ÖZET

İnternet, öğrenmek, fikir üretmek ve ürünlerin, hizmetlerin, insanların ve yerlerin hakkındaki kullanıcı yorumlarını bulmak için vazgeçilmez bir kaynak haline gelmiştir. Her gün milyonlarca çevrimiçi inceleme ürünler, insanlar ve yerler hakkında yayınlanmaktadır. Müşteri incelemeleri, ürünlerini geliştirmek isteyen işletmeler için önemli bir performans göstergesidir ve gelecekteki müşterilerin geçmiş deneyimleri anlamaları için de hayati önem taşır. Bu nedenle, duygu analizi, hızla büyüyen bir araştırma alanıdır ve müşteri incelemelerini analiz etmek için doğal dil işleme, metin madenciliği ve istatistik gibi ilgili alanlar büyük bir rol oynamaktadır. Bu çalışmada, otomatik (sözlük tabanlı) yöntemlerin sınırlamalarını ve manuel yöntemlerin etkinliğini vurgulayarak duygu analizine katkıda bulunulmaktadır. R Studio yazılımı, önerilen çalışmanın uygulanmasını kolaylaştırır. İlk olarak, web kazıma teknikleri ve veri ön işleme yoluyla Amazon'dan ürün incelemeleri ve derecelendirmeleri alırız. Ardından, üç duygu sözlüğü (Bing, NRC, Afinn) ve manuel bir yöntem kullanarak duygu analizi gerçekleştirilir. İncelemeler daha sonra olumlu veya olumsuz olarak kategorize edilir ve ardından otomatik (Bing sözlük tabanlı) ve manuel yöntemlerin sonuçlarını analiz etmek için çoklu regresyon modeli geliştirilir. Sonuçlara bakıldığında, manuel yöntemin varyansın yaklaşık %45,44'ünü açıkladığı, otomatik yöntemin ise yalnızca yaklaşık %3,26'sını açıkladığı görülmüştür ve iki model karşılaştırıldığında otomatik (Bing sözlüğü) yöntemine kıyasla manuel yöntem sonucu oluşan model anlamlı çıkmıştır.

ABSTRACT

The internet has become an essential resource for learning, generating ideas, and finding reviews for products and services. Daily, millions of reviews are posted online about products, people, and places. Customer reviews of products are a critical performance indicator for businesses looking to improve their contributions. They’re also important for future customers to understand previous customers’ experiences. Therefore, sentiment analysis is a rapidly growing research field where natural language processing, text mining, and statistics plays a major role to analyze customer reviews. In this study, the aim is to **study contributes to sentiment analysis by highlighting the limitations of automatic (lexicon based)methods and the effectiveness of manual methods.** R Studio software is used to implement the proposed study. First, we extract a product reviews and ratings from Amazon through web scraping techniques and preprocessing the data. Then, we conduct sentiment analysis using three lexicons(Bing, NRC, Afinn) and manual method. Subsequently, the reviews are categorized into positive and negative senntiments, followed by building a multiple regression model to discuss the outcomes for automatic(bing lexicon based) and manual methods. The results show that the manual method yields significant results, explaining approximately 45.44% of the variance, whereas the automatic (bing-lexicon based) method does not, explaining only approximately 3.26%.

**INTRODUCTION**

In the digital age, the internet has become a necessary resource for consumers seeking information, generating ideas, and finding reviews of products and services. Every day, millions of reviews are posted online, providing valuable insights into user experiences and imfluencing purchasing decisions. For businesses, customer reviews are essential for understanding how satisfied their customers are and spotting areas where they can improve. Potential customers, on the other hand, depend on reviews to understand the advantages and disadvantages of a product prior to making a purchase. This highlights the growing importance of sentiment analysis, a field that utilizes natural language processing (NLP), text mining and statistical techniques to extract and analyze the emotional tone(positive,negative or neutral) from customer reviews.

Researches continuosly work to improve to accuracy of sentiment analysis methods, leading to the development of numerous packages in software programmes such as R and Phyton. Given the limitations of lexicon-based sentiment analysis methods, this study aims to investigate the effectiveness of manual sentiment analysis compared to automatic methods. Lexicon-based methods rely on predefined word lists (e.g, NRC’s eight emotions, Bing’s positive/negative, AFINN’s sentiment scores) to categorize sentiment. However, these methods can struggle with nuances and context. To address this, we will use web scraping to collect Amazon reviews and apply NRC, Bing, AFINN lexicons along with manual sentiment analysis. We will then compare the explanatory power of both methods using regression modeling to assess the effectiveness of lexicon-based sentiment analysis compared to manual analysis.

Various methods have been employed to address this task, utilizing a range of different techniques. Some of them use lexicon based methods while others utilize machine learning methods. There are also few simple yet effective methods which give satisfactory results.

In a study, the researches exploring sentiment analysis and word cloud techniques in text mining. Their research on Amazon earphone reviews shows how these methods can be used to understand customer sentiment, improve customer experience enhancement, and inform customer-centric decision-making. Their work highlights the potential of these techniques for extracting insights from big data readily available online. [1] (Karim et. al., 2020)

Another study explores a web-based text analytics approach using R to analyze and summarize review data. Their research focuses on health product reviews from Shaklee’s platform. This approach utilizes R’s data processing capabilities and integrates various Natural Language Processing (NLP) features into a user-friendly menu. The menu displays all NLP features in a step-by-step manner with clear labels, simplifying the text summarization process. While the study acknowledges the proposed approach's effectiveness compared to a baseline model, further investigation into specific performance metrics would strengthen the findings. [2] (Kadir and Aliman, 2020)

In another research, they investigates how to improve understanding customer sentiment on Amazon.com reviews. By analyzing a dataset of 1000 reviews (balanced between positive and negative), the study compares different classification methods for sentiment analysis. The key finding is that K-Nearest Neighbor combined with a lexicon technique achieved the highest accuracy (92.67%) in identifying positive or negative sentiment, followed by SVM with lexicon (91.33%). This suggests lexicon techniques can significantly improve sentiment analysis for e-commerce reviews. [3](Prakaso et. al., 2018)

Another work investigates sentiment analysis of customer reviews for the Apple iPhone 14 Pro Max (1 TB, Gold) on Amazon. Researches analyze 160 reviews using machine learning techniques to categorize positive, negative, or neutral sentiment. Preprocessing techniques including tokenization, stop word removal, stemming, and punctuation removal were applied to the data. Positive and negative sentiment words were then identified through word cloud analysis. The sentiment analysis itself employed Naive Bayes, Support Vector Machines (SVM), and Logistic Regression algorithms. These algorithms achieved accuracy levels of 94% (Logistic Regression), 91% (SVM), and 90% (Naive Bayes) in classifying sentiment within the reviews. [4](Gore et. al., 2023)

**METHODOLOGY**

This study employed a mixed-methods approach, combining web scraping and sentiment analysis techniques to gather and analyze customer reviews from Amazon.com. The research process involved the following steps:

1. **Dataset:**

The dataset used in the study was collected from comments on the Amazon website.com. The collection includes a total of 70 user reviews and their star ratings. The specific product that we choosed to analyse was a Stanley Classic Vacuum Thermos.

1. **Data Processing:**

**Web Scraping**

Web scraping, also known as web extraction or harvesting, is a technique to extract data from the World Wide Web (WWW) and save it to a file system or database for later retrieval or analysis. Commonly, web data is scrapped utilizing Hypertext Transfer Protocol (HTTP) or through a web browser. This is accomplished either manually by a user or automatically by a bot or web crawler. [5] (Zao, 2017) Web scraping helps gather structured data, which means it's formatted in a way that's easy for computers to read and store in databases. In this study, web scraping was employed to extract customer reviews from Amazon.com. The R programming language and the rvest and the parallel package were utilized to navigate Amazon's web pages and extract relevant review data. The parallel package in R is a powerful tool for **parallelizing** R tasks, which means distributing them across multiple cores or processors to improve performance. This can be particularly beneficial for computationally intensive tasks like web scraping, data analysis, and machine learning.

In this study, to compile the necessary data for sentiment analysis, we employed web scraping to extract reviews and star ratings from Amazon product review pages. This process involved several key steps. First, we identified the specific URLs of the target product's review pages on Amazon.com. Next, we created a dedicated function utilizing the rvest package. This function acted as our data extraction tool, parsing the HTML content of each review page and retrieving the desired information: the review text itself and the corresponding star rating. To optimize the efficiency of this process, we leveraged parallel processing through the parallel package. This allowed us to scrape data from multiple review pages simultaneously, significantly reducing the overall time required to collect the necessary data. Finally, the extracted reviews and star ratings were stored in a structured data frame format and the collected data is converted into CSV format to be transformed in the text analytics system.

1. **Data Cleaning:**
2. **Corpus**

This section outlines the process of preparing the review data for sentiment analysis. The review data will be compiled into a corpus, which is a collection of text documents treated as a single unit for analysis. The readxl package will be used to import the reviews from an Excel file. To prepare the reviews for analysis, the text will undergo a cleaning process to remove irrelevant information and standardize the format. This involves converting text to lowercase, removing punctuation marks, stop words, digits, and extra whitespace characters. Additionally, specific words that are not relevant to sentiment analysis, such as "product," "but," "and," "even," may be removed. After cleaning, the preprocessed text will be transformed into a document-term matrix (DTM) using the DocumentTermMatrix function. A DTM is a numerical representation of the corpus, where rows represent documents (reviews) and columns represent unique words. The values in the matrix indicate the frequency of each word within each document. This step allows us to quantify the use of words within the corpus and facilitates further analysis.

1. **Word Cloud:**

Word cloud are a visual representation of word frequencies within a text corpus. They can be helpful for identifying the most frequently used words and potentially gaining insights into the overall sentiment of the reviews. In this study, we will generate word clouds using the **wordcloud2** package to visualize the most frequent words after the text cleaning process.

1. **Data Analysis Method**

**Sentiment Analysis**

Sentiment analysis is the process of automatically identifying and classifying the emotional tone and attitude within text. This is done using natural language processing (NLP) and machine learning techniques. Sentiment analysis can be used for a variety of purposes, such as analyzing customer feedback, tracking social media trends, summarizing product reviews, and measuring the effectiveness of marketing campaigns. In this study, we employed sentiment analysis to categorize customer reviews from Amazon.com as positive, negative, or neutral. We utilized a combined approach, leveraging both lexicon-based and manual sentiment analysis techniques.

**Techniques for Sentiment Analysis**

We utilized a combined approach, leveraging both lexicon-based and manual sentiment analysis techniques.

**Lexicon Based Sentiment Analysis**

Lexicon-based sentiment analysis is an automated approach for classifying the emotional tone of text data. It relies on predefined sentiment dictionaries, also known as lexicons, to categorize words or phrases according to their sentiment. Three pre-defined sentiment lexicons were leveraged for this analysis: Bing Liu's lexicon, NRC Emotion Lexicon, and AFINN. All three of these lexicons are based on unigrams (or single words). These lexicons contain many English words and the words are assigned scores for positive/negative sentiment, and also possibly emotions like joy, anger, sadness, and so forth. The **nrc** lexicon categorizes words in a binary fashion (“yes”/“no”) into categories of positive, negative, anger, anticipation, disgust, fear, joy, sadness, surprise, and trust. The **bing** lexicon categorizes words in a binary fashion into positive and negative categories. The **AFINN** lexicon assigns words with a score that runs between -5 and 5, with negative scores indicating negative sentiment and positive scores indicating positive sentiment. All of this information is tabulated in the **sentiments**dataset, and **tidytext**provides a function **get\_sentiments()**to get specific sentiment lexicons without the columns that are not used in that lexicon. [6]

**Manuel Based Sentiment Analysis**

Manual sentiment analysis is a technique for analyzing the emotional tone of text data by involving human experts. Unlike lexicon-based methods that rely on predefined sentiment dictionaries, manual sentiment analysis involves human judgment and understanding of language. In this study, each review was carefully examined, and its overall sentiment (positive and negative) was assigned based on its tone and content. This manual approach aimed to capture the sentiment more clearly, considering contextual aspects that lexicon-based methods might miss.

We will compare the results of the Bing lexicon and manual sentiment analysis to assess the effectiveness of each method. Additionally, we might explore ways to combine the strengths of both approaches to achieve a more comprehensive understanding of sentiment in the reviews. This will help us understand how well the Bing lexicon performs in classifying reviews as positive or negative. Any disagreements between the two methods will be analyzed to see where the Bing lexicon struggles, such as with sarcasm or unclear phrasing.

**APPLICATION**

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