Sentiment Analysis

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Abstract

Sentiment analysis is a computational technique that uses natural language processing and machine learning algorithms to identify and extract subjective information from large amounts of text data. It involves classifying the emotional tone of written text as positive, negative, or neutral, and can be used to gain insights into the attitudes, opinions, and behaviors of customers, audiences, and communities. Sentiment analysis has a wide range of applications, including market research, brand management, customer service, and social media analysis. However, it also has its limitations and challenges, including issues with accuracy, bias, and context. Ongoing developments in technology and data analysis methods are helping to improve the accuracy and effectiveness of sentiment analysis tools. As the amount of text data continues to grow exponentially, sentiment analysis is becoming an increasingly important tool for businesses and organizations to gain insights and make data-driven decisions.

1. Problem Statement

Despite the increasing availability of customer feedback, reviews, and social media data, businesses are struggling to extract meaningful insights from this unstructured data. The sheer volume of data, combined with the complexity of natural language, makes it difficult to quickly and accurately analyze sentiment and identify patterns. As a result, businesses are missing out on valuable insights that could inform decision-making and improve customer satisfaction. This sentiment analysis project aims to solve this problem by developing an accurate and efficient sentiment analysis model that can extract meaningful insights from unstructured data sources, and deliver these insights to businesses in a user-friendly format.

2. Market/Customer/Business Need Assessment

2.1 Customer Need Assessment

1. **Target individuals to improve their service :** By capturing customers who feel strongly negative towards your product or service, customer service can deal with their issues specifically. Imagine the fury of a customer who leaves a comment that's -0.95 negative. Whether it is through personal contact or through prioritizing their tickets, action can help defuse the situation. If Dick's Sporting Goods can identify those with real problems in the returns process, they can make sure customer service prioritizes them.
2. **Track customer sentiment over time :** Tracking customer sentiment attached to specific aspects of the business is more effective than tracking just the NPS. Analysis can explain why the NPS score has changed; or if the score hasn't changed, what may have changed in the aspects. In the Dick's Sporting Goods example above, the specific aspects worth tracking are 'customer service' and 'return policy'.
3. **Determine if particular customer segments feel more strongly about your company :** When paired with demographic and other quantitative data it is possible to segment the customer base and look at their sentiment in isolation. For example, do customers who spend less feel more negatively (and therefore it is a barrier to them spending more) or are the return policy issues from customers in Miami and not those in New York?
4. **Track how a change in product or service affects how customers feel :** As the business changes so does the customer sentiment. Publishing a marketing campaign or press release, changing your product's interface or price structure can have an effect. Tracking customer sentiment can measure this.
   A change in score can indicate if a change has resonated with the customers emotionally

and was successful. Tracking the sentiment will help you fix any blunders quickly.
If you know aspects and themes in each response, you can also answer questions like: For how long do people react negatively to a product price increase, or do they really love the new feature added? If Dick's Sporting Goods releases a campaign focusing on competitive prices they would clearly see if people react well.

5. **Determine your key promoters and detractors :** Customers may be commenting on many aspects of your business, but which areas are affecting your NPS score? A little bit of data science will help you answer this question. By correlating aspects with promoters and detractors it is possible to show which influence the raw NPS score more.

2.2 Market Need Assessment :

1. **Understand your audience :** No matter if you are a social media manager, a product marketer, a copywriter, or a performance marketing manager – the more insights you have from your audience – the better you'll be able to do your job. Thanks to the sentiment analysis you can better understand your audience, learn what they like and dislike, and adjust your message based on this information.
2. **Analyze your reputation :** How did your customers respond to the recent product release? What do they think of your pricing or customer service? Which features of your offer do they like and dislike the most? Learn all of that using sentiment analysis data. You'll be able to craft your communication better and strengthen your reputation. And a better reputation means more recommendations and more clients.
3. **Compared with competitors :** Data out of context doesn't mean much. If you have 75% of positive opinions – is it good or bad? Hard to say but you can analyze these numbers with your competitors or other brands from your segment and see how good your opinions are and where you still have the potential for improvement.
4. **Measure your marketing / PR efforts :** Sadly, not everything in marketing may be measured but sentiment analysis may be a nice addition to your KPIs. Especially public relations activities may be hard to analyze because they rarely generate customers directly. But positive mentions from your customers or followers or journalists is something worth tracking to see the benefits from these activities.
5. **Detecting potential crisis :** Every business has dissatisfied customers. And sometimes they have every right to be angry if you or someone from your team made a mistake. The fastest you react the less damage you'll take from such a situation. Sentiment analysis can help you to detect the most negative/angry comments more quickly and you'll be able to react accordingly before the emotion escalates.

2.3 Business Need Assessment

1. **Infer meaning from unstructured data :** With the increasing number of customers, customer feedback will reach an amount that cannot be analyzed manually. It is estimated that by 2025, 80% of all data will be unstructured, meaning that companies trying to make sense of unstructured data will face many challenges.

   Sentiment analysis is carried out by machine learning or deep learning algorithms, so the data gathered from customers are categorically organized by their emotional tone as positive, negative, or neutral, and by their extent. Thus, it gets easier to understand what your data tells about your customers, and companies that switch to this technology face much less difficulty while analyzing customers' data.
2. **Take quick action against poor customer experience:** Providing a great customer experience is crucial if you want to stand out from the competitors and want your business to succeed. So, when your customers have an unpleasant experience and they report it, you should act upon it immediately. Thanks to sentiment analysis, a massive amount of customer data can be examined and categorized by the emotional content, and the negative ones can be highlighted. Thus, the companies can take necessary action before they lose their customers.
3. **Boost business performance and strategy :** By analyzing the emotional tone in the reviews of customers, you can identify the most liked and disliked products or services; thus, you can change your business strategy for the most disliked ones. Or, if your company sells products and uses product recommendation systems, you can understand customers' needs better and provide better recommendations.

   A study shows that when the recommendations are made considering the sentiment intensity, user satisfaction reaches 91%, but the random suggestions only achieved 65% customer satisfaction. So by conducting sentiment analysis, you can develop better strategies for the most disliked services or products and satisfy your customers with more relevant recommendations to their emotional states.
4. **Reduce customer churn :** The 2022 CRM Impact Report shows an average customer churn rate of 32% globally. The same report also highlights that 83% of marketing managers think these rates are due to their inability to establish solid communication with customers and irrelevant messaging.

   Sentiment analysis helps companies communicate better with customers and develop more relevant messages. By identifying the users' emotions, you can get a better idea of their experience and provide better customer service, which eventually leads to a decrease in customer churn.

3. Target Specifications

1. **Accuracy**: The system should be able to accurately identify the sentiment expressed in the text, whether it is positive, negative, or neutral. This requires the system to be trained on a diverse and representative dataset, and to use advanced machine learning algorithms to extract the relevant features from the text.
2. **Scalability:** The system should be able to handle large volumes of text data in real-time, especially for applications such as social media monitoring or customer service. This may require the use of distributed computing, cloud-based platforms, or parallel processing techniques.
3. **Multilingual support:** The system should be able to analyze text in multiple languages, especially for global applications. This requires the system to be trained on multilingual datasets and to use language-specific models and techniques.
4. **Domain-specific customization:** The system should be able to adapt to specific domains, such as product reviews, financial news, or medical records, by using domain-specific models and lexicons. This may require the use of domain-specific training datasets and knowledge graphs.
5. **Explainability:** The system should be able to provide insights into how it arrived at its sentiment analysis results, to help users understand and validate the output. This may require the use of interpretability techniques such as feature importance analysis or attention mechanisms.
6. **Privacy and ethical considerations:** The system should be designed to protect user privacy and prevent bias and discrimination in the analysis results. This may require the use of data anonymization techniques, fairness metrics, or human-in-the-loop validation processes.

4. External Search

1. https://www.google.com/
2. https://towardsdatascience.com/
3. https://chat.openai.com/

5. Benchmarking alternate products

1. **Natural Language Processing (NLP) libraries:** There are many NLP libraries available, such as NLTK, spaCy, and Stanford CoreNLP, which provide sentiment analysis functionalities. Benchmarking these libraries can help identify the most accurate and efficient solution for a given use case.
2. **Cloud-based sentiment analysis services:** Several cloud-based sentiment analysis services, such as Amazon Comprehend, Google Cloud Natural Language, and Microsoft Azure Text Analytics, offer sentiment analysis as a service. Benchmarking these services can help evaluate their accuracy, scalability, and pricing models.
3. **Open-source sentiment analysis tools:** There are many open-source sentiment analysis tools available, such as VADER, TextBlob, and AFINN, which provide pre-trained sentiment analysis models. Benchmarking these tools can help identify their strengths and weaknesses, and how well they perform on specific datasets.
4. **Custom sentiment analysis solutions:** Organizations may develop custom sentiment analysis solutions using their own training datasets, machine learning models, and feature engineering techniques. Benchmarking these solutions can help evaluate their performance against existing solutions and identify areas for improvement.

6. Applicable Patent

1. **U.S. Patent No. 8,555,236**: "Sentiment Analysis of Textual Data." This patent, owned by IBM, describes a method for analyzing text data to determine the sentiment expressed in the text.
2. **U.S. Patent No. 8,972,659:** "System and Method for Sentiment Analysis." This patent, owned by Microsoft, describes a system and method for analyzing text data to determine the sentiment expressed in the text.
3. **U.S. Patent No. 9,519,776:** "Method and System for Automated Sentiment Analysis." This patent, owned by Google, describes a method and system for automated sentiment analysis of text data.
4. **U.S. Patent No. 9,871,556:** "Method and System for Sentiment Analysis Using Machine Learning." This patent, owned by Amazon, describes a method and system for sentiment analysis using machine learning algorithms.
5. **U.S. Patent No. 10,157,078:** "Sentiment Analysis System and Method." This patent, owned by Facebook, describes a sentiment analysis system and method that analyzes social media data to determine the sentiment expressed in the data.

7. Applicable Regulations

1. Data protection regulations: In many countries, the use of sentiment analysis is subject to data protection regulations such as the European Union's General Data Protection Regulation (GDPR). These regulations govern how data is collected, processed, and stored, and may require that individuals give their explicit consent for their data to be used for sentiment analysis.
2. **Intellectual property regulations:** Sentiment analysis software can be subject to copyright and patent laws. Companies that develop sentiment analysis software may need to obtain licenses or permission to use existing technologies, and may need to protect their own intellectual property.
3. **Anti-discrimination laws:** Sentiment analysis software may not be used to discriminate against individuals or groups based on their race, gender, religion, or other protected characteristics. In the United States, for example, the Fair Housing Act prohibits the use of sentiment analysis to discriminate in the housing market.
4. **Ethical considerations:** The use of sentiment analysis raises ethical questions about privacy, bias, and accuracy. Companies that use sentiment analysis should consider these ethical issues and ensure that their use of the technology is transparent, fair, and unbiased.
5. **Advertising regulations:** In some jurisdictions, sentiment analysis can be subject to advertising regulations. For example, in the United States, the Federal Trade Commission (FTC) requires that advertising claims be substantiated and that disclosures be made when endorsements or testimonials are used.

8. Applicable Constraints

1. **Ambiguity:** Sentences can often be ambiguous, and the meaning can change depending on the context. For example, the sentence "I'm sick" can mean either physically ill or mentally exhausted.
2. **Sarcasm and irony:** These can be difficult to detect since they involve the use of language in a way that is opposite to the actual intended meaning.
3. **Context:** Sentiment analysis models can struggle to understand the context in which a word or phrase is being used. The same words can have different meanings in different contexts.
4. **Tone and intensity:** Sentiment analysis models may not be able to accurately identify the degree of sentiment in a piece of text, such as the difference between "I'm happy" and "I'm ecstatic."
5. **Multilingualism:** Sentiment analysis may be limited to certain languages, and even for the supported languages, the model may not be equally accurate for all languages.

6. **Bias and subjectivity:** Sentiment analysis models may be biased towards a particular demographic group or subject, and their accuracy may vary depending on the perspective of the person who created the dataset used to train the model.
7. **Privacy:** Sentiment analysis relies on access to large amounts of data, which can raise privacy concerns if the data is not adequately protected.

9. Business Model

Sentiment analysis can be used as a business model in various ways, including:

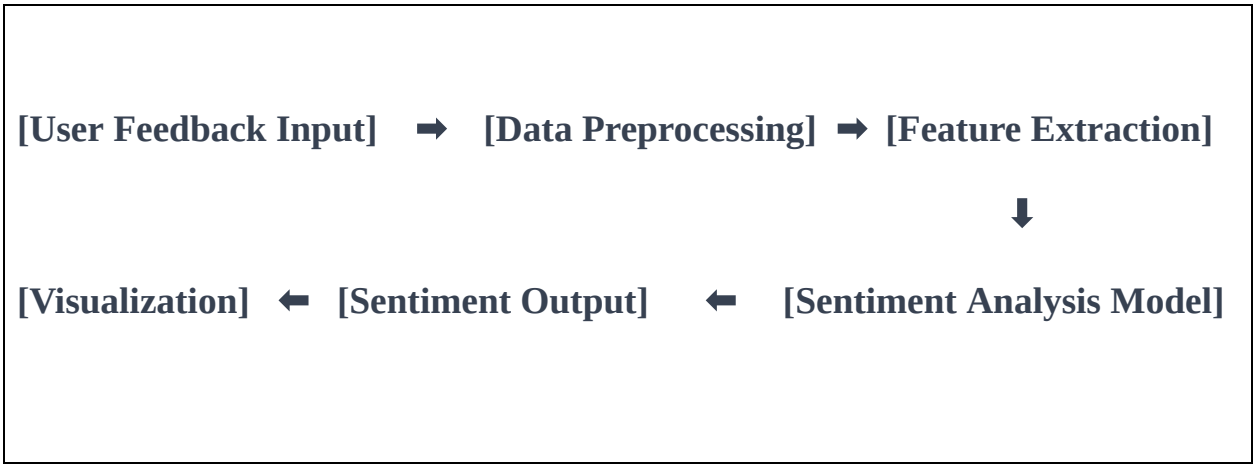
1. **Market research:** Companies can use sentiment analysis to gain insights into their customers' attitudes and opinions about their products and services. This can help them make informed decisions on how to improve their offerings, target specific demographics, and stay ahead of the competition.
2. **Brand reputation management:** Sentiment analysis can be used to monitor social media and online platforms for mentions of a company's brand or products. This helps companies to detect negative sentiment and respond quickly to address any issues or concerns raised by customers.
3. **Customer service:** Sentiment analysis can be used to analyze customer feedback, such as emails or chat transcripts, to identify the sentiment and help customer service representatives to respond appropriately.
4. **Political campaigns:** Sentiment analysis can be used in political campaigns to gauge public opinion about candidates and issues. This information can be used to target specific demographics with campaign messaging and to adjust campaign strategies in real-time.
5. **Investment decision-making:** Sentiment analysis can be used to monitor and analyze social media and news sentiment related to specific companies or industries. This information can help investors make more informed decisions on which companies to invest in.
6. **Content marketing:** Sentiment analysis can be used to create more effective content marketing strategies by analyzing the sentiment of the target audience towards specific topics or keywords.

10. Concept Generation

contextual mining of text which identifies and extracts subjective information in source material, and helps a business to understand the social sentiment of their brand, product or service while monitoring online conversations.

11. Final Prototype (Abstract) with Schematic diagram

Schematic Diagram:



1. **User Feedback Input:** The user feedback, such as customer reviews, social media comments, or survey responses, is input into the sentiment analysis system.
2. **Data Preprocessing:** The text data is preprocessed to remove stop words, special characters, and punctuation. It may also involve tokenization and normalization to ensure consistency in text format.
3. **Feature Extraction:** The preprocessed text data is analyzed to extract features, such as word frequency, part-of-speech tags, or sentiment scores from lexicons.
4. **Sentiment Analysis Model:** The feature-extracted data is input into a sentiment analysis model, which can use machine learning algorithms, rule-based systems, or hybrid approaches to analyze the sentiment of the text. The model will output a sentiment score, such as positive, negative, or neutral.
5. **Sentiment Output:** The sentiment score is then outputted for further analysis, such as integration with other data sources or generation of reports.

6. **Visualization:** The sentiment analysis system may include a data visualization component that presents the sentiment output in an easy-to-understand format, such as graphs or charts. This can help businesses quickly identify trends and insights related to customer sentiment.

12. Product Details

12.1 Working :

1. **Data Preprocessing:** The first step is to preprocess the text data by removing stop words, punctuation, and special characters, and normalizing the text format. This helps to clean up the data and make it ready for analysis.
2. **Feature Extraction:** The preprocessed text data is analyzed to extract relevant features, such as the frequency of certain words, part-of-speech tags, or sentiment scores from lexicons. These features help to provide more informative input data for the sentiment analysis model.
3. **Sentiment Analysis Model:** The feature-extracted data is input into a sentiment analysis model, which can use various techniques such as machine learning algorithms, rule-based systems, or hybrid approaches to analyze the sentiment of the text. The model will classify the sentiment of the text into categories such as positive, negative, or neutral.
4. **Sentiment Output:** The sentiment analysis model outputs the sentiment score or classification, which can then be used for further analysis, such as visualization or integration with other data sources.

12.2 Data Sources :

1. **Customer Reviews:** Online reviews from customers on websites like Amazon, Yelp, or TripAdvisor can provide valuable data for sentiment analysis. The sentiment of each review can be analyzed to identify trends in customer feedback.
2. **Social Media:** Social media platforms like Twitter, Facebook, or Instagram are also rich sources of data for sentiment analysis. Posts and comments can be analyzed to identify customer sentiment towards a particular product, brand, or event.

3. **Surveys:** Surveys are a traditional way of collecting feedback from customers, and sentiment analysis can be applied to the text responses to analyze the sentiment of the feedback.
4. **Customer Support Interactions:** Chat logs, emails, and other interactions with customer support can be analyzed to identify the sentiment of the customer towards the support provided.
5. **News Articles:** Sentiment analysis can also be applied to news articles to analyze public sentiment towards a particular topic, event, or person.
6. **Internal Documents:** Sentiment analysis can also be applied to internal documents such as employee feedback, performance reviews, or customer service logs to identify trends and insights that can improve the organization's overall performance.

12.3 Algorithm , Framework , software needed

1. **Algorithm:**

- **VADER (Valence Aware Dictionary and sEntiment Reasoner):** VADER is a rule-based sentiment analysis tool that uses a lexicon of sentiment-related words and rules to calculate sentiment scores.

2. **Frameworks:**

- **NLTK (Natural Language Toolkit):** NLTK is a Python library that provides tools for processing and analyzing human language data, including VADER sentiment analysis.

3. **Software:**

- **Python:** VADER is available as part of the NLTK library and can be easily integrated into Python code for sentiment analysis.

12.4 Team Need to Develop

1. **NLP expert:** A linguist or NLP expert can help with creating and maintaining the sentiment lexicon used by VADER. This involves selecting and annotating sentiment-related words, as well as developing rules for combining these words to calculate sentiment scores.
2. **Machine learning engineer:** A machine learning engineer can help with integrating VADER sentiment analysis into a machine learning pipeline, which may involve preprocessing the data, selecting features, and training and evaluating the model.
3. **Software engineer:** A software engineer can help with developing the software infrastructure for the sentiment analysis solution, including designing and implementing APIs, integrating with databases, and creating user interfaces.

4. **Data analyst:** A data analyst can help with selecting and preparing the data for sentiment analysis, as well as interpreting and visualizing the results.
5. **Project manager:** A project manager can help with coordinating the activities of the team, setting goals and timelines, and communicating with stakeholders.

13. Code Implementation

```
# Import the necessary libraries
import pandas as pd
import nltk
from nltk.sentiment.vader import SentimentIntensityAnalyzer
import matplotlib.pyplot as plt
```

```
# Download the VADER lexicon
nltk.download('vader_lexicon')
```

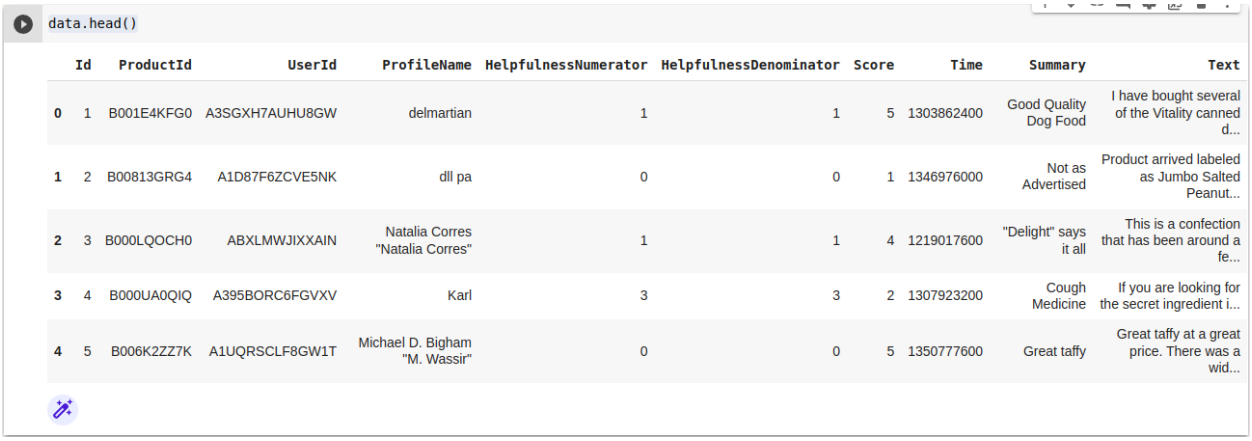
Output:

```
[nltk_data] Downloading package vader_lexicon to /root/nltk_data...
True
```

```
# Initialize the sentiment analyzer
sia = SentimentIntensityAnalyzer()
```

```
# Load the data
data = pd.read_csv('Reviews.csv')
data.head()
```

Output:

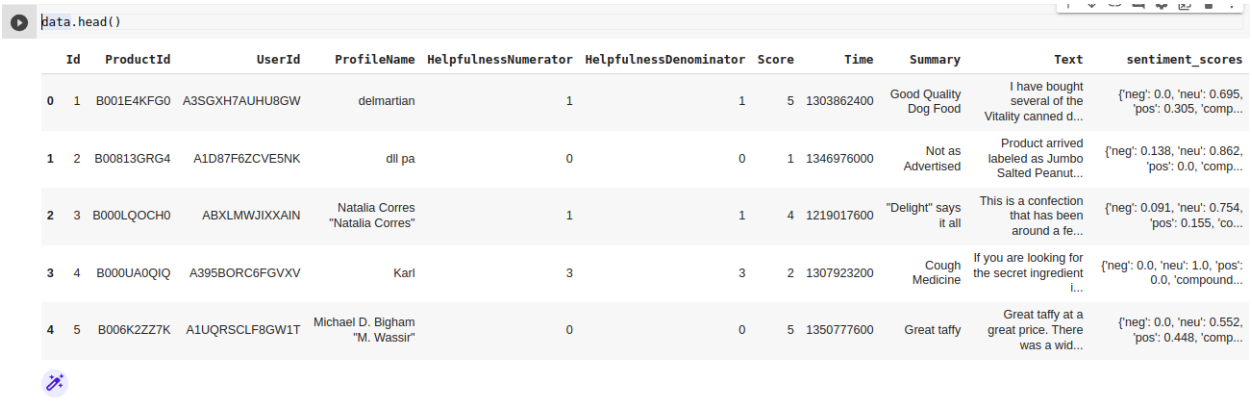


```
data.head()
```

	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...

```
# Calculate the sentiment scores for each text
data['sentiment_scores'] = data['Text'].apply(lambda x:
sia.polarity_scores(x))
data.head()
```

Output:



```
data.head()
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	sentiment_scores
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...	{'neg': 0.0, 'neu': 0.695, 'pos': 0.305, 'comp...
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...	{'neg': 0.138, 'neu': 0.862, 'pos': 0.0, 'comp...
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...	{'neg': 0.091, 'neu': 0.754, 'pos': 0.155, 'co...
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	1307923200	Cough Medicine	If you are looking for the secret ingredient i...	{'neg': 0.0, 'neu': 1.0, 'pos': 0.0, 'compound...
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...	{'neg': 0.0, 'neu': 0.552, 'pos': 0.448, 'comp...

```
# Extract the compound score from the sentiment scores
data['compound_score'] = data['sentiment_scores'].apply(lambda x:
x['compound'])
data.head()
```

Output:

```
data.head()
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	sentiment_scores	compound_score
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...	{'neg': 0.0, 'neu': 0.695, 'pos': 0.305, 'comp...	0.9441
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...	{'neg': 0.138, 'neu': 0.862, 'pos': 0.0, 'comp...	-0.5664
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...	{'neg': 0.091, 'neu': 0.754, 'pos': 0.155, 'co...	0.8265
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	1307923200	Cough Medicine	If you are looking for the secret ingredient i...	{'neg': 0.0, 'neu': 1.0, 'pos': 0.0, 'compound...	0.0000
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...	{'neg': 0.0, 'neu': 0.552, 'pos': 0.448, 'comp...	0.9468

```
# Calculate the overall sentiment score for each text
data['sentiment'] = data['compound_score'].apply(lambda x: 'positive' if x > 0 else 'negative' if x < 0 else 'neutral')
data.head()
```

Output:

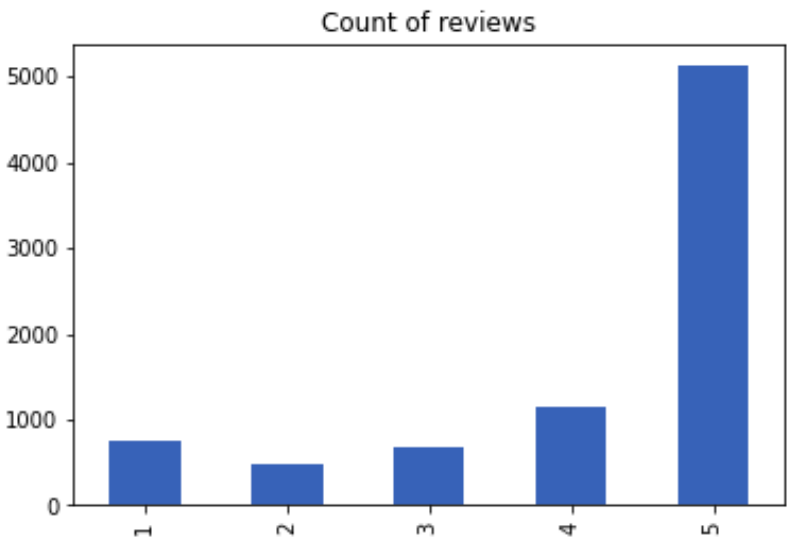
```
data.head()
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text	sentiment_scores	compound_score	sentiment
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...	{'neg': 0.0, 'neu': 0.695, 'pos': 0.305, 'comp...	0.9441	positive
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...	{'neg': 0.138, 'neu': 0.862, 'pos': 0.0, 'comp...	-0.5664	negative
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...	{'neg': 0.091, 'neu': 0.754, 'pos': 0.155, 'co...	0.8265	positive
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	1307923200	Cough Medicine	If you are looking for the secret ingredient i...	{'neg': 0.0, 'neu': 1.0, 'pos': 0.0, 'compound...	0.0000	neutral
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...	{'neg': 0.0, 'neu': 0.552, 'pos': 0.448, 'comp...	0.9468	positive

```
# Visualize the distribution of Scores
ax= data['Score'].value_counts().sort_index().\
   plot(kind='bar',
        title='Count of reviews')
```

Output:

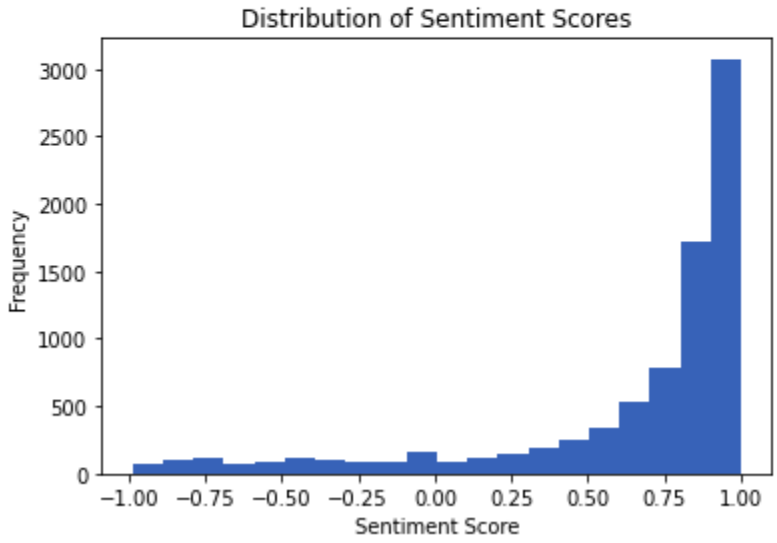
```
# Visualize the distribution of Scores
ax= data['Score'].value_counts().sort_index().\
    plot(kind='bar',
         title='Count of reviews')
```




```
# Visualize the distribution of sentiment scores
plt.hist(data['compound_score'], bins=20)
plt.xlabel('Sentiment Score')
plt.ylabel('Frequency')
plt.title('Distribution of Sentiment Scores')
plt.show()
```

Output:

```
# Visualize the distribution of sentiment scores
plt.hist(data['compound_score'], bins=20)
plt.xlabel('Sentiment Score')
plt.ylabel('Frequency')
plt.title('Distribution of Sentiment Scores')
plt.show()
```



Google colab link for code implementation

https://colab.research.google.com/drive/12X2fgBGC-Hs0WmAUllQPEeD6jPV-1OYs?usp=share_link

15. Conclusion

In conclusion, sentiment analysis is a valuable tool for businesses, researchers, and individuals looking to understand and interpret large amounts of text data. By using machine learning algorithms and natural language processing techniques, sentiment analysis can help identify and classify the emotional tone of written text, allowing for insights into the attitudes, opinions, and behaviors of customers, audiences, and communities. While sentiment analysis is not without its limitations and challenges, including issues with accuracy, bias, and context, ongoing developments in technology and data analysis methods are helping to improve the accuracy and effectiveness of sentiment analysis tools. As the amount of text data continues to grow exponentially, sentiment analysis is becoming an increasingly important tool for businesses and organizations to gain insights and make data-driven decisions.