Problem Statement

(Sentiment Analysis on Review)

2.1 Problem Statement:

You work for an online retailer, and one of your company's tasks is to examine user reviews of different products. It is your responsibility to compile a report that categorizes the products according to user reviews.

2.2 Dataset Information:

The Reviews.csv dataset contains 60145 rows and 10 columns.

2.3 Objective:

1. Analyse the customer reviews data, perform EDA and statistical tests to gather insights about the products.
   a. Highest and lowest rating for the products. Percentage wise product ratings for the entire data.
   b. Total number of reviews by unique profiles. How many customers or profiles have reviewed more than one product?
2. Perform sentiment analysis on the reviews data, and classify the reviews based on the sentiment associated with the same

2.4 Importing Libraries

In [31]:

```
# Importing libraries
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from nltk.tokenize import RegexpTokenizer
from nltk.tokenize import word_tokenize
from nltk.stem.wordnet import WordNetLemmatizer
#To track function execution
from tqdm import tqdm
from bs4 import BeautifulSoup

#Libraries for Sentimental analysis
from nltk.sentiment.vader import SentimentIntensityAnalyzer

#Libraries for visualization
from os import path
from PIL import Image
from wordcloud import WordCloud, STOPWORDS, ImageColorGenerator
import seaborn as sns
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

#Libraries for ML
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
```

2.5 Reading dataset

In [12]:

```
# Reading dataframe
df = pd.read_csv(r"Reviews.csv")
```

In [14]:

```
df.head(5)
```

Out[14]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	4	1219017600	"Delight" says it all	This is a confection that has been around a fe...
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	1307923200	Cough Medicine	If you are looking for the secret ingredient i...
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	0	0	5	1350777600	Great taffy	Great taffy at a great price. There was a wid...

In [16]:

```
df.shape
```

Out[16]:

```
(568454, 10)
```

Check the null values in the dataset.

The profile name and summary feature has null values.

```
In [18]: 1 df.isnull().sum()
```

```
Out[18]: Id                      0
         ProductId               0
         UserId                  0
         ProfileName            16
         HelpfulnessNumerator    0
         HelpfulnessDenominator  0
         Score                   0
         Time                    0
         Summary                27
         Text                    0
         dtype: int64
```

```
In [19]: 1 df[df["ProfileName"].isnull()]
```

Out[19]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text
25509	25510	B000LKZB4Y	A36BVYD0NT7Z0F	NaN	0	0	5	1314576000	These are the best mints and no aspartame or BHT	I was so shocked to find out that almost all g...
38874	38875	B000AYDGZ2	A36BVYD0NT7Z0F	NaN	2	3	1	1278374400	doesn't anyone care that they are putting BHT ...	I called Kellogg's to see why Special K red be...
49800	49801	B000CRHQN0	A2LYFY32LXQDON	NaN	0	0	2	1282608000	They were melted and the chocolate had turned ...	We love these bars but i won't order them ship...
67077	67078	B0006348H2	A2P0P67Y55SNOX	NaN	1	1	5	1314662400	Wheatgrass	Kitty seems to like this sprinkled on her food...
106550	106551	B001EQ5DG0	A1P500QXEG3IUZ	NaN	0	0	5	1326758400	Finally!	You cannot find this in the stores anymore, it...
137613	137614	B000CQE3HS	AGT3BYX5P9SLH	NaN	0	0	5	1324684800	awesome	i love them they are amazing I would eat them ...
163191	163192	B000CQID1A	AGT3BYX5P9SLH	NaN	0	0	5	1324684800	awesome	i love them they are amazing I would eat them ...

The null values are removed using dropna function before proceeding with the analysis.

```
In [20]: 1 # Dropping Null values
         2 df.dropna(inplace=True)
```

```
In [21]: 1 # Checking if null value exist again
         2 df.isnull().sum()
```

```
Out[21]: Id                     0
         ProductId              0
         UserId                 0
         ProfileName            0
         HelpfulnessNumerator   0
         HelpfulnessDenominator 0
         Score                  0
         Time                   0
         Summary                0
         Text                   0
         dtype: int64
```

In [23]:
```
#  Checking the columns of the reviews.
df.columns

```

Out[23]:
```
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerator',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text'],
      dtype='object')
```

In [24]:
```
#Checking the shape of the dataframe.
df.shape
```

Out[24]:
```
(568411, 10)
```

In [25]:
```
# Checking for the info of the dataframe.
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 568411 entries, 0 to 568453
Data columns (total 10 columns):
 #   Column                  Non-Null Count   Dtype
---  ------                  --------------   -----
 0   Id                      568411 non-null  int64
 1   ProductId               568411 non-null  object
 2   UserId                  568411 non-null  object
 3   ProfileName             568411 non-null  object
 4   HelpfulnessNumerator    568411 non-null  int64
 5   HelpfulnessDenominator  568411 non-null  int64
 6   Score                   568411 non-null  int64
 7   Time                    568411 non-null  int64
 8   Summary                 568411 non-null  object
 9   Text                    568411 non-null  object
dtypes: int64(5), object(5)
memory usage: 47.7+ MB
```

In [26]:
```
# Statistical analysis of the dataframe.
df.describe()
```

Out[26]:

	Id	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time
count	568411.000000	568411.000000	568411.000000	568411.000000	5.684110e+05
mean	284227.440964	1.743874	2.227876	4.183309	1.296261e+09
std	164099.020907	7.636781	8.288752	1.310368	4.803792e+07
min	1.000000	0.000000	0.000000	1.000000	9.393408e+08
25%	142114.500000	0.000000	0.000000	4.000000	1.271290e+09
50%	284224.000000	0.000000	1.000000	5.000000	1.311120e+09
75%	426341.500000	2.000000	2.000000	5.000000	1.332720e+09
max	568454.000000	866.000000	923.000000	5.000000	1.351210e+09

In [27]:
```
# Checking number of reviews for each score.
df["Score"].value_counts()
```

Out[27]:
```
5    363111
4     80655
1     52264
3     42638
2     29743
Name: Score, dtype: int64
```

2.3 Exploratory Data Analysis

Note that more than 75% of our data is belonging to positive class (Score=4,5), i.e. we have imbalanced dataset.

 # 1. Analyze the customer reviews data, perform EDA and statistical tests to gather insights about the products.

a. Highest and lowest rating for the products. Percentage wise product ratings for the entire data.

```
In [84]:  1 df.head()
```

Out[84]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	word_count
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...	49
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...	31
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	4	1219017600	"Delight" says it all	This is a confection that has been around a fe...	99

```
In [85]:  1
          2 df.groupby('ProductId')['Score'].max()
```

```
Out[85]: ProductId
         0006641040    5
         141278509X    5
         2734888454    5
         2841233731    5
         7310172001    5
                      ..
         B009UOFTUI    1
         B009UOFU20    1
         B009UUS05I    5
         B009WSNWC4    5
         B009WVB40S    5
         Name: Score, Length: 74258, dtype: int64
```

In [86]:
```
df.groupby('ProductId')['Score'].min()
```

Out[86]:
```
ProductId
0006641040    1
141278509X    5
2734888454    2
2841233731    5
7310172001    1
              ..
B009UOFTUI    1
B009UOFU20    1
B009UUS05I    5
B009WSNWC4    5
B009WVB40S    5
Name: Score, Length: 74258, dtype: int64
```

In [32]:
```
total = df["Score"].count()
print(total)
```

```
568411
```

Out[32]:

	Rating	Total
0	5	363111
1	4	80655
2	1	52264
3	3	42638
4	2	29743

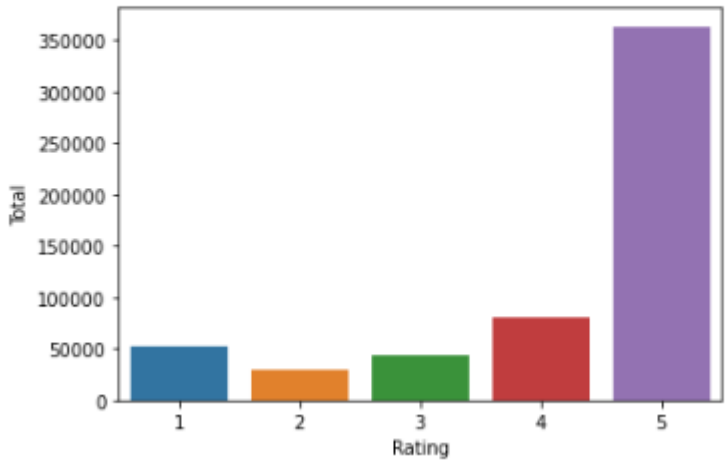
In [33]:
```
percent_plot = pd.DataFrame({"Total":df["Score"].value_counts()})
percent_plot.reset_index(inplace = True)
percent_plot.rename(columns={"index":"Rating"},inplace=True)
percent_plot
```

Out[33]:

	Rating	Total
0	5	363111
1	4	80655
2	1	52264
3	3	42638
4	2	29743

```
In [34]: 1 sns.barplot(x="Rating",y="Total", data=percent_plot)
```

```
Out[34]: <AxesSubplot:xlabel='Rating', ylabel='Total'>
```



As we can see, a sizable percentage of all reviews—63.88%—are 5-star. 4-stars (14.18%) are the next most common rating, followed by 1- star (9.19%), 3- stars (7.50%), and 2- stars (5.23%).

```
In [36]: 1 percent_plot["Percent"] = percent_plot["Total"].apply(lambda x: (x/total)*100)
```

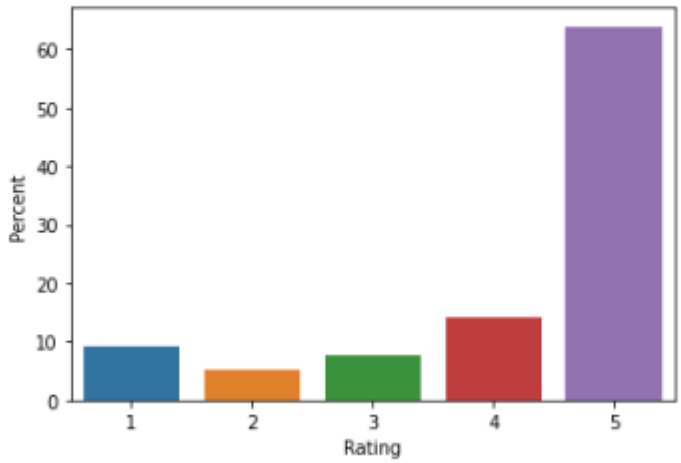
```
In [37]: 1 percent_plot
```

Out[37]:

	Rating	Total	Percent
0	5	363111	63.881769
1	4	80655	14.189557
2	1	52264	9.194755
3	3	42638	7.501262
4	2	29743	5.232657

In [38]:
```
sns.barplot(x="Rating", y="Percent", data = percent_plot)
```

Out[38]: <AxesSubplot:xlabel='Rating', ylabel='Percent'>



Text Exploration

In [39]:
```
df.columns

```

Out[39]:
```
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerator',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text'],
      dtype='object')
```

In [40]:
```
df["word_count"] = df["Text"].apply(lambda x: len(str(x).split(" ")))
df[["Text","word_count"]].head()
```

Out[40]:

	Text	word_count
0	I have bought several of the Vitality canned d...	49
1	Product arrived labeled as Jumbo Salted Peanut...	31
2	This is a confection that has been around a fe...	99
3	If you are looking for the secret ingredient i...	43
4	Great taffy at a great price. There was a wid...	30

In [41]:
```
# Checking the statistics of word count to check for range and average number of the words in each article.
df["word_count"].describe()
```

Out[41]:
```
count    568411.000000
mean         82.008950
std          80.808843
min           3.000000
25%          34.000000
50%          58.000000
75%         100.000000
max        3526.000000
Name: word_count, dtype: float64
```

In [42]:
```
#Checking for top 20 most repeated words - Gives insights on data specific stop words.

common_words = pd.Series(' '.join(df["Text"]).split()).value_counts()
common_words[:20]
```

Out[42]:
```
the     1628022
I       1388024
and     1228619
a       1163101
to       992344
of       789642
is       714256
it       631240
for      519980
in       512386
this     488303
that     400460
my       364014
with     336238
have     335281
but      324902
are      310922
was      307851
not      285042
you      280381
dtype: int64
```

In [43]:
```
# Checking 20 most uncommon words
common_words[-20:]
```

Out[43]:
```
"shakey"              1
hand....You           1
hot...Its             1
expensive......My     1
drinkers....Doesn't   1
hot....its            1
butt...And            1
pot.....One           1
coffee....So          1
simple.....Put        1
"coax"                1
didn't...Keep         1
process....Lets       1
better....But         1
CLOGS....Found        1
use...IT              1
"groves"              1
chip,or               1
"ceramic",            1
,product              1
dtype: int64
```

2.3 Text Preprocessing

In [47]:
```
# Removing Stopwords
import nltk
nltk.download('stopwords')

stop_words = set(stopwords.words("english"))
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\Hp\AppData\Roaming\nltk_data...
[nltk_data]   Unzipping corpora\stopwords.zip.
```

In [48]:
```
# Adding common words from our document to stop_words

add_words = ["the","I","and","a","to","of","is","it","for","in","this","that","my","with",
"have",
"but",
"are",
"was",
"not",
"you"]
stop_words = stop_words.union(add_words)
```

In [52]:
```
import nltk
nltk.download('punkt')
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\Hp\AppData\Roaming\nltk_data...
[nltk_data]   Unzipping tokenizers\punkt.zip.
```

Out[52]: True

#Below Function is to clean the text and prepare it for the next phase.

In [64]:
```
#Below Function is to clean the text and prepare it for the next phase.

from tqdm import tqdm
corpus = []

def clean_content(df):
    cleaned_content = []

    for sent in tqdm(df["Text"]):

        #Removing HTML comtent
        review_content = BeautifulSoup(sent).get_text()

        #Removing non-alphabetic charecters
        review_content = re.sub("[^a-zA-Z]"," ", review_content)

        #Tokenize the sentences
        words = word_tokenize(review_content.lower())

        #Removing the stop words
        sto_words_removed = [word for word in words if not word in stop_words]
        sto_words_removed = " ".join(sto_words_removed)
        corpus.append(sto_words_removed)
        cleaned_content.append(sto_words_removed)

    return (cleaned_content)
```

In [55]:
```
df["cleaned_text"] = clean_content(df)
```

```
  0%|                                                                                | 83/568411 [00:00<21:35, 438.57it/s]C:\ProgramData\Anaconda3\lib\site-packages\bs4\__init__.py:435: MarkupResemblesLocatorWarning: The input looks more like a filename than markup. You may want to open this file and pass the filehandle into Beautiful Soup.
  warnings.warn(
100%|████████████████████████████████████████████████████████████████| 568411/568411 [13:21<00:00, 708.98it/s]
```

In [65]:
```
df.head()
```

Out[65]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	word_count	cl
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...	49	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...	31	ji

2.4 Sentimental Analysis

Performed Sentiment Analysis to classify the Reviews into Positive or negative reviews.

Input: Text column of the dataFrame.

Output: Sentimental score report card with percentage of negative, positive, neutral and compound sentiment. Using this score report card, classified the sentence into possitive or negative sentence. 0 - Negative Sentence 1 - Positive Sentence

In [72]:
```
# Initializing the sentimental Intenity Analyzer
import nltk
nltk.download('vader_lexicon')
sid = SentimentIntensityAnalyzer()
```

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

In [73]:
```
# checking the polarity scores for first 5 articles
for i in range(0,5):
    print(sid.polarity_scores(df.loc[i]["Text"]))
```

```
{'neg': 0.0, 'neu': 0.695, 'pos': 0.305, 'compound': 0.9441}
{'neg': 0.138, 'neu': 0.862, 'pos': 0.0, 'compound': -0.5664}
{'neg': 0.091, 'neu': 0.754, 'pos': 0.155, 'compound': 0.8265}
{'neg': 0.0, 'neu': 1.0, 'pos': 0.0, 'compound': 0.0}
{'neg': 0.0, 'neu': 0.552, 'pos': 0.448, 'compound': 0.9468}
```

In [74]:
```
df["sentimental_scores"] = df["Text"].apply(lambda x: sid.polarity_scores(x))
```

In [75]:
```
df["compound_sentiment"] = df["sentimental_scores"].apply(lambda score_dict: score_dict["compound"])
```

In [76]:
```
df.head()
```

Out[76]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	word_count	c
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...	49	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...	31	
										This is a		

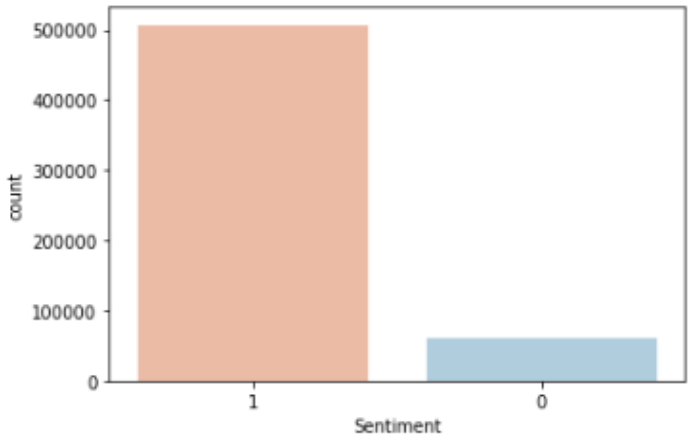
In [77]:
```
df["sentiment"] = df["compound_sentiment"].apply(lambda x: 1 if x >= 0 else 0)
df.head()
```

Out[77]:

essNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	word_count	cleaned_text	sentimental_scores	compound_sentiment	sentiment
1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...	49	bought several vitality canned dog food produc...	{'neg': 0.0, 'neu': 0.695, 'pos': 0.305, 'comp...	0.9441	1
0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...	31	product arrived labeled jumbo salted peanuts p...	{'neg': 0.138, 'neu': 0.862, 'pos': 0.0, 'comp...	-0.5664	0
					This is a					

#We can observe that the dataset mostly consists of positive sentiments which is shown in the below graph.

```
2
3 sns.countplot(x="sentiment", order = [1,0], data=df, palette='RdBu')
4 plt.xlabel("Sentiment")
5 plt.show()
```



In [80]:

```
1 sns.countplot(x="sentiment", order = [1,0], data=df, palette='RdBu')
2 plt.xlabel("Sentiment")
3 plt.show()
```