



Analysis of AAPL Sentiment and Investor Behavior Toward Apple Lawsuit Case

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Abstract. Apple is a significant company that draws investors' attention due to its various legal issues. When encountering problems, investors must make decisions that involve both rational and irrational aspects and are often influenced by psychological biases. These biases can affect their judgment, leading to investment decisions that may not always align with objective financial analysis. This study aims to analyze investor sentiment towards the two legal cases faced by Apple and relate it to behavioral finance theory. Using the Naïve Bayes classification method, we analyzed 16,955 tweets from X social media related to these cases and achieved a classification accuracy of 76%. The analysis results show that positive sentiment is more dominant than neutral and negative sentiment. These findings indicate that despite Apple's involvement in significant legal issues, investor perceptions remain optimistic about the company's prospects and stock value. This suggests that investor behavior is influenced by psychological biases such as overconfidence, representativeness, and availability, which are essential to consider in investment decisions. Understanding these biases can provide valuable insights for investors and policymakers in developing strategies to mitigate their impact and improve financial decision-making.

Keywords: Investor Sentiment, Apple Legal Case, Naïve Bayes, Psychological Biases, Behavioral Finance.

1 Introduction

Apple is one of the major companies known for its innovation and high-quality products, such as the iPhone, iPad, and Mac, which dominate the market. However, Apple's success has not been without challenges. The company has faced intense competition and legal issues. A recent case that highlights these ongoing challenges involves a copyright lawsuit against the Apple Watch and the alleged monopoly lawsuit case by the U.S. Department of Justice.

When a company becomes embroiled in a significant case, whether legal, financial, or related to its products and services, it often leads to a surge in media coverage directed toward the entity. [1] find that if a company has a patent infringement lawsuit, it may cause a negative perception by investors. Additionally, a study by [2] at the Pakistan Stock Exchange demonstrates how heuristic biases negatively affect investment decisions. Based on the explanation, legal issues faced by a company can attract the

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R. Hurriyati et al. (eds.), *Proceedings of the 9th Global Conference on Business, Management and Entrepreneurship (GCBME 2024)*, Advances in Economics, Business and Management Research 342, https://doi.org/10.2991/978-94-6463-817-2_24

attention of investors because they can cause negative perceptions and a decrease in investment value. Given this event, many investors will undoubtedly engage in discussions and express their opinions regarding the issues on social media.

This study analyzes investor sentiment from social media concerning two legal cases involving Apple. Utilizing the Naïve Bayes algorithm, sentiments are categorized as positive, neutral, or negative. This study aims to examine investor perceptions of Apple and its stock value during these legal issues and correlate the findings of the sentiment analysis with behavioral finance theories. Specifically, the research aims to highlight psychological biases such as overconfidence, representativeness, and availability to explain investor behavior in evaluating the legal challenges faced by Apple.

1.1 Sentiment Analysis

Sentiment analysis is a computational process that involves identifying, extracting, and categorizing opinions, sentiments, and emotions expressed in textual data[3]. The goal of sentiment analysis is to assign a polarity (positive, negative, or neutral) to the textual expressions, thereby providing valuable insights for decision-making processes in various domains. Naïve Bayes classifier is a machine learning algorithm widely used for sentiment analysis. This method uses the concept of probability to classify data [4]. Sentiment analysis using naïve Bayes has been applied to various fields. For example, in the Stock Market field, [5] conducted research to find the relationship between headlines, news sentiment, and stock.

1.2 Overconfidence Bias

Overconfidence is a bias where one overestimates intuition, judgment, and cognitive skills [6]. People tend to overestimate their predictive abilities and the accuracy of the information they possess rather than their actual performance. According to [7], when investors consistently achieve success, they tend to experience overconfidence bias and begin making irrational decisions, which results in market inefficiency.

1.3 Representativeness Bias

Representativeness is a cognitive bias where decisions are made based on mental stereotypes. Representativeness bias leads individuals to rely excessively on stereotypes, resulting in predictions that do not accurately reflect the situation [6].

1.4 Availability Bias

Availability bias is a mental shortcut where people judge likelihood based on how familiar or frequent an outcome seems. [6]. The availability bias is used by individuals in probabilistic situations to avoid risk, but it negatively impacts decision-making [8].

2 Methods

This study analyzes investor sentiment on Social Media X (formerly Twitter) regarding Apple's legal case using Text Blob, Afinn, and Vader sentiment for labeling and the Naïve Bayes Classifier for text classification. The data processing and testing process is divided into several stages, as shown in Figure 1.

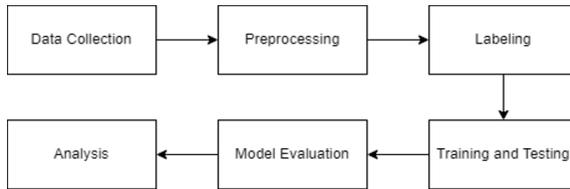


Figure 1 Stage of research

2.1 Data Collection

Data for the study was collected using the Twitter API. The timing of data collection was based on two legal lawsuit cases experienced by Apple: first, related to the Apple Watch lawsuit case on December 26, 2023, data was collected for 7 days post-incident until January 1, 2024, and the second case, related to the lawsuit by the Department of Justice on March 21, 2024, data was collected until March 27, 2024. The total amount of data obtained was 16,955 tweets. The keyword used was “AAPL lang:en”. This keyword was specifically chosen for its relevance to Apple stock investors, ensuring that the data gathered was directly related to investor sentiments regarding these events.

2.2 Data Preprocessing

The tweet data obtained from the data collection process is unstructured, so at this stage, several steps are taken to remove noise and make the data processable. There are four processes at this stage: 1) *Cleaning* is a process to reduce complexity in sentiment analysis; data is cleansed of components that are out of context and unnecessary, such as emoticons, characters, symbols, and URL links. 2) *Tokenizing*: After the data cleaning, each collected tweet is transformed into sentences or tokenized word by word. 3) *Filtering*, also known as stopword removal, deletes frequently occurring words that do not carry meaningful information for analysis. 4) *Lemmatizer* converts words with the same meaning into a single base form by understanding the context of those words.

2.3 Data Labeling

Machine learning requires input for sentiment analysis and to avoid misclassification during the learning process. Labeling is essential for assigning weights to individual words and determining positive, negative, or neutral for the naïve Bayes input. This

process is carried out using three different methods: Text Blob, Afinn, and Vader so that the weight of words from each text can be determined. After the labeling process, the results were 4084 labeled as positive sentiment, 3282 as neutral, and 1148 as negative sentiment.

2.4 Data Training and Testing

Data is divided for training and validation testing at this stage with a 50:50 ratio. Specifically, 50% of the data is used for training and 50% for testing. The total amount of training data is 8,477 from each Apple lawsuit case. After this stage, the Naïve Bayes model could classify 8478 sentiment data into positive, negative, or neutral categories.

2.5 Model Evaluation

After training and testing data using the Naïve Bayes algorithm, a classification report is used to measure the model's performance in classifying data. This report compares the classification results produced by the model with the actual data. The classification report has four parameters, namely: 1) *Accuracy* is a parameter that indicates how accurately the system can classify sentiment. It calculates the total comparison between the number of sentiments correctly classified against the total sentiment data. 2) *Precision* is a parameter that evaluates the correct classification of positive sentiment against those classified as positive. 3) *Recall* is a parameter that assesses the model's ability to identify the number of positive sentiments relative to the actual proportion of positive sentiments. 4) *The F1-score* is a parameter that calculates the average ratio of precision and recall.

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Acc: 0.7633769322235434
Report:
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	precision	recall	f1-score	support
positive	0.61	0.62	0.62	109
negative	0.73	0.72	0.73	319
neutral	0.83	0.83	0.83	413
accuracy			0.76	841
macro avg	0.72	0.73	0.72	841
weighted avg	0.76	0.76	0.76	841

Figure 2 Model evaluation result

3 Result and Discussion

The classification results obtained using the Naïve Bayes algorithm, as shown in the confusion matrix in Figure 2, indicate a total accuracy of 76%, with 6,443 out of 8,478 sentiments correctly classified. The precision, recall, and F1-Score also account for 76% of each. The classification details from the total 8478 data for each case are as follows in Figure 3.

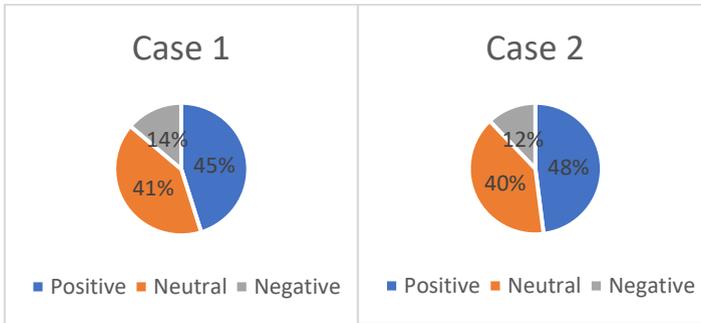


Figure 3 Model evaluation result

Based on the classification result of two legal cases faced by Apple, it was found that positive sentiment is more dominant compared to neutral and negative sentiment, both for the patent infringement case (45% positive, 41% neutral, 14% negative) and the alleged monopoly case (48% positive, 40% neutral, 12% negative). These findings contradict previous research[1], which indicated that patent infringement cases and lawsuits typically create negative perceptions among investors. These findings suggest that despite Apple's involvement in significant legal issues, investors remain optimistic about the company's prospects and stock value.

These findings align with Pompian's (2006) behavioral finance theory [6], highlighting the impact of psychological biases on investor decision-making. Overconfidence bias leads investors to overestimate their ability to assess risks, maintaining positive sentiment toward Apple despite its legal challenges. They believe the company will overcome these issues, reinforcing their optimistic outlook. Representativeness bias also plays a role, where investors rely on Apple's past success to predict future performance, assuming its dominance will persist regardless of legal risks. This tendency can cause them to underestimate potential company stock value threats. Additionally, availability bias influences perception, as investors recall positive narratives about Apple more easily than negatively. Media coverage further amplifies this effect, reinforcing the belief in Apple's resilience.

Understanding these biases is crucial for investors to make more rational decisions. As Pompian (2006) suggests, awareness of cognitive tendencies can help mitigate irrational behavior, encouraging objective risk assessment and portfolio diversification.

4 Conclusion

This study examines investor sentiment regarding Apple's legal issues and its connection to behavioral finance theory. The findings reveal that investor sentiment remains predominantly positive despite Apple's involvement in legal disputes. This suggests that investors view Apple as a strong and stable company, reflecting confidence in its long-term prospects.

The dominance of positive sentiment can be attributed to several psychological biases that influence investor behavior. Overconfidence bias leads investors to believe

they possess sufficient information to assume Apple will overcome legal challenges without significant consequences. Representativeness bias causes investors to rely on Apple's history of success as a basis for expecting continued stability despite ongoing legal uncertainties. Meanwhile, availability bias makes positive narratives about Apple more accessible in investors' minds, reinforcing an optimistic perception while downplaying potential risks.

These findings highlight that investor sentiment remains optimistic despite legal challenges. This suggests that psychological biases play a crucial role in shaping investor decisions. Recognizing these biases can help investors adopt a more rational approach by objectively considering risks. Furthermore, financial analysts and policy-makers can use these insights to develop strategies that encourage balanced and well-informed investment decisions, ensuring better risk management in response to market dynamics.

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