



Article

Can Online Consumer Reviews Identify Key Evidence Regarding Common Consumer Choices for High-Tech Pet Products?

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Abstract: Online consumer reviews (OCRs) significantly influence consumer purchase decisions for new products. Therefore, today's companies actively seek practical approaches for analyzing these OCRs. This study proposes a comprehensive method for OCR analysis using topic modeling and association rule analysis to overcome the current limitations in topic interpretation and topic overlap in text mining. Meanwhile, to examine the development of the high-tech industry and customer interest in the pet care field, this study synthesizes and analyzes reviews from consumers who are using healthcare products in the pet industry. To this end, we first collected 20,820 customer reviews from Amazon.com (accessed on 2 August 2023) for high-tech pet products and categorized them into three distinct product categories. Topic modeling was then conducted on each category, revealing five key topics per category. Subsequently, association rules analysis was performed on the customer reviews associated with the most representative topic. As a result, we were able to demonstrate that 'satisfaction' emerged as the most crucial topic across all three categories of high-tech pet products. Satisfaction is a topic expressing consumers' attitudes after experiencing the product, and they used words to describe their feelings in the product reviews. A diverse range of associated terms was also identified that represented the essence of each product's corresponding representative explanations. By leveraging these approaches, we are confident that pet product companies and market players will gain valuable insights into consumer preferences and behavior.



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Keywords: online consumer reviews; topic modeling; association rules; data mining

1. Introduction

In recent years, the rise of digital transformation in business operations has presented new challenges for managing systems [1–4]. This transformation, driven by the integration of big data analysis, social media networks, and artificial intelligence has revolutionized business practices [5]. Companies equipped with big data analytic capabilities have thus witnessed enhanced performance and results [6]. The COVID-19 pandemic also accelerated the importance of online shopping, with customers preferring its safety and convenience, flexibility, and cost effectiveness over shopping in physical stores.

E-commerce platforms like Amazon.com actively encourage customers to share their experiences and opinions using online reviews, providing additional valuable insights into product functionality, utility, and consumer perceptions [7]. Text mining techniques have also gained popularity for analyzing product reviews in different service industries, such as hotels [8], airlines [9], and restaurants [10]. Analyzing product reviews has proven to be beneficial for numerous applications, including product advertising, purchase decision making, customer satisfaction analysis, and personalized product recommendations [11–16]. Online consumer reviews (OCRs) have also become indispensable tools for navigating purchasing decisions and establishing greater trustworthiness and credibility for products,

services, and businesses. Positive reviews can also enhance a business's general reputation and boost consumer confidence.

In order to summarize the vast number of available reviews effectively, it is crucial to develop comprehensive methods and consider the significant impact of OCRs on online marketing. While the existing approaches focus on extracting various elements, such as feature vectors, latent representations, user preferences, and sentiment content from reviews, they often fall short of providing a holistic summary. Topic classification has emerged as a necessity in real-life scenarios, as it enables faster and more accurate reading, comprehension, selection, and retrieval of information. Topic modeling, particularly the Latent Dirichlet Allocation (LDA) algorithm, has proven to be effective in mining consumer review data [17–19]. Particularly, understanding the common and distinctive topics associated with specific products allows for a more detailed comparison and evaluation of customer perceptions towards those products.

Further still, by exploring the associated terms within individual topics, we can identify the specific terms that customers frequently use together in OCRs related to particular products. To address this issue, association rule mining discovers interesting relationships and correlation patterns in large datasets and found significant application in market analysis and the understanding of customer shopping behavior [20]. In this study, we conducted an association rule analysis and focused on the main topics associated with specific products to uncover customers' primary concerns that are often hidden within their product evaluations.

High-tech pet products are pet-related products and accessories that integrate advanced technology and innovative features that are designed to improve hygiene and interactions between pets and their owners. These products use modern technology, including electronic sensor connectivity and smart features, to provide various positive benefits to your pets and their companions. Today's popular high-tech pet products include smart pet feeders, pet activity trackers, interactive pet toys, and much more. This high-tech industry plays a vital role in improving the different aspects of modern society by enriching the lives of people and their animals, as well as supporting local economies. Indeed, the trend of pet ownership and spending is widespread globally, so the pet industry today makes a significant contribution to the economy, including pet food and product manufacturing, veterinary services, pet retail, and more.

Advances in pet-related technology and products also improve the lives of both pets and their owners, enhancing the quality of care and the overall experience of pet ownership. The pet care market has witnessed substantial growth and is a promising e-commerce category in the consumer packaged goods industry [20]. However, market analysis of pet-related products and services remains an underrepresented area of research. We chose to study this market, especially its customer segments, by combining two research methods to achieve detailed attention in this research field and contribute to further assessment of the high-tech pet product market segment that is growing successfully today.

After the COVID-19 pandemic, online shopping has become more popular than ever, and pet product purchases now happen both online and in physical stores. That choice often depends on convenience, product availability, and the desire to test or sample a product. Therefore, consumer purchasing behavior now commonly relies on reviews and recommendations from other pet owners or experts when making their purchase decisions. Positive reviews and word of mouth can strongly influence that choice. Reputable reviewers on diverse online review sites can enhance consumer attraction to similar products via such product reviews [21].

This study focuses on proposing the combined use of topic modeling techniques and association rules for OCR analysis of high-tech pet products that are sold on Amazon.com. This new approach for discovering popular topics, important keywords, and their relationships will be beneficial in the future when analyzing consumer preferences and behavior based on product feature evaluations. Two research questions (RQ) are thus offered to address the above research goals as follows:

RQ1. *Do common topics exist in OCRs for high-tech pet products?*

RQ2. *What are the associated terms that distinguish each main topic in the OCRs of high-tech pet products?*

The study is organized as follows. Section 2 reviews the existing literature on analytics using topic modeling and association rules. Section 3 presents the research methods proposed for this study and describes the experimental process. Section 4 discusses the experimental results, and Section 5 concludes the study with a summary, the implications of the study, and its limitations.

2. Literature Review

Analyzing OCRs using various data mining techniques is an active area of research. Recent studies have explored different services, such as online business, digital banking, restaurant service quality, and airline customer satisfaction. The importance of these studies is the potential benefits that will arise from understanding and identifying the factors that govern these online reviews, thereby ultimately suggesting new and more appropriate solutions for improving these services.

Online customer reviews are written or visual comments by customers about products, services, or businesses to rate products purchased on various online platforms and websites. One of the previous studies on OCR by Lee and Choeh (2020) researched eWOM (electronic word-of-mouth). Their study compared the prediction power of business intelligence methods for different subsamples of products created according to high or low reviews and reviewer helpfulness levels. That study contributes to the sampling or pre-processing strategy used to predict product sales using eWOM [22]. Another study by Anastasiei et al. (2023) focused on the influence of network centrality and network density on the propensity to engage in positive and negative eWOM, using social media usage as a moderating variable. Their research demonstrates that companies should make continuous efforts to detect and correct negative online publicity that affects product reputation and sales [23]. Zelenka et al. (2021) further proposed a trust model for online reviews of travel services and destination reviews [24]. This study revealed how review verification can be improved to increase trust in review sites.

In previous studies that used topic modeling techniques, Zibarzani et al. (2022) developed a hybrid approach by combining clustering, supervised learning, and topic modeling techniques [25]. Their research focused on exploring consumer satisfaction and service preferences for restaurants during the COVID-19 crisis. Additionally, the authors investigated the moderate impact of COVID-19 safety precautions on restaurant quality and satisfaction. Another study by Xie et al. (2022) aimed at developing online shopping channels for fresh agricultural products and employed the LDA model to identify the factors that influence consumers' preferences when purchasing these products online [26]. Hong and Wang (2021) proposed a novel framework that synthesized customer opinions from product reviews [27]. They integrated grammar rules, the LDA model, and deep neural networks to demonstrate the effectiveness of the framework for generating personalized summaries by allowing users to select product attributes of interest and then focus on the most interesting comments. Another case study using topic modeling and sentiment analysis of online reviews for airlines was conducted by Kwon et al. (2021) [28]. It found important words in online reviews about prominent in-flight issues via frequency analysis.

Still, another study focused on the airline industry and presented a novel framework for measuring customer satisfaction [29]. By using text mining methods to explore OCRs, the study provided guidelines airline companies could use to improve their competitiveness. The practical implications of the research highlighted the importance of focusing on customer service for first-class passengers, comfort for premium economy passengers, and efficient handling of luggage and wait time for economy-class travelers. Zhang et al. (2022) proposed a customer requirements identification framework that utilized topic modeling, specifically the LDA method, to extract the key product attributes that customers are

most interested in having from online reviews. The framework considered three types of emotions: positive, negative, and neutral [30]. Majumder et al. (2022) conducted another study that analyzes reviews from Amazon.com for three products: video games, digital music, and groceries [31]. Their text mining analysis uncovered sentiment polarization, identified sentiment patterns, and examined the perceived usefulness of reviews, even under censorship.

In previous studies, the association rules technique has been applied across different fields. Liao and Chang (2016) developed a recommendation system that utilized a data mining approach and preliminary set-based association rules to analyze Internet customers' preferences [32]. By understanding customer preferences, Internet businesses can provide appropriate electronic catalogs, increase the attractiveness of their product categories, and promote direct sales and marketing via user recommendation systems. Kim and Kang (2019) analyzed online car reviews of three competitive automobile brands by using text mining and association rules methods to assess the advantages and disadvantages of each vehicle [33]. Another study by Chiang (2011) proposed an improved model and procedure to exploit the association rules of customer values in the online shopping industry in Taiwan [34]. Dogan (2023) introduced a novel method called profit-supported association rule mining that used Fuzzy Theory (P-FARM), which not only recommends frequent items but also takes a company's profit into account whenever making product suggestions. This method lets companies make better decisions by providing them with more profitable products and fewer rules [35]. Using the a priori algorithm, Yıldız et al. (2023) developed a systematic approach for creating hyper-personalized product recommendations for customers in the fashion retail industry [36].

Cheng and Shannayne (2020) employed both topic modeling and association rules techniques to analyze digital banking application reviews [37]. Their study utilized topic modeling, specifically LDA, to uncover customer interests and exploit customer concerns related to digital banking features by considering rating scores based on association rules. The results revealed the areas where digital banking applications could further optimize customer satisfaction and retention.

Compared to that related work, this study focuses on examining and analyzing OCRs specifically for high-tech pet products on Amazon.com. We compared and analyzed OCRs of high-tech pet products to identify consumer concerns and derive meaningful associated terms and relationships between these topics of interest. Our study sought to provide insights into the unique aspects of high-tech pet products and their consumer reviews that can contribute to the overall existing knowledge.

Table 1 below provides a summary of the previous research in OCRs analytics.

Table 1. Comparison of the present study to other research efforts.

Reference	Purpose	Technique
Lee and Choeh (2020) [22]	This study compared the prediction power of business intelligence methods for different subsamples of products created based on high or low reviews and reviewer helpfulness levels.	-
Anastasiei et al., (2023) [23]	This article notes the influence of network centrality and network density on the propensity to engage in positive and negative eWOM, using social media use as a moderating variable.	-
Zelenka et al., (2021) [24]	This paper proposed a trust model for online reviews of travel services and destination reviews.	-
Zibarzani et al., [25]	This effort explores consumer satisfaction and service preferences in restaurants during the COVID-19 crisis, using clustering, supervised learning, and topic modeling techniques.	LDA

Table 1. Cont.

Reference	Purpose	Technique
Xie et al., (2022) [26]	This study utilizes the LDA model to indicate the factors that influence consumers' preferences when purchasing fresh agricultural products online.	LDA
Hong and Wang (2021) [27]	This article proposes a novel framework that combines grammar rules, the LDA model, and the deep neural network to synthesize customer opinions from product reviews.	LDA
Kwon et al., (2021) [28]	This research conducted topic modeling and sentiment analysis on Skytrax (airlinequality.com, accessed on 2 August 2023) posts, where there is a lot of interest and engagement from people who have used or are willing to use that knowledge for airlines.	Topic modeling
Lucini et al., (2020) [29]	This study presents a novel framework for measuring customer satisfaction in the airline industry using text-mining methods.	Text mining
Zhang et al., (2022) [30]	This paper proposes a customer requirements identification framework using topic modeling, specifically the LDA model.	LDA
Majumder et al., (2022) [31]	This paper argues that peripheral sources, such as review content, the star rating, and the length of the review, can significantly impact product search.	Text mining
Liao and Chang (2016) [32]	This study develops a recommendation system to analyze Internet customers' preferences by using a data mining approach and preliminary set-based association rules.	Association rules
Kim and Kang (2019) [33]	This article analyzes online car reviews of three different competitive automobile brands using text mining and association rules methods.	Text mining, association rules
Chiang (2011) [34]	This paper proposes a new procedure and an improved model to better leverage the association rules of customer values in the online shopping industry in Taiwan.	Association rules
Dogan (2023) [35]	This study introduces a novel method called P-FARM, which helps companies make better decisions by providing them with more profitable products with fewer rules.	Association rules
Yıldız et al., (2023) [36]	This study presents a customer segmentation model and an association rule mining algorithm to generate highly personalized product recommendations for individual customers.	Association rules
Cheng and Shannayne (2020) [37]	This study performs topic modeling, using LDA to uncover customer interests and explore customer concerns regarding digital banking features, using association rules and rating scores.	LDA, Association rules
This study	We compare and analyze OCRs of high-tech pet products to identify consumer concerns and derive meaningful associated terms for these topics of interest.	LDA, Association rules

3. The Experiments

3.1. Research Framework

Based on the previous research [38,39] and our knowledge, we proposed the research framework of this study as shown in Figure 1. We first identified the top five most popular high-tech pet products being purchased on Amazon.com and collected the OCRs for these products from 2018 to 2022. The OCRs were categorized into three distinct product categories. Next, topic modeling was conducted for each category, resulting in the identification of five key topics within each category. Subsequently, association rules

analysis was performed on the customer reviews associated with the most representative topic found in each category.

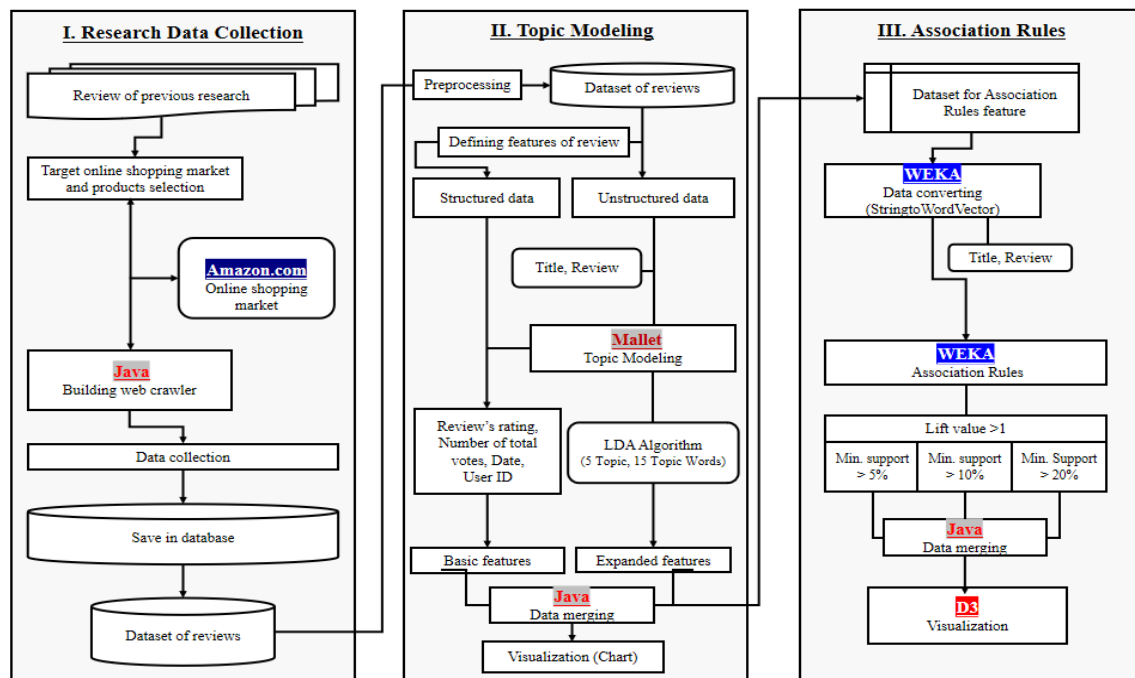


Figure 1. Research framework of the study process.

3.2. Data Collection

Amazon.com provides information on the best-selling products in each produce category. We thus obtained information about the top five best-selling high-tech pet products from Amazon.com. That summarized product information is presented in Table 2.

Table 2. High-tech pet products information.

No.	Product	Rating * (Reviews **)	Image	Main Features
1	Furbo dog camera	32,708 (9715)		• 1080p Full HD camera with a livestream feature for monitoring pets using a smartphone, day and night. • Sends notifications to the smartphone when the pet is barking. • Treat tossing with pets' favorite treats and playing a game of catch.
2	Petlibro automatic pet feeder	15,260 (4068)		• Food dispenser with remote app control. • Precise portion control for a healthy pet life, allowing programming of feeding schedules. • Records voice messages to remind about mealtime.
3	Sure pet care microchip pet feeder	9772 (4978)		• Identification of each pet using an ID Microchip to prevent food stealing and reduce stress during mealtimes in multi-pet homes. • Control of portions to help manage weight.

Table 2. Cont.

No.	Product	Rating * (Reviews **)	Image	Main Features
4	Wopet automatic pet feeder	5687 (1595)		- Schedules automated feeding using the built-in programmable timer. - Controls the portion size for each feeding. - Records a custom message.
5	Wickedbone automatic pet toy	1742 (464)		- Auto-play mode to attract the pet's attention, featuring 12 types of emotionally driven systems. - Driving mode via the Wickedbone app available for iOS and Android, allowing movement control via a virtual joystick.

* Total number of star ratings ranged from one to five stars. ** Total number of reviews gathered.

As shown in Part I of Figure 1, we developed a web crawler using Java, using Eclipse as the integrated development environment (IDE) to collect the OCRs. It is worth noting that Amazon.com imposes a limit of 5000 reviews per product for a single request. Therefore, for products with OCRs exceeding this limit, we employed a multi-collection approach by gathering reviews multiple times based on the product's rating. This technique allowed us to collect all the OCRs that were available.

Of the five products that we collected data on, three belonged to the same product type, the automatic pet feeder. Therefore, we grouped these three products together into an 'automatic pet feeder' category for further analysis.

We classified the high-tech pet products into three categories and conducted topic modeling analysis on the OCRs within each category. We analyzed the OCRs written in English; thus, any OCRs written in languages other than English were excluded during the pre-processing step, as shown below in Table 3.

Table 3. Results of removing data in other languages.

No.	Product	Before Removing Data	After Removing Data
1	Furbo dog camera	9715 reviews	6998 reviews
2	Petlibro automatic pet feeder	4068 reviews	3449 reviews
3	Sure pet care microchip pet feeder	4978 reviews	1771 reviews
4	Wopet automatic pet feeder	1595 reviews	1593 reviews
5	Wickedbone automatic pet toy	464 reviews	457 reviews

3.3. Topic Modeling

Topic modeling is a method used for unsupervised document classification. It enables the grouping of digital data to identify natural topics when the specific focus is unclear [40] by analyzing 'bags' or collections of words altogether, rather than individual word counts, and capturing the contextual dependence of word meanings in natural language. This approach aids in self-organization, understanding, search, and summarization of large electronic repositories. One widely used technique for topic modeling is LDA. We applied the LDA algorithm in this study to conduct the topic modeling analysis on the collected OCRs of high-tech pet products.

LDA or Latent Dirichlet Allocation is a popular topic modeling technique that extracts topics from a given corpus. The term 'latent' implies that something exists, but is not yet fully developed, thereby suggesting hidden or concealed aspects. The desired topics we aimed to extract from these data are also considered 'latent topics' that are yet to be

discovered. LDA assumes that each document in the collection is a mixture of various topics, and each topic is represented by a distribution of words. The input provided to LDA is a collection of documents represented as bags of words (word frequency counts) or vectors of word probabilities. LDA generates two main outputs:

- Document–Topic Matrix: Each document is represented as a distribution over several topics, indicating the relative importance (RI) of each topic within the document.
- Topic–Word Matrix: Each topic is represented as a distribution over its words, indicating the likelihood of each word occurring in the topic.

LDA is a powerful technique for unsupervised topic discovery, as it can handle large document collections, capture the distributional semantics of words, and provide interpretable results. As shown in Part II of Figure 1, prior to the analysis conducted in this study, several pre-processing steps were performed to collect the data for subsequent analysis. Then, the review features, including rating, votes, date, and user ID, were defined to categorize structured data. Additionally, unstructured data from the reviews, such as titles and review texts, were considered. For this study, we utilized Mallet (<https://mimno.github.io/Mallet>, accessed on 2 August 2023), a natural language processing tool used for tasks such as document classification, clustering, topic modeling, and information extraction. Mallet is a statistical machine learning application. We defined a topic range of five, so as to identify the main topics within the consumer evaluations of high-tech pet products. Each topic was represented by 15 keywords.

The results of the LDA analysis displayed five consumer evaluation topics for each category of high-tech pet products. These topics represented the major themes or categories that emerged from the review analysis. Java was used to implement a data merging parser that assigned topics to the evaluation data and aggregated the results. By utilizing this method, we aimed to uncover and categorize the opinions and emotions expressed by consumers in their reviews of high-tech pet products.

3.4. Association Rules Algorithm

The association rules algorithm plays a vital role in drawing meaningful conclusions for business problems by calculating the number of associated terms within the dataset [41]. The algorithm considers key indicators, such as support, confidence, and lift. The support value represents the ratio of transactions that contain a specific product or combination of products to the total number of transactions. For example, of 100 customers, if 50 buy product A, 50 buy product B, and 25 buy both products A and B, the support for the combination of product A and B would be 25%. Confidence, on the other hand, represents the conditional probability of a customer who buys product A also buying product B. It is calculated as the probability of the rule occurring in a new transaction that contains the products on the left side of the rule. For instance, if 25 out of the 50 customers who bought product A also bought product B, then the confidence for the rule (product A, product B) would be 50%. Lift, the third value, indicates the increased likelihood of a customer buying product B if that customer has already purchased product A. Meaningful conclusions are typically drawn by filtering out the rules with a lift greater than 1.

The current study focuses on combining the topic modeling algorithm with the association rules. Association rules aim to uncover the unique and unexplored rules that derive from pre-defined topics. The process involves identifying associated terms within product review topics and establishing connections by discovering common terms among the different elements. As shown in Part III in Figure 1, Weka version 3.8 (<https://www.cs.waikato.ac.nz/ml/weka/>, accessed on 2 August 2023), an open-source data mining tool, was utilized to analyze the association rules between keywords and topics as identified by the LDA algorithm. Weka has a comprehensive set of tools and algorithms for data analysis and mining. We converted string data (including review titles and content) into word vectors. Specific parameters were then set for the association rules algorithm, such as support values at 5%, 10%, and 20%, which determined the minimum occurrence frequency necessary for a rule to be considered significant. Additionally, the lift value was set to be

greater than 1, indicating a positive rule correlation. The resulting rules were then combined and organized for further analysis or presentation.

To visualize the merged results, D3, data-driven documents, was employed. D3 enables the creation of dynamic and interactive visualizations, effectively communicating the discovered association rules. By employing this approach, this study aims to apply the association rules algorithm to unveil meaningful relationships between associated terms and the topics related to high-tech pet products. These results can then be further analyzed and interpreted and contribute to a better understanding of the discovered associations.

4. Experiment Results

4.1. Results of Topic Modeling

Table 4 presents the detailed results for the first category, specifically the Furbo dog camera product, using the LDA model with five topics, each consisting of 15 keywords. In general, there are various ways to determine the optimal number of topics and keywords, but in this study, the number of topics and keywords were set in a heuristic way to facilitate the clearest interpretation of the results.

Table 4. Topic model results for the Furbo dog camera product.

No.	RI	Keywords	Topic
1	0.62289	love, great, furbo, dog, product, dogs, treats, check, easy, fun, home, loves, camera, awesome, day	satisfaction
2	0.2462	furbo, work, customer, product, service, connect, working, app, WIFI, time, support, worked, issues, back, device	service
3	0.16537	dog, furbo, barking, home, alerts, day, dogs, anxiety, check, house, alert, time, mind, person, camera	barking alerts
4	0.3104	treats, treat, camera, dog, good, time, quality, great, app, works, it's, video, furbo, sound, work	treatment quality
5	0.10501	camera, features, subscription, pay, nanny, free, dog, it's, product, money, worth, furbo, buy, price, premium	worth

Among these topics, Topic 1 exhibited the highest RI at 0.62289. RI refers to the relative proportion of the topic among all the documents reviewed. It represents a value between 0 and 1 and indicates the RI of the topic. This value signifies the significance of the topic, with higher values indicating that the topic is more important within its document set. The keywords associated with Topic 1 included 'love', 'great', 'easy', 'fun', and 'awesome'. These words express the positive emotions of consumers, leading us to label this topic as 'satisfaction'. In this paper, we determine the topic's name based on the meanings of the keywords. Thus, we identified the meanings of the keywords according to the different products' main features as expressed in objective or subjective terms in the OCRs. We also chose proper topic names that captured the essence of each keyword. These topic names represent the dominant concern of customers for that product. Following that focus, Topic 4 named 'treatment quality' achieved a RI of 0.3104, with keywords such as 'treat', 'camera', 'quality', 'works', 'video', and 'sound'. Topic 2, representing 'service', attained a RI of 0.2462, featuring words like 'work', 'customer', 'product', 'service', 'connect', 'working', 'app', 'WIFI', 'time', and 'support'. The remaining topics were labeled as 'barking alerts' and 'worth'.

Figure 2 shows the frequency of appearance of each topic from year 2018 to 2022. Notably, Topic 1 exhibited fluctuations from Q1-2018 to Q2-2019. Starting from Q3-2019, there was an upward trend in the number of consumer reviews related to Topic 1, reaching its peak in Q1-2020. However, there was a significant decline thereafter, reaching its lowest

point in Q2-2020. This decline could be indicative of a decrease in consumers' purchasing power during the later period, spanning Q2-2020 to Q4-2022.

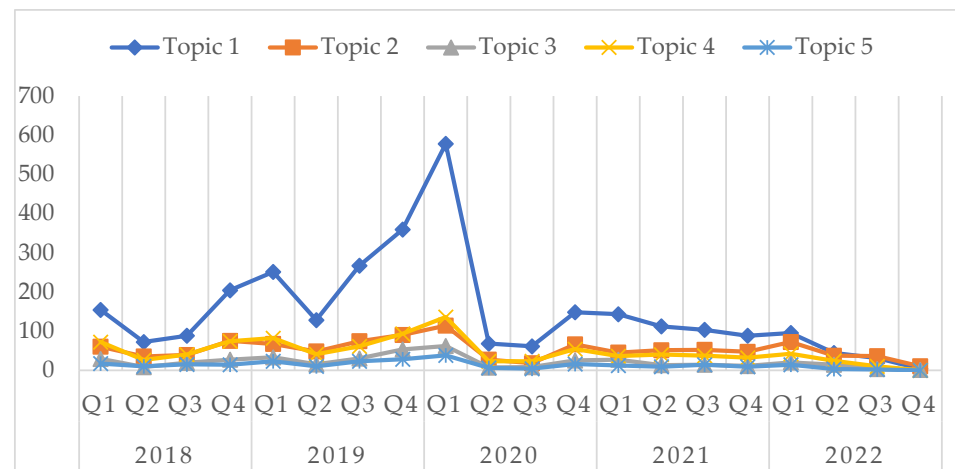


Figure 2. Number of OCRs for the Furbo dog camera product for 5 topics.

All the topics identified in the analysis pertained to the Furbo dog camera product and covered various aspects such as 'satisfaction', 'service', 'barking alerts', 'treatment quality', and 'worth'. Each topic represented a different perspective or aspect of that product. For instance, when consumers discuss the topic of 'satisfaction', the keywords associated with that topic are likely to include words like 'love', 'great', and 'awesome'. Similarly, when referring to the topic of 'service', keywords such as 'customer', 'support', and 'issues' are likely to appear. The different topics thus offer key insights into different aspects of the product as it is perceived by consumers.

In the second category, automatic pet feeder, we combined the reviews of three products, namely the Petlibro automatic pet feeder, the Sure pet care microchip pet feeder, and the Wopet automatic pet feeder, using the LDA model. The results are shown in Table 5. Topic 5, 'satisfaction', received the highest RI score of 0.63703. The keywords associated with this topic included 'great', 'feeder', 'easy', 'product', 'love', 'works', 'set', 'feed', 'feeding', 'recommend', and others. These words reflect the positive sentiments expressed by those consumers who have used automatic pet feeder products. It is evident that most of these consumers have had a positive experience based on their evaluation of these products. Topic 3, which relates to the working mode, achieved an RI of 0.27944, while Topic 2, which focused on training, achieved an RI of 0.26576. On the other hand, Topics 4 and 1 had relatively lower accuracies within this particular category.

Table 5. Topic model results for the automatic pet feeder product.

No.	RI	Keywords	Topic
1	0.12097	food, lid, feeder, cat, bowl, top, cats, open, design, plastic, tray, stainless, steel, easily, good	design
2	0.26576	cat, food, cats, feeder, eat, eating, bowl, open, training, back, it's, microchip, problem, works, fat	training
3	0.27944	food, portion, time, it's, set, size, feeder, easy, works, great, portions, good, small, feeding, batteries	working mode
4	0.15129	feeder, product, working, customer, work, months, service, stopped, worked, company, app, WIFI, great, year, unit	service
5	0.63703	cat, great, feeder, easy, food, product, love, works, sets, cats, time, day, feed, feeding, recommends	satisfaction

Figure 3 provides a detailed overview of the occurrence of the topics over a four-year period. In this category, a notable prominence was observed from Q3-2020 to Q2-2021, during which the number of consumer reviews related to Topic 5 was the highest. This finding indicates that customers bought and wrote more reviews during this specific period. Except for Topic 5, similar trends were observed for other topics as well, further indicating increased consumer engagement and feedback during that time period.

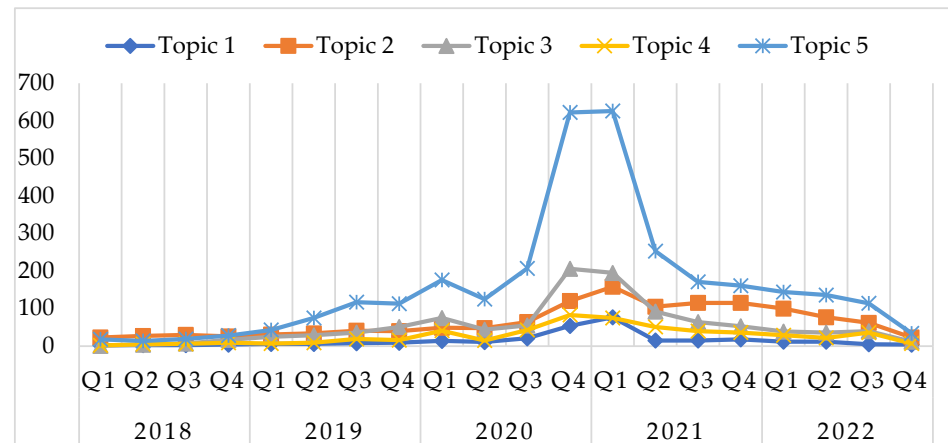


Figure 3. Number of OCRs for automatic pet feeder product for 5 topics.

Thus, all the identified topics in this analysis represented automatic pet feeder products and encompassed their aspects, such as ‘design’, ‘training’, ‘working mode’, ‘service’, and ‘satisfaction’. The period from Q3-2020 to Q2-2021 appeared to be the focal point, with the highest concentration of consumer purchases and feedback appearing within this category.

Table 6 presents the results of the topic modeling analysis for the third category, which focused on the Wickedbone automatic pet toy product. Among its topics, Topic 2 stood out with the highest RI score of 1.34427. This topic was associated with positive keywords, such as ‘fun’, ‘great’, ‘loves’, and ‘good’. The dominance of positive reviews indicates they were more prevalent than negative reviews, indeed a positive sign for online shopping. However, it is also worth noting that Wickedbone was the only product that elicited the topic of ‘dissatisfaction’, as represented by the keywords of ‘money’, ‘waste’, ‘don’t’, and ‘buy’. This topic received a relatively high RI score of 0.47437, suggesting that there were some negative reviews associated with the category.

Table 6. Topic model results for Wickedbone automatic pet toy product.

No.	RI	Keywords	Topic
1	0.09097	carpet, hardwood, varram, fast, floors, collie, border, gobone, leaving, years, rug, devices, rate, things, wheels	usage
2	1.34427	dog, toy, dogs, bone, play, fun, great, loves, mode, good, interactive, it's, time, thing, puppy	satisfaction
3	0.13793	port, plastic, charging, ends, reviews, tiny, didn't, instructions, directions, tires, modes, point, cover, figured, plug	instruction
4	0.47437	it's, product, money, waste, work, don't, minutes, I'm, didn't, doesn't, dog, day, buy, bought, company	dissatisfaction
5	0.30542	app, phone, bone, work, connect, toy, give, device, Bluetooth, connection, price, charge, charged, item, requires	connectivity

Figure 4 depicts the temporal distribution of topic occurrences. Notably, Topic 2, which pertains to ‘satisfaction’, demonstrated substantial fluctuations, with its peak observed in Q1-2022. Conversely, Topic 4, associated with ‘dissatisfaction’, and Topic 5, related to ‘connectivity’, exhibited alternating dominance throughout the different stages. Topic 1, focusing on ‘usage’, and Topic 3, addressing ‘instructions’, showed relatively less variability in comparison.

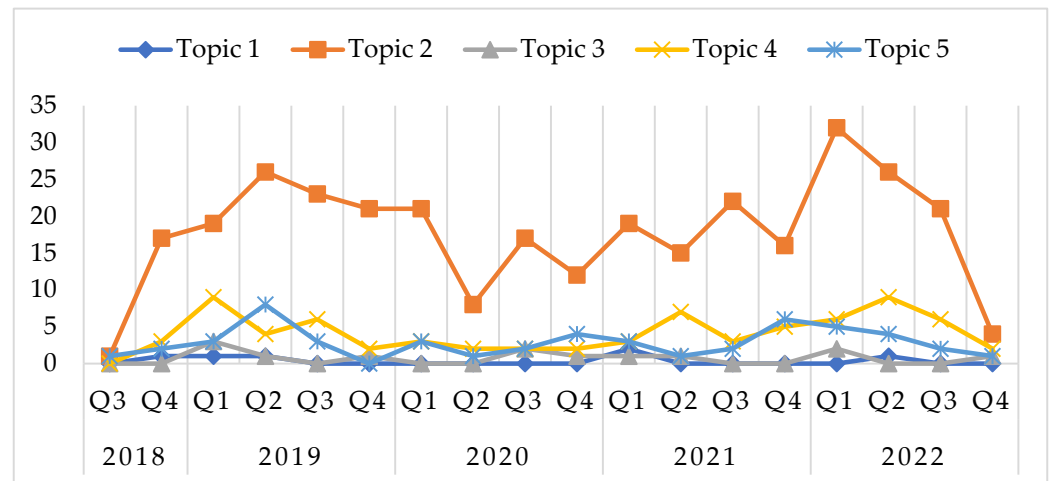


Figure 4. Number of OCRs for Wickedbone automatic pet toy product for 5 topics.

Therefore, the evaluation of the Wickedbone automatic pet toy revolved around topics related to ‘usage’, ‘satisfaction’, ‘instruction’, ‘dissatisfaction’, and ‘connectivity’. It is also important to note that the number of assessments was relatively consistent across different periods.

In response to RQ1, the outcome of this study indicated that customers show a strong interest in satisfaction for the three categories related to high-tech pet products available on Amazon.com. It is evident that customers highly value quality products with high ratings, leading to their satisfaction and increased likelihood of purchase. By analyzing the topic modeling, we determined the identified topics that reflected customers’ interests and preferences when shopping for and reviewing these particular products.

4.2. Results of Applying Key Association Rules

Two aspects were seen as enhancing the quality and relevance of the analysis of association rules. The first aspect involved controlling the support value, thereby ensuring that the association rules analyzed were based on their complete occurrence in the dataset. Therefore, the analysis focused on identifying statistically and practically meaningful associations in consumer behavior. The second aspect involved fixing the support value and then controlling the top number of association rules. This approach allowed for a comparison of different association rules based on consistent criteria. Regardless of their frequencies of occurrence, this method facilitated the identification of the most relevant and significant associations within the dataset. It also provided a means to prioritize and compare rules effectively, thereby ensuring consistent evaluation and interpretation of the gathered findings.

First, an association rules analysis was conducted for Topic 1, which is associated with satisfaction and represents the largest proportion among the five topics identified in the Furbo dog camera. Table 7 shows that higher support values tend to yield fewer rules. For instance, at a support value of 5%, a total of 376 rules were found, while at a 10% support value, there were 50 rules, and at a 20% support value, only six rules were identified. When examining the 5% support value, the associated terms of ‘easy’ and ‘set’ exhibited a lift value of 5.69. This value implies that when the keyword ‘easy’ appears, the likelihood of ‘set’ appearing has a positive correlation value of 5.69 and vice versa. Since most of the

associated terms found in OCRs do occur together, the lift value remains the same in the opposite instance.

Table 7. Furbo dog camera and its different support values.

(a) Support Value = 0.05			
No.	Source	Target	Value
1	easy	set	5.69
2	set	easy	5.69
3	tossing	treat	2.41
4	treat	tossing	2.41
5	give	treat	2.09
6	treat	give	2.09
7	day	dog&treat	1.74
...	...	...	...
374	product	dog	1.03
375	love	dog&work	1.02
376	dog&work	love	1.02
(b) Support value = 0.1			
No.	Source	Target	Value
1	gog&furbo	treat	1.57
2	treat	dog&furbo	1.57
3	furbo	love&treat	1.48
4	love&treat	furbo	1.48
5	great	product	1.48
6	product	great	1.48
7	furbo&love	treat	1.47
...	...	...	...
48	work	dog	1.04
49	furbo	great	1.03
50	great	furbo	1.03
(c) Support value = 0.2			
No.	Source	Target	Value
1	dog	treat	1.34
2	treat	dog	1.34
3	love	treat	1.16
4	treat	love	1.16
5	dog	love	1.14
6	love	dog	1.14

In this section, all visualization was conducted by using D3. Figure 5 shows that with a 10% support value, the keywords 'dog', 'furbo', and 'treat' serve as central nodes and are linked to other words. Additionally, 'love' and 'great' also appear relatively frequently. At a 20% support value, a trio of keywords, namely 'treat', 'dog', and 'love', form an interconnected circle, indicating that in 20% of the most popular reviews, these

three keywords appear concurrently. This result suggests that consumers are particularly interested in this product's potential for treating dogs.

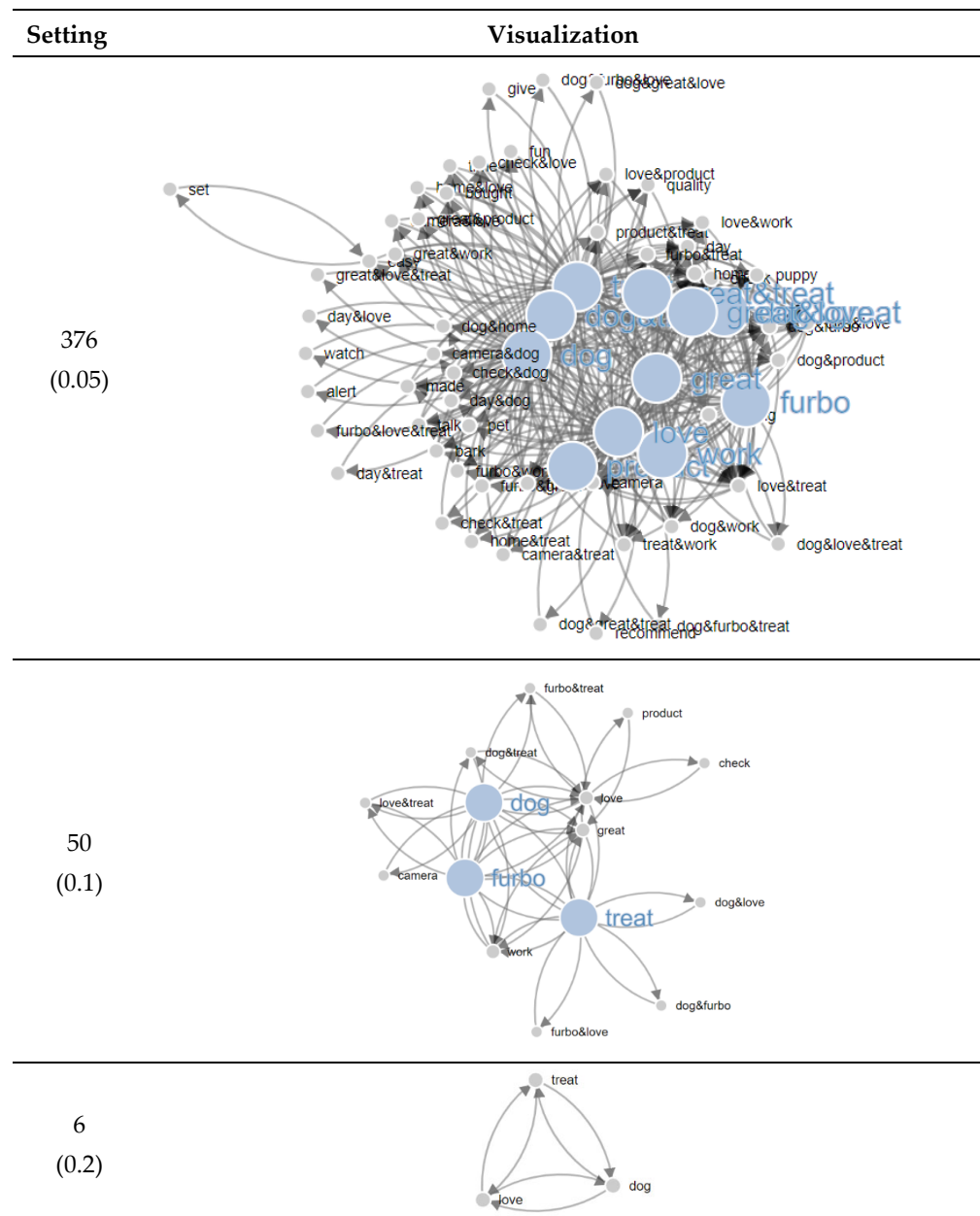


Figure 5. The Furbo dog camera visualized for its different support values.

Figure 6 provides a detailed overview of keywords with a support value of 10% for the Furbo camera product. For example, the top 10 keyword sets include 'great $\leftrightarrow$ product', 'dog & treat $\leftrightarrow$ furbo $\leftrightarrow$ love & treat', and 'dog & furbo $\leftrightarrow$ treat $\leftrightarrow$ furbo & love'. This analysis indicates that these sets of keywords will frequently appear together in 10% of consumer reviews.

In summary, for the representative topic in the first category, the analysis reveals that at a support value of 5%, a total of 376 rules were found, while at 10% and 20%, support values of 50 and 6 rules appeared, respectively. Notably, in 20% of the consumer reviews for the Furbo dog camera, the keywords 'treat $\leftrightarrow$ dog $\leftrightarrow$ love' consistently appear in a repeating rule circle, highlighting their strong association and indicating customer satisfaction with the product's therapeutic properties for dogs.

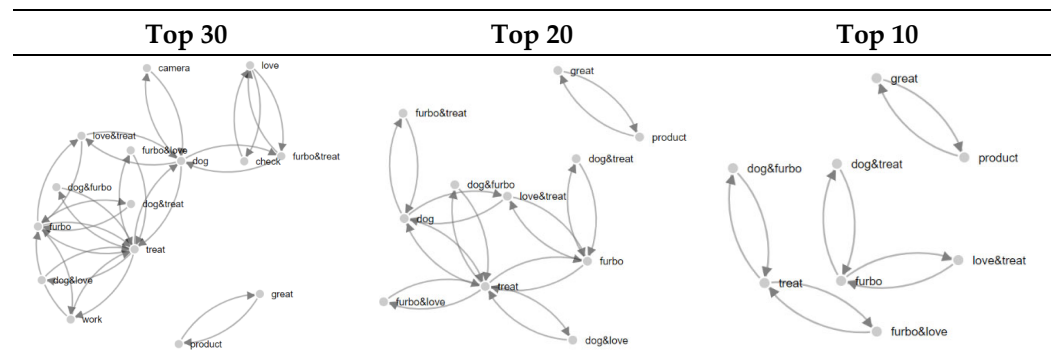


Figure 6. Details of the Furbo dog camera visualized for 10% support value.

Second, the association rules analysis was conducted for Topic 5, which represents satisfaction and offered the largest proportion of the five topics identified for the Automatic pet feeder. Table 8 provides insights into these associations at different support values. At a support value of 5%, there is a lift value of 3.33 between the keywords 'food & portion' and 'cat & size', indicating a higher likelihood of these keywords appearing together in consumer reviews. As the support value increases to 10%, a lift value of 2.84 is observed between the keywords 'feeder & portion' and 'size', indicating a stronger association between these terms. These findings highlight the significant interest of consumers in the pet diet features of this particular product.

Table 8. Automatic pet feeder and its different support values.

(a) Support Values = 0.05			
No.	Source	Target	Value
1	food&portion	cat&size	3.33
2	cat&size	food&portion	3.33
3	feeder&portion	size&time	3.27
4	size&time	feeder&portion	3.27
5	feeder&portion	cat&size	3.23
6	cat&size	feeder&portion	3.23
7	easier&portion	feeder&size	3.09
...	...	...	...
3634	easier&set	cat&food	1
3635	day	easier	1
3636	easier	day	1
(b) Support value = 0.1			
No.	Source	Target	Value
1	feeder&portion	size	2.84
2	size	feeder&portion	2.84
3	portion	size	2.77
4	size	portion	2.77
5	portion	feeder&size	2.77
6	feeder&size	portion	2.77
7	eat	cat&food	1.9
...	...	...	...
474	cat	work	1.01

Table 8. Cont.

475	cat&feeder	product	1
476	product	cat&feeder	1
(c) Support value = 0.2			
No.	Source	Target	Value
1	food	time	1.29
2	time	food	1.29
3	feeder&food	cat	1.28
4	cat	feeder&food	1.28
5	cat&feeder	food	1.27
6	food	cat&feeder	1.27
7	feeder	time	1.26
...	...	...	...
32	cat	easier	1.02
33	work	cat	1.01
34	cat	work	1.01

The visualization shown in Figure 7 demonstrates the associations between the terms for each support value. As the support value decreases, the number of rules increases. At a support value of 20%, a substantial portion of the reviews revolves around the 'cat', 'food', and 'feeder' nodes, indicating their prominence in the dataset. A large number of reviews accounted for by this 20% support value prioritized for further exploration and more detailing.

Figure 8 offers a detailed view of the associations when the support value is 20%. The top 10 associations revealed noteworthy links, such as the association between 'work' and 'great', indicating consumers' satisfaction with this product. Additionally, there was a notable interest seen in the relationship between 'time' and 'feeder', as well as between 'time' and 'food'. These findings reaffirm the significance of the meal scheduling feature and the ability to set feeding times in the eyes of consumers.

In summary, the analysis results for the representative topic in the second category, Automatic pet feeder, can be summarized as follows. This category encompasses three related products: Petlibro automatic pet feeder, Sure pet care microchip pet feeder, and Wopet automatic pet feeder, as well as a large volume of data. The number of association rules found at different support values were as follows: 3636 rules at 5%, 476 rules at 10%, and 34 rules at 20%. Notably, with a support value of 20%, the top 10 rules revealed three representative associations, including: 'cat ↔ feeder & food', 'feeder ↔ time ↔ food ↔ cat & feeder', and 'work ↔ great'.

Lastly, the association rules analysis was conducted for Topic 2, which represented satisfaction and accounted for the largest proportion among the five topics identified for the Wickedbone automatic pet toy. These analysis results are shown in Table 9, and some intriguing findings emerge, particularly when the support value was set at 5%. Unlike the other categories, certain keywords displayed notable lift values for this support value. For instance, the keywords 'loaded' and 'media' exhibited a remarkably high lift value of 18.82, while the words 'interactive' and 'mode' also showed a substantial lift value of 4.68. These findings indicate that these particular features garnered significant interest from 5% of consumers.

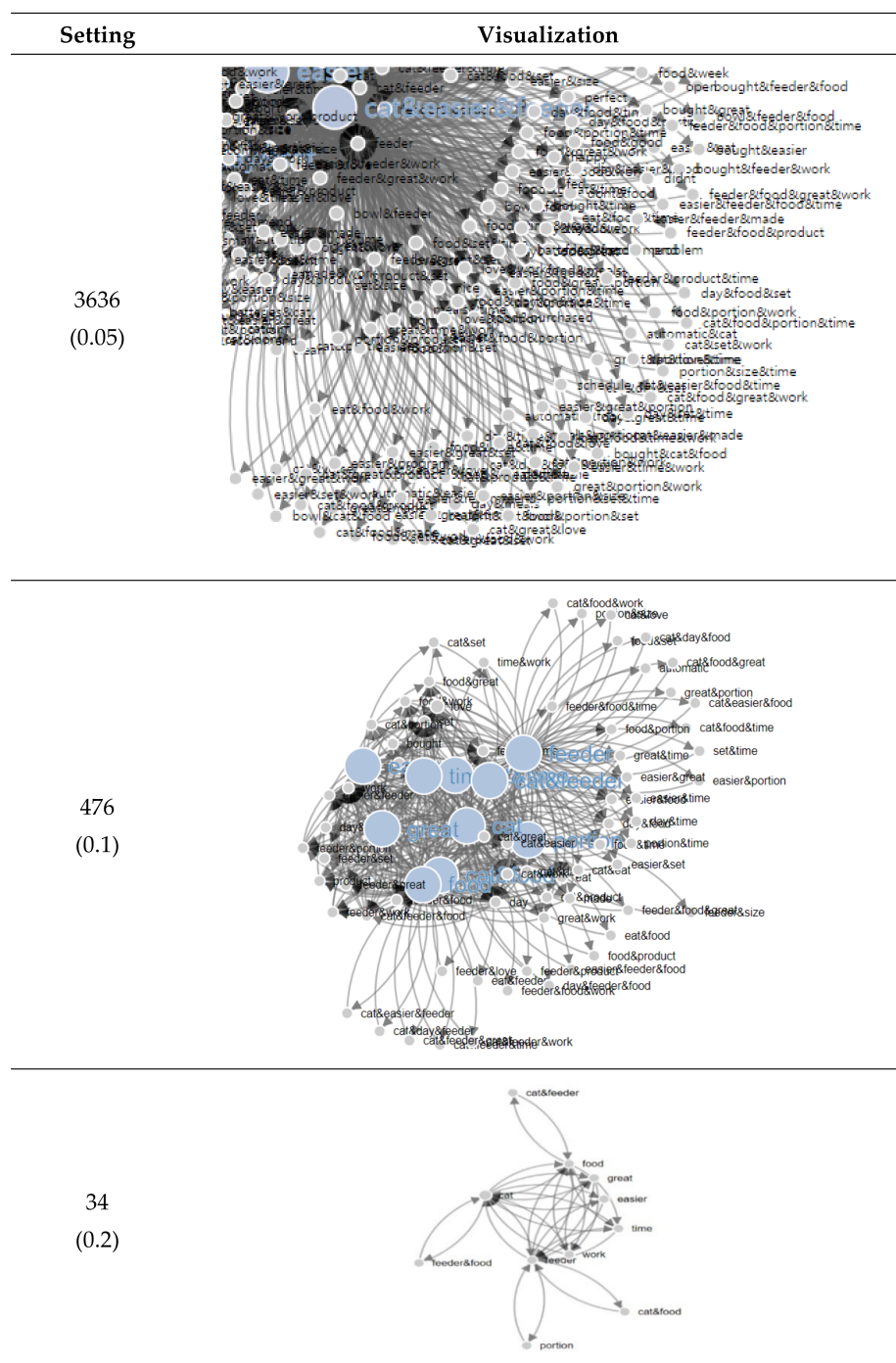


Figure 7. Automatic pet feeder visualized for its different support values.

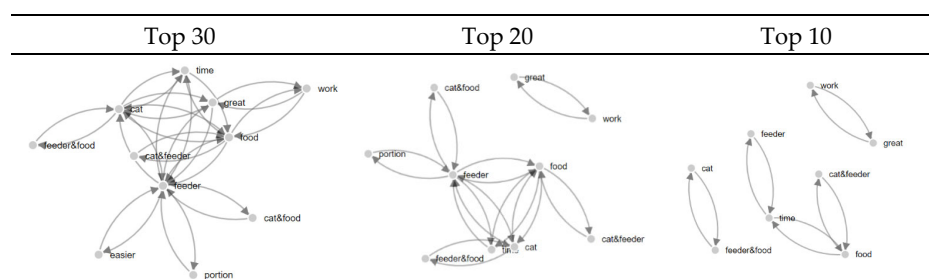


Figure 8. Details of the automatic pet feeder visualized at 20% support value.

Table 9. Wickedbone automatic pet toy for different support values.

(a) Support Value = 0.05			
No.	Source	Target	Value
1	loaded	media	18.82
2	media	loaded	18.82
3	interactive	mode	4.68
4	mode	interactive	4.68
5	dog&interactive	mode	4.34
6	mode	dog&interactive	4.34
7	interactive	dog&mode	4.03
...	...	...	...
1014	dog	bought	1.01
1015	play	product	1.01
1016	product	play	1.01
(b) Support value = 0.1			
No.	Source	Target	Value
1	fun	dog&play	2.08
2	dog&play	fun	2.08
3	dog&fun	play	1.93
4	play	dog&fun	1.93
5	love	play&toys	1.93
6	play&toys	love	1.93
7	love&toys	play	1.9
...	...	...	...
90	dog	charging	1.01
91	app	dog	1.01
92	dog	app	1.01
(c) Support value = 0.2			
No.	Source	Target	Value
1	toys	play	1.43
2	play	toys	1.43
3	play	dog	1.25
4	dog	play	1.25
5	dog	toys	1.14
6	toys	dog	1.14

Figure 9 shows the associations at a support value of 10%, where the keywords ‘dog’ and ‘toy’ served as central nodes and were connected to other keywords. At a support value of 20%, the three keywords that primarily described the main function of the product were ‘dogs’, ‘toys’, and ‘play’.

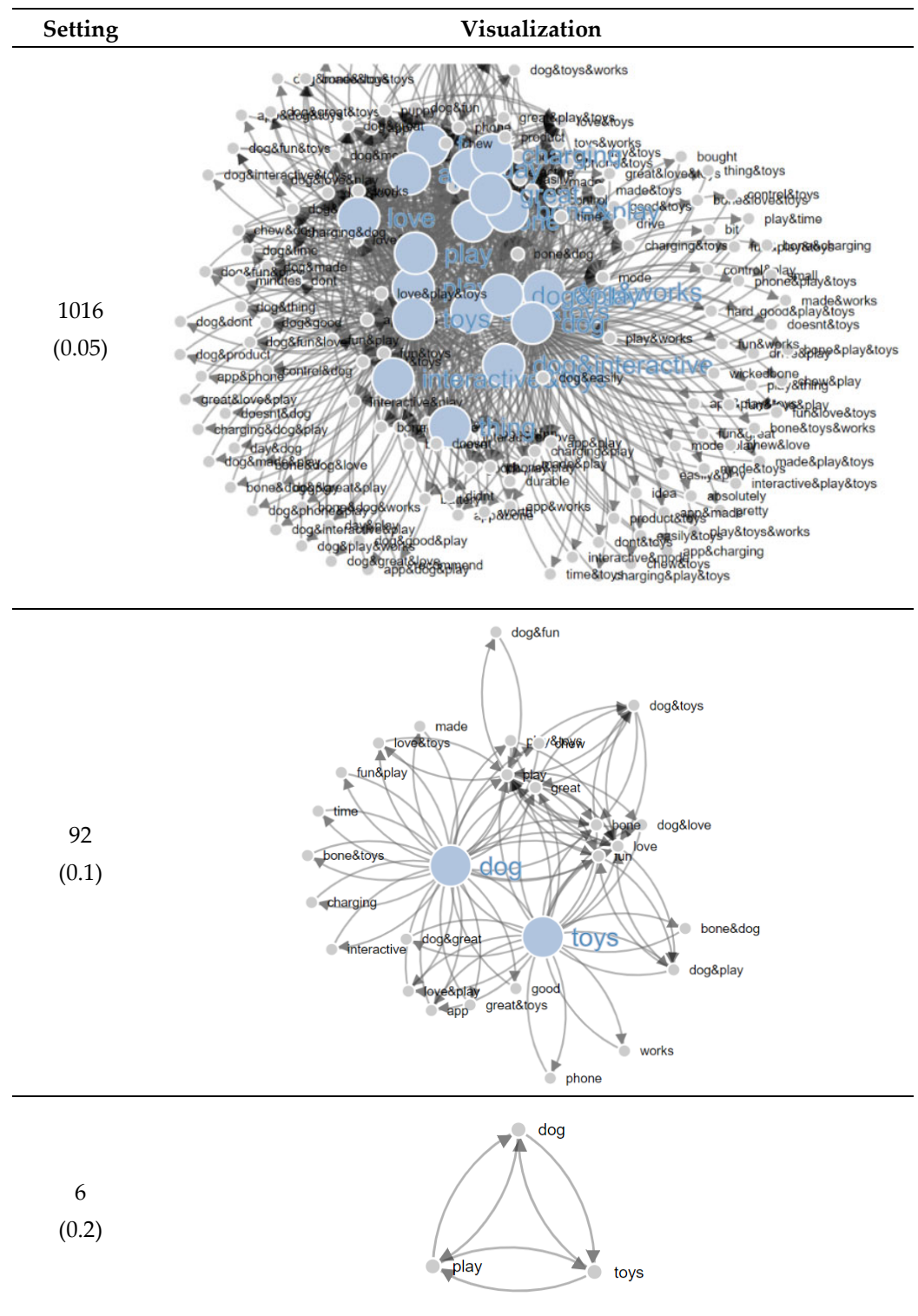


Figure 9. The Wickedbone automatic pet toy visualized for its different support values.

A more detailed exploration of the keyword relationships at a support value of 10% is depicted in Figure 10 below. Among the different support values, 10% represents the second most prominent section, offering several links that warrant further examination. Notably, as the ranking increases, the number of connections between the word topics decreases. In the top 10 associations, only three sets of links were observed for this product.

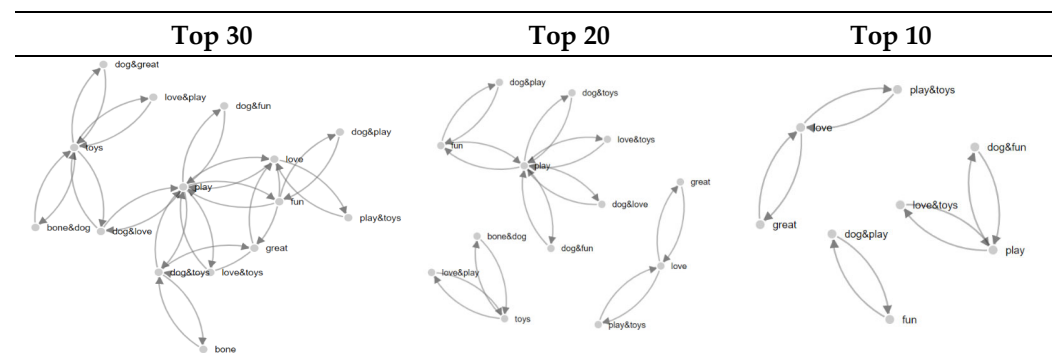


Figure 10. Details of Wickedbone automatic pet toy visualized at 10% support value.

In summary, the analysis results for the representative topic of the third category, Wickedbone automatic pet toy, can be summarized as follows. At a support value of 5%, a total of 1016 rules were found, while at 10%, 92 rules were discovered, and at 20%, only six rules were identified. This result indicates that in 20% of consumer reviews that evaluated Wickedbone automatic pet toy products, there was a consistent circular relationship between the keywords ‘dog ↔ play ↔ toys ↔ dog’.

The findings of this study indicate that the association rules analysis conducted on the three identified categories consistently revealed the highest RI for the satisfaction topic. In response to RQ2, the associated terms representing the product’s functionality frequently appeared within the context of customer satisfaction for high-tech pet products. In the case of the Furbo dog camera, the combination of the keywords ‘treat,’ ‘dog,’ and ‘love’ simultaneously appeared in 20% of the most popular reviews, indicating a strong consumer interest in the “treat” feature for dogs. Similarly, for the automatic pet feeder, consumers exhibited a specific preference for the ‘time ↔ feeder’ and ‘time ↔ food’ associations, thereby underscoring their personal emphasis on meal scheduling capabilities. For the Wickedbone automatic pet toy, the keywords ‘loaded’ and ‘media’ displayed a high lift value of 8.82, while the keywords ‘interactive’ and ‘mode’ also exhibited a significant lift value of 4.68 when considering a customer support value of 5%.

Overall, the results obtained from these association rules analyses emphasize the crucial role of customer satisfaction when evaluating high-tech pet products. It is also noteworthy that words related to product functionality consistently emerged in the context of customer satisfaction across all three product categories.

5. Conclusions

This study utilized a combination of topic modeling and association rules techniques to analyze the OCRs of high-tech pet products sold on Amazon.com. The study sought to uncover common topics, significant keywords, and their relationships and gain further insights into consumer preferences based on product features. Using the LDA model, the findings consistently revealed that the ‘satisfaction’ topic achieved the highest RI across all product categories, indicating a strong association between consumer reviews and satisfaction levels for high-tech pet products. Further, the association rules analysis highlighted the finding that terms related to product functionality were frequently observed within the satisfaction topic and across the three product categories. Therefore, enhancing customer satisfaction by focusing on identified key product functionality that effectively meets their needs in high-tech pet products is important.

This research represents a departure from traditional approaches to provide a new perspective on the field of text mining. Leveraging the combined power of topic modeling and association rules, we entered uncharted territory to enable a more complete and multidimensional analysis of text data. Our research is thus unique not only in its innovative approach but also in the field it is studying, namely the high-tech pet industry. This emerging field is currently relatively unexplored, so previous research and coverage

of it is limited. Thus, our work not only advances the field of text mining but also drives new frontiers in research. In doing so, we hope to inspire further research and stimulate more interest in this fascinating and, as yet, still underrepresented field.

This study offers three notable implications. First, the application of the LDA algorithm allows for the identification of common topics in customer reviews, thereby providing valuable insights for potential customers to use to assess product quality based on a substantial number of reviews. Secondly, by integrating the association rules algorithm with LDA, this study was able to unveil the detailed associations between keywords. This approach will prove beneficial in better understanding customer interests in pet products and better determining the factors that drive customer satisfaction during their product experiences and applying them well. Lastly, this research has practical implications for businesses by letting them discover key links in consumer preferences and behavior in the high-tech pet products industry. The recommendations for further product development are based on identified key product functions related to customer satisfaction. Businesses can use the key insights from this research to tailor their marketing messages and target specific consumer segments more effectively in the future.

This study does have some limitations. The analysis focused solely on popular words and phrases found in reviews, seeking key useful associations between them. Moreover, due to the limitations of data processing, reviews in languages other than English were excluded, resulting in a reduction in the total available data. Therefore, we will analyze OCRs written in multiple languages and use state-of-the-art text mining techniques, such as applying Large Language Models, to comprehensively evaluate global consumer trends in the future. However, we are confident that this study will contribute to a deeper understanding of consumer behavior in the high-tech pet product industry and provide valuable insights into customer interests and the determinants of customer satisfaction overall.

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References

- Galindo-Martín, M.A.; Castano-Martínez, M.A.; Méndez-Picazo, M.T. Digital transformation, digital dividends and entrepreneurship: A quantitative analysis. *J. Bus. Res.* **2019**, *101*, 522–527. [\[CrossRef\]](#)
- Del Giudice, M.; Scuotto, V.; Papa, A.; Tarba, S.; Bresciani, S.; Warkentin, M. A self-tuning model for smart manufacturing SMEs: Effects on digital innovation. *J. Prod. Innov. Manag.* **2020**, *38*, 68–89. [\[CrossRef\]](#)
- Bresciani, S.; Huarng, K.H.; Malhotra, A.; Ferraris, A. Digital transformation as a springboard for product, process and business model innovation. *J. Bus. Res.* **2021**, *128*, 204–210. [\[CrossRef\]](#)
- Chakraborty, D.; Paul, J. Healthcare apps' purchase intention: A consumption values perspective. *Technovation* **2022**, *120*, 102481. [\[CrossRef\]](#)
- Erevelles, S.; Fukawa, N.; Swayne, L. Big data consumer analytics and the transformation of marketing. *J. Bus. Res.* **2016**, *69*, 897–904. [\[CrossRef\]](#)
- Ferraris, A.; Del Giudice, M.; Grandhi, B.; Cillo, V. Refining the relation between cause-related marketing and consumers purchase intentions. *Int. Mark. Rev.* **2019**, *37*, 661–669. [\[CrossRef\]](#)
- Guha, S.; Kumar, S. Emergence of big data research in operations management, information systems, and healthcare: Past contributions and future roadmap. *Prod. Oper. Manag.* **2018**, *27*, 1724–1735. [\[CrossRef\]](#)

8. Bi, J.W.; Liu, Y.; Fan, Z.P.; Zhang, J. Wisdom of crowds: Conducting importance-performance analysis (IPA) through online reviews. *Tour. Manag.* **2019**, *70*, 460–478. [\[CrossRef\]](#)
9. Park, S.; Lee, J.S.; Nicolau, J.L. Understanding the dynamics of the quality of airline service attributes: Satisfiers and dissatisfiers. *Tour. Manag.* **2020**, *81*, 104163. [\[CrossRef\]](#) [\[PubMed\]](#)
10. Büschken, J.; Allenby, G.M. Sentence-based text analysis for customer reviews. *Mark. Sci.* **2016**, *35*, 953–975. [\[CrossRef\]](#)
11. Yin, F.; Wang, Y.; Liu, J. The construction of sentiment lexicon based on context-dependent part-of-speech chunks for semantic disambiguation. *IEEE Access* **2020**, *8*, 63359–63367. [\[CrossRef\]](#)
12. Reed, D.R.; Mainland, J.D.; Arayata, C.J. Sensory nutrition: The role of taste in the reviews of commercial food products. *Physiol. Behav.* **2019**, *209*, 112579. [\[CrossRef\]](#) [\[PubMed\]](#)
13. Wang, Z.; Gu, S.; Xu, X. GSLDA: LDA-based group spamming detection in product reviews. *Appl. Intell.* **2018**, *48*, 3094–3107. [\[CrossRef\]](#)
14. Hou, T.; Yannou, B.; Leroy, Y. Mining customer product reviews for product development: A summarization process. *Expert Syst. Appl.* **2019**, *132*, 141–150. [\[CrossRef\]](#)
15. Kumar, S.; Yadava, M.; Roy, P.P. Fusion of EEG response and sentiment analysis of products review to predict customer satisfaction. *Inf. Fusion* **2019**, *52*, 41–52. [\[CrossRef\]](#)
16. Cao, M.; Zhou, S.; Gao, H. A recommendation approach based on product attribute reviews: Improved collaborative filtering considering the sentiment polarity. *Intell. Autom. Soft Comput.* **2019**, *25*, 595–604. [\[CrossRef\]](#)
17. Ma, B.; Zhang, D.; Yan, Z. An LDA and synonym lexicon based approach to product feature extraction from online consumer product reviews. *J. Electron. Commer. Res.* **2013**, *14*, 304.
18. Alshamrani, S.; Abuhamad, M.; Abusnaina, A. Investigating online toxicity in users interactions with the mainstream media channels on YouTube. In Proceedings of the 5th International Workshop on Mining Actionable Insights from Social Networks, Online, 20 October 2020; pp. 1–6.
19. Wang, Z.; Hu, Y.; Liu, H. Analysis of online Comments on Agricultural products based on LDA theme Model and intuitionistic Fuzzy TOPSIS. *Data Acquis. Process.* **2020**, *35*, 965–977.
20. Roberts, R. Pet Industry Trends, Growth & Statistics in 2022 and Beyond: Unleashing Your Ecommerce Pet Marketing Strategies. Common Thread Collect. 2022. Available online: <https://commonthreadco.com/blogs/coachs-corner/pet-industry-trends-growth-ecommerce-marketing> (accessed on 2 August 2023).
21. Chen, C.D.; Ku, E.C.S. Diversified Online Review Websites as Accelerators for Online Impulsive Buying: The Moderating Effect of Price Dispersion. *J. Internet Commer.* **2021**, *20*, 113–135. [\[CrossRef\]](#)
22. Lee, S.; Choeh, J.Y. Using the Social Influence of Electronic Word-of-Mouth for Predicting Product Sales: The Moderating Effect of Review or Reviewer Helpfulness and Product Type. *Sustainability* **2020**, *12*, 7952. [\[CrossRef\]](#)
23. Anastasiei, B.; Dospinescu, N.; Dospinescu, O. Word-of-Mouth Engagement in Online Social Networks: Influence of Network Centrality and Density. *Electronics* **2023**, *12*, 2857. [\[CrossRef\]](#)
24. Zelenka, J.; Azubuike, T.; Pásková, M. Trust Model for Online Reviews of Tourism Services and Evaluation of Destinations. *Adm. Sci.* **2021**, *11*, 34. [\[CrossRef\]](#)
25. Zibarzani, M.; Abumalloh, R.A.; Nilashi, M.; Samad, S.; Alghamdi, O.A.; Nayer, F.K.; Ismail, M.Y.; Mohd, S.; Mohammed Akib, N.A. Customer satisfaction with Restaurants Service Quality during COVID-19 outbreak: A two-stage methodology. *Technol. Soc.* **2022**, *70*, 101977. [\[CrossRef\]](#) [\[PubMed\]](#)
26. Xei, C.; Tian, X.; Feng, X.; Zhang, X.; Ruan, J. Preference Characteristics on Consumers' Online Consumption of Fresh Agricultural Products under the Outbreak of COVID-19: An Analysis of Online Review Data Based on LDA Model. *Procedia Comput. Sci.* **2022**, *207*, 4486–4495.
27. Hong, M.; Wang, H. Research on customer opinion summarization using topic mining and deep neural network. *Math. Comput. Simul.* **2021**, *185*, 88–144. [\[CrossRef\]](#)
28. Kwon, H.J.; Ban, H.J.; Jun, J.K.; Kim, H.S. Topic Modeling and Sentiment Analysis of Online Review for Airlines. *Information* **2021**, *12*, 78. [\[CrossRef\]](#)
29. Lucini, F.R.; Tonetto, L.M.; Fogliatto, F.S.; Anzanello, M.J. Text mining approach to explore dimensions of airline customer satisfaction using online customer reviews. *J. Air Transp. Manag.* **2020**, *83*, 101760. [\[CrossRef\]](#)
30. Zhang, M.; Sun, L.; Wang, G.A.; Li, Y.; He, S. Using neutral sentiment reviews to improve customer requirement identification and product design strategies. *Int. J. Prod. Econ.* **2022**, *254*, 108641. [\[CrossRef\]](#)
31. Majumder, M.G.; Gupta, S.D.; Paul, J. Perceived usefulness of online customer reviews: A review mining approach using machine learning & exploratory data analysis. *J. Bus. Res.* **2022**, *150*, 147–164.
32. Liao, S.; Chang, H. A rough set-based association rule approach for a recommendation system for online consumers. *Inf. Process. Manag.* **2016**, *52*, 1142–1160. [\[CrossRef\]](#)
33. Kim, S.G.; Kang, J. Analyzing the discriminative attributes of products using text mining focused on cosmetic reviews. *Inf. Process. Manag.* **2018**, *54*, 938–957. [\[CrossRef\]](#)
34. Chiang, W. To mine association rules of customer values via a data mining procedure with improved model: An empirical case study. *Expert Syst. Appl.* **2011**, *38*, 1716–1722. [\[CrossRef\]](#)
35. Dogan, O. A Recommendation System in E-Commerce with Profit-Support Fuzzy Association Rule Mining (P-FARM). *J. Theor. Appl. Electron. Commer. Res.* **2023**, *18*, 831–847. [\[CrossRef\]](#)

36. Yıldız, E.; Şen, C.G.; Işık, E.E. A Hyper-Personalized Product Recommendation System Focused on Customer Segmentation: An Application in the Fashion Retail Industry. *J. Theor. Appl. Electron. Commer. Res.* **2023**, *18*, 571–596. [[CrossRef](#)]
37. Cheng, L.C.; Shannayne, L.R. Analysing Digital Banking Reviews Using Text Mining. In Proceedings of the International Conference on Advances in Social Networks Analysis and Mining, The Hague, The Netherlands, 7–10 December 2020.
38. Kim, J.; Lee, H.; Lee, H. Mining the determinants of review helpfulness: A novel approach using intelligent feature engineering and explainable AI. *Data Technol. Appl.* **2023**, *57*, 108–130. [[CrossRef](#)]
39. Kim, H.; Lee, E.; Yoo, D.H. Do SEC Filings Indicate any Trends? Evidence from the Sentiment Distribution of Forms 10-K and 10-Q with FinBERT. *Data Technol. Appl.* **2023**, *57*, 293–312. [[CrossRef](#)]
40. David, M.B.; Andrew, Y.N.; Michael, I.J. Latent Dirichlet Allocation. *J. Mach. Learn. Res.* **2003**, *3*, 993–1022.
41. Agrawal, R.; Imielinski, T.; Swami, A. Mining Association Rules between Sets of Items in Large Databases. *ACM SIGMOD Int. Conf. Manag. Data* **1993**, *22*, 207–216. [[CrossRef](#)]

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