hypothesis :\nThere are differences in review scores among different products is
true'
```

2.0.4 Length of the review text correlates with the review score:Is there a correlation between the length of the review text and the review score? Perform a correlation analysis using Panda

[25]:
```
adata.head()
```

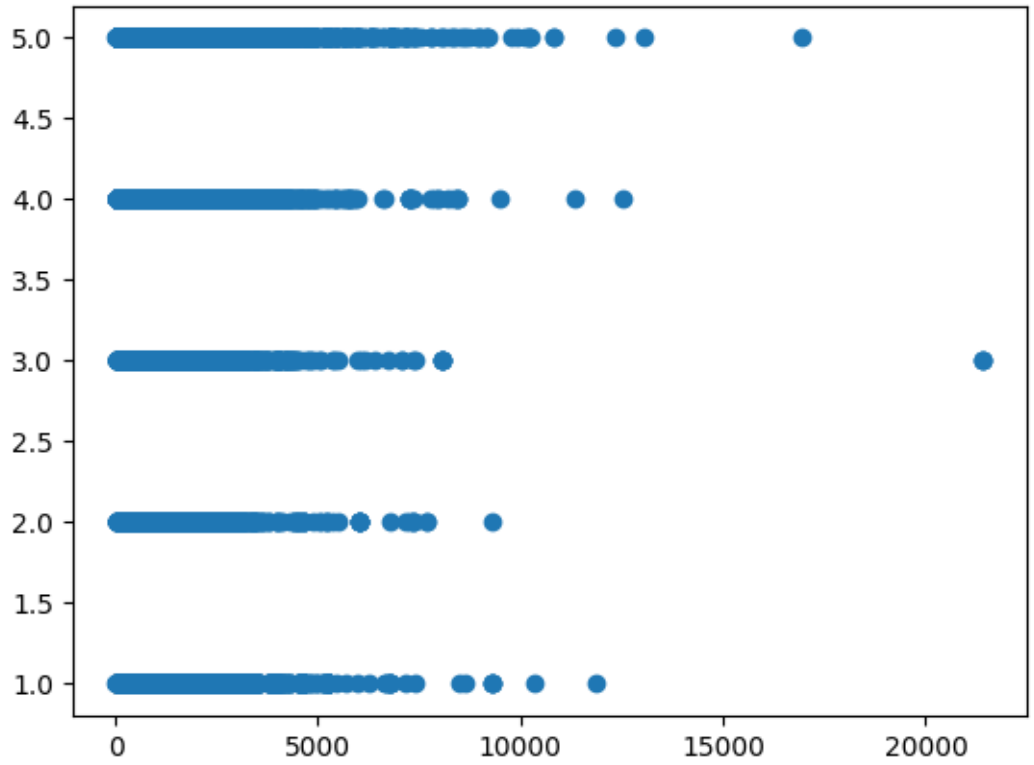
[25]:
```
    Id   ProductId          UserId                      ProfileName  \
0   1  B001E4KFG0  A3SGXH7AUHU8GW                       delmartian
1   2  B00813GRG4  A1D87F6ZCVE5NK                           dll pa
2   3  B000LQOCH0   ABXLMWJIXXAIN  Natalia Corres "Natalia Corres"
3   4  B000UA0QIQ  A395BORC6FGVXV                             Karl
4   5  B006K2ZZ7K  A1UQRSCLF8GW1T    Michael D. Bigham "M. Wassir"

   HelpfulnessNumerator  HelpfulnessDenominator  Score       Time  \
0                     1                       1      5 2011-04-27
1                     0                       0      1 2012-09-07
2                     1                       1      4 2008-08-18
3                     3                       3      2 2011-06-13
4                     0                       0      5 2012-10-21

                Summary                                                Text  \
0  Good Quality Dog Food  I have bought several of the Vitality canned d…
1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut…
2  "Delight" says it all  This is a confection that has been around a fe…
3         Cough Medicine  If you are looking for the secret ingredient i…
4            Great taffy  Great taffy at a great price.  There was a wid…

   helpfulness_ratio
0                1.0
1                NaN
2                1.0
3                1.0
4                NaN
```

[26]:
```
adata['text_len'] = adata['Text'].apply(len)
adata.head()
```

[26]:
```
    Id   ProductId          UserId                      ProfileName  \
0   1  B001E4KFG0  A3SGXH7AUHU8GW                       delmartian
```

```
1   2  B00813GRG4  A1D87F6ZCVE5NK                           dll pa
2   3  B000LQOCH0   ABXLMWJIXXAIN  Natalia Corres "Natalia Corres"
3   4  B000UA0QIQ  A395BORC6FGVXV                             Karl
4   5  B006K2ZZ7K  A1UQRSCLF8GW1T    Michael D. Bigham "M. Wassir"

   HelpfulnessNumerator  HelpfulnessDenominator  Score       Time  \
0                     1                       1      5 2011-04-27
1                     0                       0      1 2012-09-07
2                     1                       1      4 2008-08-18
3                     3                       3      2 2011-06-13
4                     0                       0      5 2012-10-21

                Summary                                                 Text  \
0  Good Quality Dog Food  I have bought several of the Vitality canned d…
1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut…
2  "Delight" says it all  This is a confection that has been around a fe…
3         Cough Medicine  If you are looking for the secret ingredient i…
4            Great taffy  Great taffy at a great price.  There was a wid…

   helpfulness_ratio  text_len
0                1.0       263
1                NaN       190
2                1.0       509
3                1.0       219
4                NaN       140
```

[27]:
```
plt.scatter(adata['text_len'],adata['Score'])
plt.show()
```



[28]:
```
correlation = adata['text_len'].corr(adata['Score'])
print(correlation)
```

```
-0.07733381425483822
```

[29]:
```
spearman_corr = adata['text_len'].corr(adata['Score'], method='spearman')
print(f"Spearman Correlation: {spearman_corr}")
```

```
Spearman Correlation: -0.12305109503337823
```

Hypothesis Analysis Report

[30]:
```
""" The correlation value of -0.077 indicates a very weak negative correlation␣
 ↪between the two columns.
so the hypothesis Length of the review text correlates with the review score:␣
 ↪is false"""
```

[30]:
```
' The correlation value of -0.077 indicates a very weak negative correlation
between the two columns.\nso the hypothesis Length of the review text correlates
with the review score: is false'
```

2.0.5 Certain users are more active in leaving reviews:

[31]:
```
rev=adata.groupby('ProfileName')['Score'].count().reset_index()
rev.sort_values(by='Score',ascending=False,inplace=True)
rev.head(10)
```

[31]:

	ProfileName	Score
23567	C. F. Hill "CFH"	451
130936	O. Brown "Ms. O. Khannah-Brown"	421
59551	Gary Peterson	389
144148	Rebecca of Amazon "The Rebecca Review"	365
31378	Chris	363
103809	Linda	290
83289	John	261
121926	Mike	260
186777	c2	256
101353	Laura	253

[32]:
```
rev['Score'].value_counts()
```

[32]:
```
Score
1      142222
2       29404
3       12790
4        9536
5        5266
        ...
173         1
176         1
179         1
180         1
451         1
Name: count, Length: 192, dtype: int64
```

Hypothesis Analysis Report

[33]:
```
"""

Score
1      142222
2       29404
3       12790
4        9536
5        5266
        ...
173         1
176         1
179         1
```

```
180         1
451         1
Name: count, Length: 192, dtype: int64

As you can see the people who are less active made 1 review throught the data␣
 ↪and there are 142222 of them
while the person who made 451 review(which is the highest review count) is only␣
 ↪1 these prove Certain users are more active in leaving reviews
thus hypothesis true """
```

[33]:
```
'\n\nScore\n1      142222\n2       29404\n3       12790\n4        9536\n5
5266\n        …  \n173         1\n176         1\n179         1\n180
1\n451         1\nName: count, Length: 192, dtype: int64\n\nAs you can see the
people who are less active made 1 review throught the data and there are 142222
of them\nwhile the person who made 451 review(which is the highest review count)
is only 1 these prove Certain users are more active in leaving reviews \nthus
hypothesis true '
```

2.0.6 Reviews have become more detailed over time: How has the average length of reviews changed over time? Perform a time series analysis using Pandas.

[34]:
```
adata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 568454 entries, 0 to 568453
Data columns (total 12 columns):
 #   Column                  Non-Null Count   Dtype
---  ------                  --------------   -----
 0   Id                      568454 non-null  int64
 1   ProductId               568454 non-null  object
 2   UserId                  568454 non-null  object
 3   ProfileName             568454 non-null  object
 4   HelpfulnessNumerator    568454 non-null  int64
 5   HelpfulnessDenominator  568454 non-null  int64
 6   Score                   568454 non-null  int64
 7   Time                    568454 non-null  datetime64[ns]
 8   Summary                 568454 non-null  object
 9   Text                    568454 non-null  object
 10  helpfulness_ratio       298402 non-null  float64
 11  text_len                568454 non-null  int64
dtypes: datetime64[ns](1), float64(1), int64(5), object(5)
memory usage: 52.0+ MB
```

[35]:
```
adata['year']=adata['Time'].dt.year
adata.head()
```

[35]:

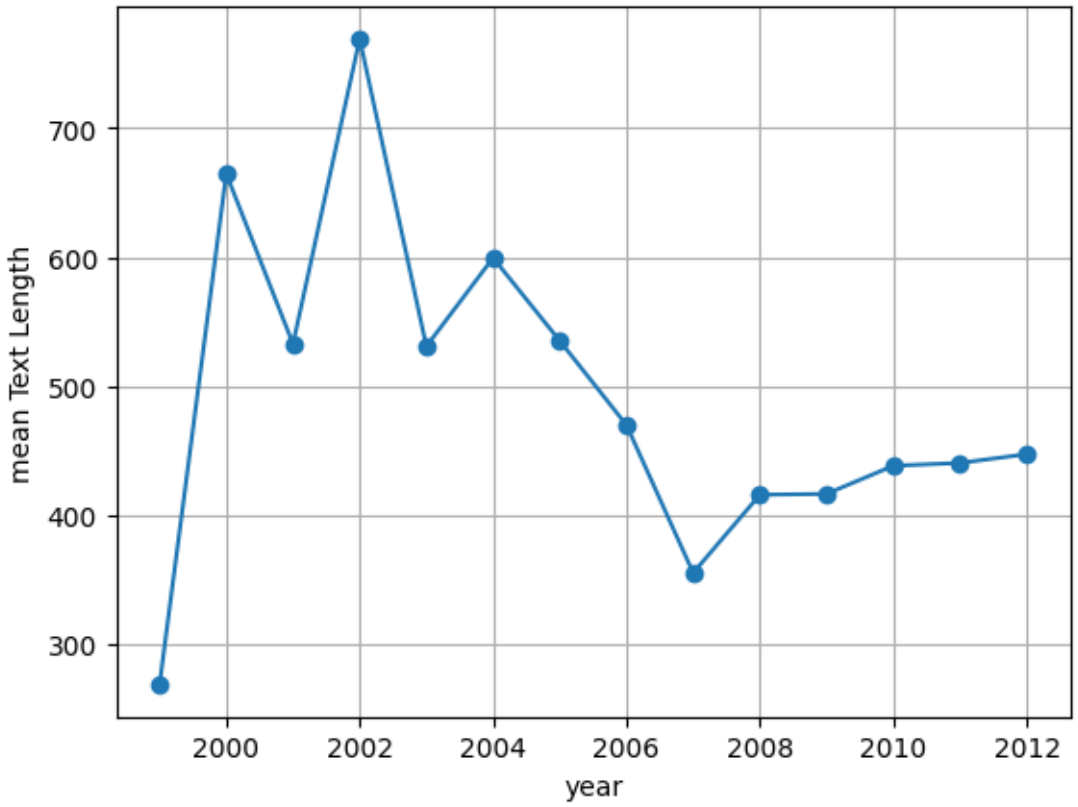
	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	helpfulness_ratio	text_len	year
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	2011-04-27	Good Quality Dog Food	I have bought several of the Vitality canned d…	1.0	263	2011
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	2012-09-07	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut…	NaN	190	2012
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	4	2008-08-18	"Delight" says it all	This is a confection that has been around a fe…	1.0	509	2008
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	2011-06-13	Cough Medicine	If you are looking for the secret ingredient i…	1.0	219	2011
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	0	0	5	2012-10-21	Great taffy	Great taffy at a great price. There was a wid…	NaN	140	2012

[36]:
```
alen=adata.groupby('year')['text_len'].mean().reset_index()
alen
```

[36]:

	year	text_len
0	1999	269.000000
1	2000	664.562500
2	2001	532.769231
3	2002	769.150685
4	2003	530.916667
5	2004	599.452763
6	2005	535.145318
7	2006	469.911707
8	2007	355.394978
9	2008	415.908702
10	2009	416.554079
11	2010	438.361790
12	2011	440.540524
13	2012	447.310723

[37]:
```
plt.plot(alen['year'],alen['text_len'],marker='o')
plt.grid(True)
plt.xlabel('year')
plt.ylabel('mean Text Length')
plt.show()
```



Hypothesis Analysis Report

[38]:
```
"""

The mean text length peaked around 2002, with subsequent fluctuations and a␣
 ↪noticeable decline after 2004.
Post-2006, the text length stabilized at a lower level, showing no significant␣
 ↪upward trend.
If reviews were becoming more detailed over time, we would expect a consistent␣
 ↪upward trend in the mean text length.
These Means the hypothesis Reviews have become more detailed over time is false␣
 ↪"""
```

[38]:
```
' \n\nThe mean text length peaked around 2002, with subsequent fluctuations and
a noticeable decline after 2004.\nPost-2006, the text length stabilized at a
```

```
lower level, showing no significant upward trend.\nIf reviews were becoming more
detailed over time, we would expect a consistent upward trend in the mean text
length.\nThese Means the hypothesis Reviews have become more detailed over time
is false '
```

2.0.7 High-rated reviews receive more helpfulness votes: Do reviews with higher scores receive more helpfulness votes? Analyze the data using NumPy and Pandas

[39]:
```
hv = adata[(adata['helpfulness_ratio'] != 0.000000) &␣
 ↪(~adata['helpfulness_ratio'].isna())]
hv.head()
```

[39]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	helpfulness_ratio	text_len	year
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	2011-04-27	Good Quality Dog Food	I have bought several of the Vitality canned d…	1.0	263	2011
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	4	2008-08-18	"Delight" says it all	This is a confection that has been around a fe…	1.0	509	2008
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	2011-06-13	Cough Medicine	If you are looking for the secret ingredient i…	1.0	219	2011
8	9	B000E7L2R4	A1MZYO9TZK0BBI	R. James	1	1	5	2011-11-23	Yay Barley	Right now I'm mostly just sprouting this so my…	1.0	131	2011
10	11	B0001PB9FE	A3HDKO7OW0QNK4	Canadian Fan	1	1	5	2005-02-08	The Best Hot Sauce in the World	I don't know if it's the cactus or the tequila…	1.0	779	2005

[40]:
```
hv['helpfulness_ratio'].value_counts()
```

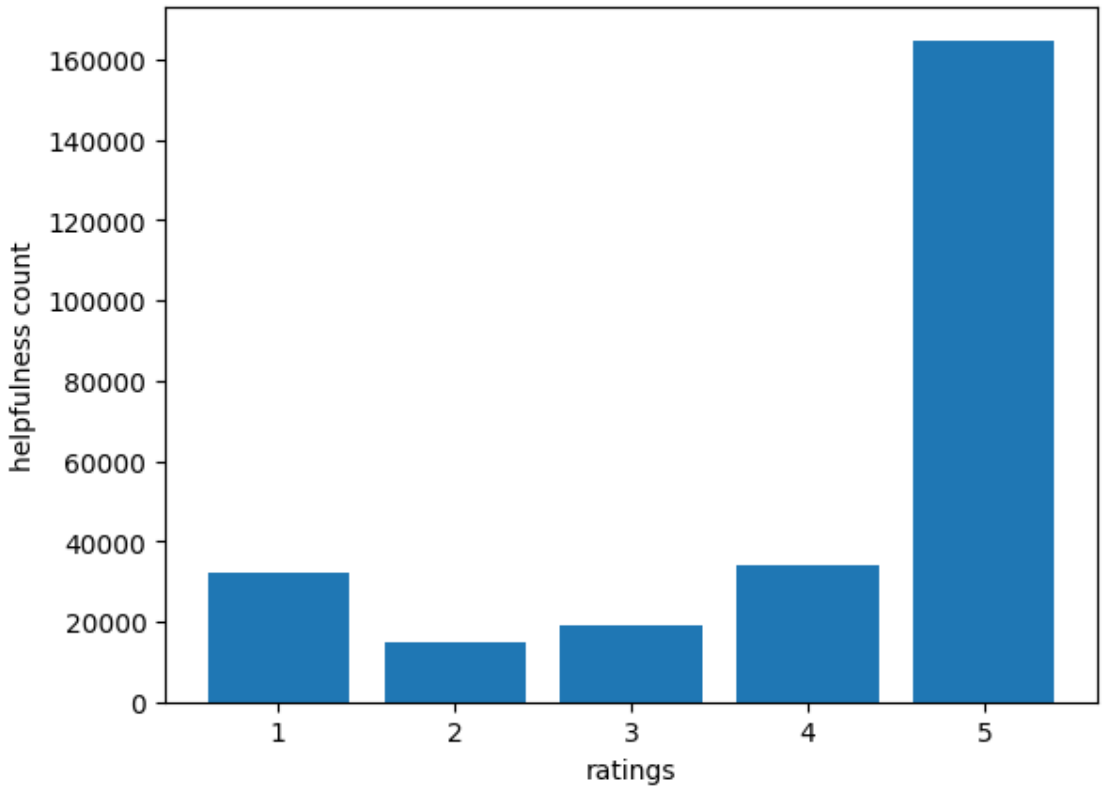
[40]:
```
helpfulness_ratio
1.000000    183309
0.500000     21623
0.666667     10514
0.750000      6364
0.333333      5365
              ...
0.860870         1
0.896226         1
0.915094         1
0.914410         1
0.991411         1
Name: count, Length: 950, dtype: int64
```

[41]:
```
res=hv.groupby('Score')['helpfulness_ratio'].count().reset_index()
res
```

[41]:

	Score	helpfulness_ratio
0	1	31942
1	2	14931
2	3	19155
3	4	33859
4	5	164741

[42]:
```
plt.bar(res['Score'],res['helpfulness_ratio'])
plt.xlabel('ratings')
plt.ylabel('helpfulness count')
plt.show()
```



Hypothesis Analysis Report

[43]:
```
""" as in above bar chart the rating 5 has more helpfulness than other ratings
so the hypothesis  High-rated reviews receive more helpfulness votes is true"""
```

[43]:
```
' as in above bar chart the rating 5 has more helpfulness than other ratings
\nso the hypothesis  High-rated reviews receive more helpfulness votes is true'
```

2.0.8 Products with more reviews tend to have higher average scores:Is there a relationship between the number of reviews a product has and its average score? Perform a statistical analysis using Pandas.

[44]:
```
adata.head()
```

[44]:

	Id	ProductId	UserId	ProfileName	\
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	

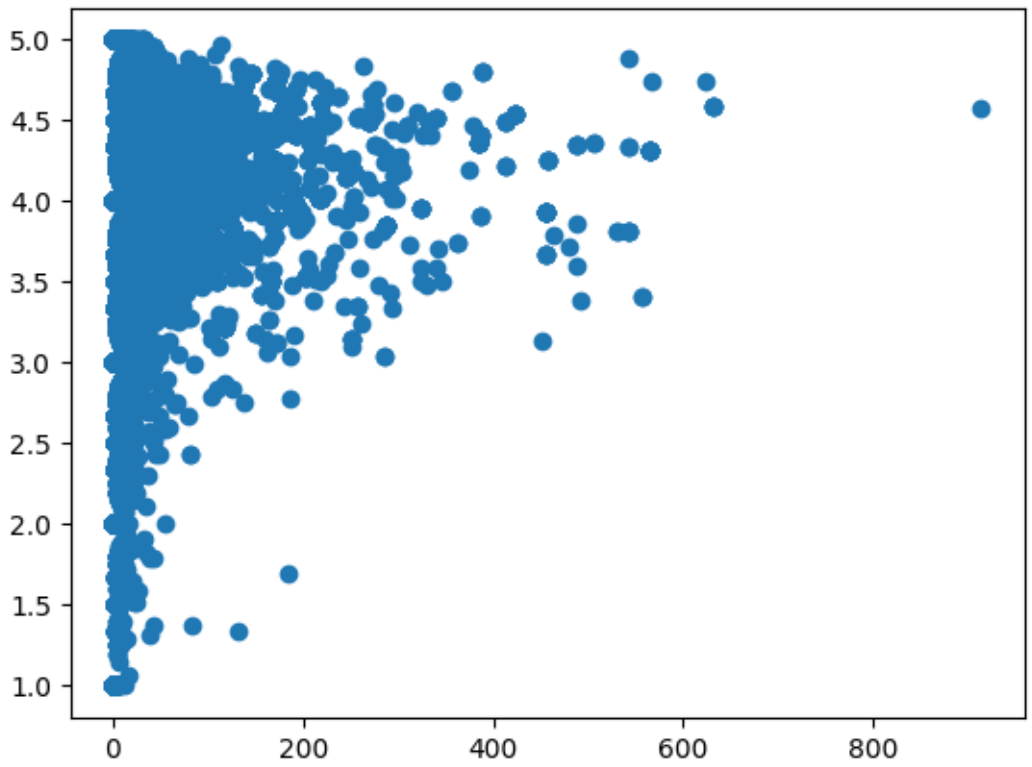
	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	\

```
0                     1                       1      5 2011-04-27
1                     0                       0      1 2012-09-07
2                     1                       1      4 2008-08-18
3                     3                       3      2 2011-06-13
4                     0                       0      5 2012-10-21

                 Summary                                                Text  \
0  Good Quality Dog Food  I have bought several of the Vitality canned d…
1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut…
2  "Delight" says it all  This is a confection that has been around a fe…
3         Cough Medicine  If you are looking for the secret ingredient i…
4            Great taffy  Great taffy at a great price.  There was a wid…

   helpfulness_ratio  text_len  year
0                1.0       263  2011
1                NaN       190  2012
2                1.0       509  2008
3                1.0       219  2011
4                NaN       140  2012
```

[45]:
```
pr = adata.groupby('ProductId').agg(
    review_count=('Text', 'count'),  # Count the number of reviews
    avg_score=('Score', 'mean')     # Calculate the average score
).reset_index()
pr.sort_values(by='review_count', ascending=False, inplace=True)

pr
```

[45]:
```
        ProductId  review_count  avg_score
71170  B007JFMH8M           913   4.582694
37898  B0026RQTGE           632   4.588608
42257  B002QWHJOU           632   4.588608
42263  B002QWP89S           632   4.588608
42264  B002QWP8H0           632   4.588608
…            …             …         …
21719  B000YPQC08             1   5.000000
51301  B003YU5T6I             1   5.000000
21720  B000YPQC44             1   5.000000
21721  B000YPQE6U             1   5.000000
74257  B009WVB40S             1   5.000000

[74258 rows x 3 columns]
```

[46]:
```
plt.scatter(pr['review_count'],pr['avg_score'])
plt.show()
```



[47]:
```
from scipy import stats
pearson_corr = pr['review_count'].corr(pr['avg_score'])
spearman_corr = stats.spearmanr(pr['review_count'], pr['avg_score'])
kendall_corr = stats.kendalltau(pr['review_count'], pr['avg_score'])
pearson_corr
spearman_corr
kendall_corr
```

[47]:
```
SignificanceResult(statistic=-0.1696748469382458, pvalue=0.0)
```

[48]:
```
spearman_corr
```

[48]:
```
SignificanceResult(statistic=-0.2276678675802709, pvalue=0.0)
```

[49]:
```
kendall_corr
```

[49]:
```
SignificanceResult(statistic=-0.1696748469382458, pvalue=0.0)
```

Hypothesis Analysis Report

[50]:
```
"""
71170       B007JFMH8M       913       4.582694
37898       B0026RQTGE       632       4.588608
```

```
42257        B002QWHJOU        632        4.588608
42263        B002QWP89S        632        4.588608
42264        B002QWP8H0        632        4.588608
...         ...         ...          ...
21719        B000YPQC08        1        5.000000
51301        B003YU5T6I        1        5.000000
21720        B000YPQC44        1        5.000000
21721        B000YPQE6U        1        5.000000
74257        B009WVB40S        1        5.000000


as you can see the product having 1 review count has 5.0 avg_score while␣
 ↪review_count 913 has avg score=4.5
and the corelation between review_count and avg_score is negative
thus the hypothesis Products with more reviews tend to have higher average␣
 ↪scores is false"""
```

[50]:
```
'\n71170\tB007JFMH8M\t913\t4.582694\n37898\tB0026RQTGE\t632\t4.588608\n42257\tB0
02QWHJOU\t632\t4.588608\n42263\tB002QWP89S\t632\t4.588608\n42264\tB002QWP8H0\t63
2\t4.588608\n…\t…\t…\t…\n21719\tB000YPQC08\t1\t5.000000\n51301\tB003YU5T
6I\t1\t5.000000\n21720\tB000YPQC44\t1\t5.000000\n21721\tB000YPQE6U\t1\t5.000000\
n74257\tB009WVB40S\t1\t5.000000\n\n\nas you can see the product having 1 review
count has 5.0 avg_score while review_count 913 has avg score=4.5\nand the
corelation between review_count and avg_score is negative \nthus the hypothesis
Products with more reviews tend to have higher average scores is false'
```

2.0.9 Negative reviews are often shorter than positive reviews:How does the length of negative reviews compare to the length of positive reviews? Analyze the data using Pandas.

[51]:
```
pip install vaderSentiment
```

```
Requirement already satisfied: vaderSentiment in
c:\users\arjun\appdata\local\programs\python\python310\lib\site-packages (3.3.2)
Requirement already satisfied: requests in
c:\users\arjun\appdata\local\programs\python\python310\lib\site-packages (from
vaderSentiment) (2.32.3)
Requirement already satisfied: charset-normalizer<4,>=2 in
c:\users\arjun\appdata\local\programs\python\python310\lib\site-packages (from
requests->vaderSentiment) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in
c:\users\arjun\appdata\local\programs\python\python310\lib\site-packages (from
requests->vaderSentiment) (2.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in
c:\users\arjun\appdata\local\programs\python\python310\lib\site-packages (from
requests->vaderSentiment) (1.26.20)
Requirement already satisfied: certifi>=2017.4.17 in
c:\users\arjun\appdata\local\programs\python\python310\lib\site-packages (from
```

```
requests->vaderSentiment) (2023.11.17)
Note: you may need to restart the kernel to use updated packages.


[notice] A new release of pip is available: 24.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

[52]:
```
sent=adata[~(adata['Summary']=='NoData')]
from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer
analyzer = SentimentIntensityAnalyzer()

# Function to calculate sentiment
def get_sentiment(text):
    scores = analyzer.polarity_scores(text)
    return scores['compound']  # Compound score: Overall sentiment

# Apply sentiment analysis to each row
sent['sentiment_score'] = sent['Summary'].apply(get_sentiment)

# Classify sentiment as Positive, Negative, or Neutral
sent['sentiment'] = sent['sentiment_score'].apply(
    lambda score: 'Positive' if score > 0.05 else 'Negative' if score < -0.05␣
 ↪else 'Neutral'
)

sent.head()
```

```
C:\Users\arjun\AppData\Local\Temp\ipykernel_1764\697581697.py:11:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  sent['sentiment_score'] = sent['Summary'].apply(get_sentiment)
C:\Users\arjun\AppData\Local\Temp\ipykernel_1764\697581697.py:14:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  sent['sentiment'] = sent['sentiment_score'].apply(
```

[52]:

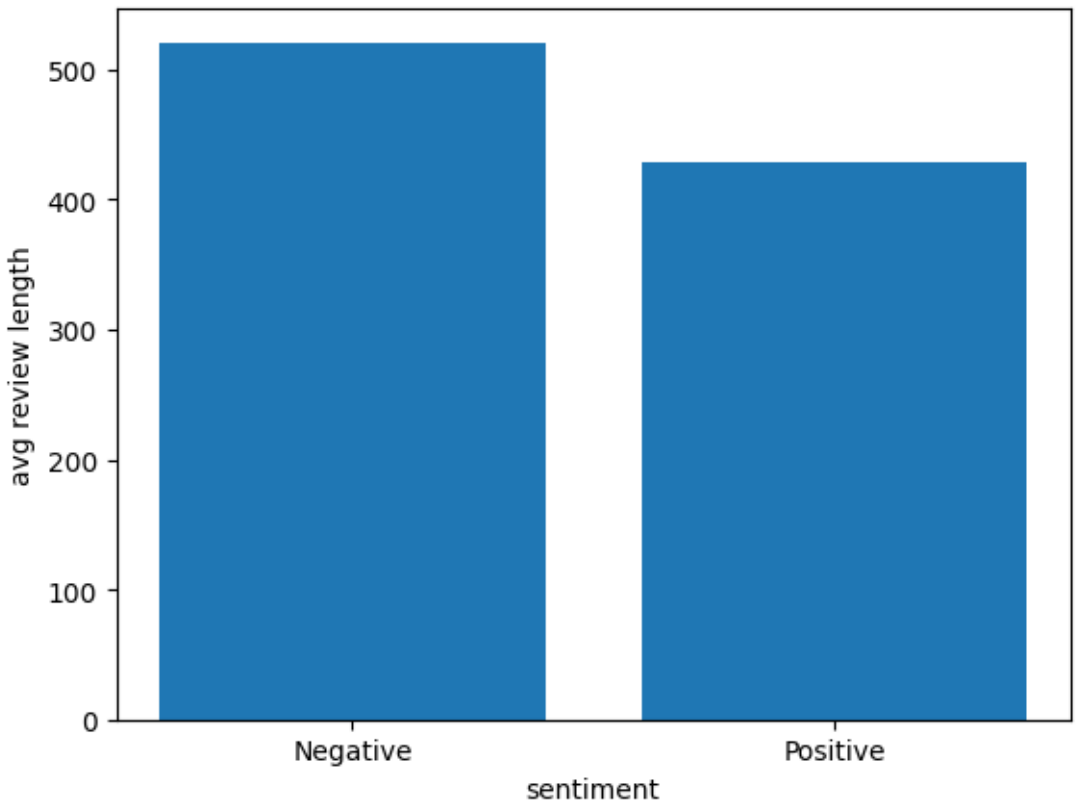
	Id	ProductId	UserId	ProfileName	\
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	

```
3   4  B000UA0QIQ  A395BORC6FGVXV                              Karl
4   5  B006K2ZZ7K  A1UQRSCLF8GW1T    Michael D. Bigham "M. Wassir"

   HelpfulnessNumerator  HelpfulnessDenominator  Score       Time  \
0                     1                       1      5 2011-04-27
1                     0                       0      1 2012-09-07
2                     1                       1      4 2008-08-18
3                     3                       3      2 2011-06-13
4                     0                       0      5 2012-10-21

                Summary                                                Text  \
0  Good Quality Dog Food  I have bought several of the Vitality canned d…
1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut…
2  "Delight" says it all  This is a confection that has been around a fe…
3         Cough Medicine  If you are looking for the secret ingredient i…
4            Great taffy  Great taffy at a great price.  There was a wid…

   helpfulness_ratio  text_len  year  sentiment_score sentiment
0                1.0       263  2011           0.4404  Positive
1                NaN       190  2012           0.0000   Neutral
2                1.0       509  2008           0.5994  Positive
3                1.0       219  2011           0.0000   Neutral
4                NaN       140  2012           0.6249  Positive
```

[53]:
```
ans=sent[~(sent['sentiment']=='Neutral')]
final=ans.groupby('sentiment')['text_len'].mean().reset_index()
final
```

[53]:
```
  sentiment    text_len
0  Negative  520.722392
1  Positive  428.973881
```

[54]:
```
plt.bar(final['sentiment'],final['text_len'])
plt.xlabel('sentiment')
plt.ylabel('avg review length')
plt.show()
```



Hypothesis Analysis Report

[55]:
```
"""
By analyzing deeper the average length of a positive review is 428
while  negative review is 520
which means hypothesis Negative reviews are often shorter than positive␣
↪reviews is false"""
```

[55]:
```
' \nBy analyzing deeper the average length of a positive review is 428\nwhile
negative review is 520 \nwhich means hypothesis Negative reviews are often
shorter than positive reviews is false'
```

2.0.10 Review scores and helpfulness ratios differ across products:What are the average review scores and helpfulness ratios for the top 10 products? Analyze the data using Pandas.

[56]:
```
adata.head()
```

[56]:
```
    Id   ProductId          UserId                      ProfileName  \
0   1  B001E4KFG0  A3SGXH7AUHU8GW                       delmartian
1   2  B00813GRG4  A1D87F6ZCVE5NK                           dll pa
2   3  B000LQOCH0   ABXLMWJIXXAIN  Natalia Corres "Natalia Corres"
```

```
3   4  B000UA0QIQ  A395BORC6FGVXV                              Karl
4   5  B006K2ZZ7K  A1UQRSCLF8GW1T    Michael D. Bigham "M. Wassir"

   HelpfulnessNumerator  HelpfulnessDenominator  Score       Time  \
0                     1                       1      5 2011-04-27
1                     0                       0      1 2012-09-07
2                     1                       1      4 2008-08-18
3                     3                       3      2 2011-06-13
4                     0                       0      5 2012-10-21

                Summary                                                Text  \
0  Good Quality Dog Food  I have bought several of the Vitality canned d…
1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut…
2  "Delight" says it all  This is a confection that has been around a fe…
3         Cough Medicine  If you are looking for the secret ingredient i…
4            Great taffy  Great taffy at a great price.  There was a wid…

   helpfulness_ratio  text_len  year
0                1.0       263  2011
1                NaN       190  2012
2                1.0       509  2008
3                1.0       219  2011
4                NaN       140  2012
```

[57]:
```
rh=adata[(adata['helpfulness_ratio'] != 0.000000) &␣
 ↪(~adata['helpfulness_ratio'].isna())]

res=rh.groupby('ProductId').agg(
      # Count the number of reviews
    avg_score=('Score', 'mean'),
    avg_helpfulness=('helpfulness_ratio', 'mean')# Calculate the average score
).reset_index()
res.head(10)
```

[57]:
```
     ProductId  avg_score  avg_helpfulness
0   0006641040   4.157895         0.939327
1   141278509X   5.000000         1.000000
2   2734888454   2.000000         1.000000
3   7310172001   4.346939         0.880068
4   7310172101   4.346939         0.880068
5   B00002N8SM   1.200000         0.550000
6   B00002Z754   5.000000         1.000000
7   B00004CI84   4.151899         0.798768
8   B00004CXX9   4.000000         0.760465
9   B00004RAMS   3.250000         0.835836
```

[58]:
```
res['avg_score'].value_counts()
```

[58]:
```
avg_score
5.000000    19268
4.000000     4362
3.000000     2838
1.000000     2778
4.500000     1813
             …
4.586957        1
3.394737        1
3.707317        1
4.351064        1
4.485714        1
Name: count, Length: 1021, dtype: int64
```

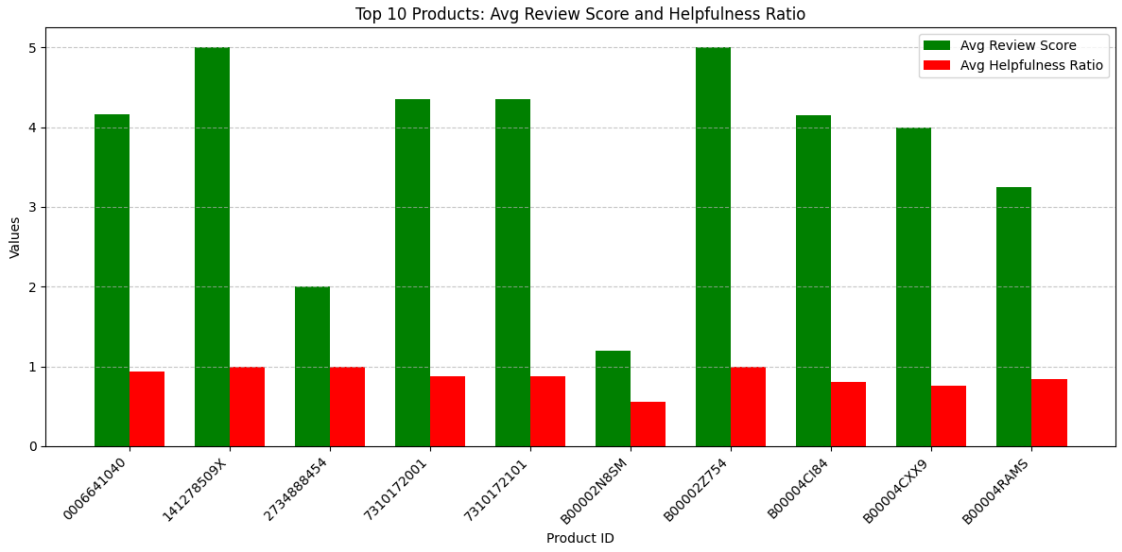
[59]:
```
res['avg_helpfulness'].value_counts()
```

[59]:
```
avg_helpfulness
1.000000    26363
0.500000     1344
0.750000     1157
0.666667      782
0.833333      760
             …
0.775510        1
0.803644        1
0.783503        1
0.837912        1
0.866432        1
Name: count, Length: 5197, dtype: int64
```

[64]:
```
res=res.head(10)
```

[65]:
```
x = np.arange(len(res['ProductId']))  # X-axis positions
width = 0.35  # Width of the bars

fig, ax = plt.subplots(figsize=(12, 6))

# Bars for average review scores
bars1 = ax.bar(x - width/2, res['avg_score'], width, label='Avg Review Score',␣
 ↪color='green')

# Bars for average helpfulness ratios
bars2 = ax.bar(x + width/2, res['avg_helpfulness'], width, label='Avg␣
 ↪Helpfulness Ratio', color='red')

# Adding labels and title
ax.set_xlabel('Product ID')
```

```
ax.set_ylabel('Values')
ax.set_title('Top 10 Products: Avg Review Score and Helpfulness Ratio')
ax.set_xticks(x)
ax.set_xticklabels(res['ProductId'], rotation=45, ha='right')
ax.legend()

# Adding a grid for better readability
ax.grid(axis='y', linestyle='--', alpha=0.7)

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



Hypothesis Analysis Report

[ ]:
```
"""
according to the analysis of numbers

5.000000    19268
4.000000     4362
3.000000     2838
1.000000     2778
4.500000     1813
            ...
4.586957        1
3.394737        1
3.707317        1
4.351064        1
4.485714        1
```

```
avg_helpfulness
1.000000    26363
0.500000     1344
0.750000     1157
0.666667      782
0.833333      760
            ...
0.775510        1
0.803644        1
0.783503        1
0.837912        1
0.866432        1



and above bar plt shows sample of top 10 product there is differ in the␣
 ↪helpfulness ratio and review scores between products
which shows hypothesis review scores and helpfulness ratios differ across␣
 ↪products is true """
```

This notebook was converted with convert.ploomber.io