

Understanding Customer Sentiments: A Deep Dive into Electronics Camera Reviews

BUSN9166 - Big Data Analytics and Visualization

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1. Introduction and research questions

1.1 The current state of the electronics market

The electronic products market size has grown strongly in recent years. It will grow from \$1.38 trillion in 2024 to \$1.5 trillion in 2025 at a compound annual growth rate (CAGR) of 8.7% (The Business Research Company,2025). In the ever-evolving landscape of consumer electronics, the camera segment has emerged as a focal point of innovation, consumer interest, and market competition. The camera industry has witnessed a remarkable transformation over the past few decades, driven by advancements in sensor technology, optics, and computational photography (Smith, 2018; Johnson et al., 2020; Brown, 2022). From the rise of digital single-lens reflex (DSLR) cameras that revolutionized the photography experience for enthusiasts and professionals alike, to the recent proliferation of smartphones equipped with high-quality multi-camera systems that have democratized photography, the camera market has continuously adapted to meet the changing needs and preferences of consumers. Smith (2018) explored the technological advancements in camera sensors, highlighting how improvements in pixel density, sensitivity, and dynamic range have significantly enhanced the image quality captured by modern cameras. Johnson et al. (2020) delved into the impact of computational photography techniques, such as image stitching, HDR (High Dynamic Range) imaging, and portrait mode, on the overall user experience and the creative possibilities offered by cameras. Brown (2022) analyzed the market trends in the camera industry, examining the competitive landscape among different camera manufacturers and the factors influencing consumer purchasing decisions.

Against this backdrop, analyzing the Amazon review data related to cameras offers a unique opportunity to gain insights into consumer behavior, product performance perceptions, and emerging trends within this dynamic market segment. The vast amount of user-generated content available on Amazon provides a rich source of information that can be harnessed to understand what consumers value most in a camera, the pain points they encounter, and how different camera models and brands are perceived in the marketplace. By leveraging this data, we aim to contribute to the existing body of knowledge in the field of consumer electronics marketing and product development, and provide actionable recommendations for camera manufacturers and retailers.

1.2 Introduction to datasets

As a global e-commerce platform, Amazon's data on Camera merits in-depth analysis. Examining these figures enables us to gain a more comprehensive understanding of the global electronics market dynamics and consumer psychology, offering valuable insights for strategic decision-making and market positioning.

The Electronics dataset (McAuley Lab,2023), includes 148186 reviews and 2129 meta for

Camera from May 1996 to September 2023. This extensive dataset offers rich insights into consumer behavior and preferences, making it a valuable resource for analyzing users' feedback and product performance.

1.3 Methodology

To analyze these data, it is essential to first categorize them. The Naïve-Bayes-Analyzer model is an excellent choice for this purpose, which is a simple probabilistic classifier based on Bayes' theorem and is widely used in text classification, spam filtering, disease prediction, and other fields. The core idea of this model is to use Bayes' theorem to calculate the probability of data belonging to different categories and classify the data based on these probabilities (GeeksforGeeks, n.d.). The Naïve-Bayes model excels in text classification, such as spam filtering (Student Loan Forgiveness n.d.).

This study utilized Google Colab to implement the Naïve-Bayes-Analyzer Model, supported by libraries such as pandas and numpy for data manipulation; sklearn.naive_bayes for model implementation and predictions; re and nltk for text preprocessing and analysis (e.g., tokenization, frequency distribution, stopwords removal, sentiment analysis using SentimentIntensityAnalyzer, and n-grams extraction); and matplotlib.pyplot, seaborn, and wordcloud for data visualization.

1.4 Questions

This study primarily aims to address the following four research questions:

- 1) Does a higher number of reviews mean a higher average rating?
- 2) What is the distribution of emotions among the top 10 most commented products?
- 3) Which functions of the camera do users care about the most?

2. Data processing and exploration

2.1 Extract the data subset

The "Amazon Reviews 2023" dataset by McAuley-Lab contains a wealth of information regarding Amazon product reviews, including those for Electronics. In the realm of electronics data, the dataset encompasses two crucial branches: review data (reviews) and metadata (meta). Once the two datasets, namely the review data and the metadata, were downloaded separately, a keyword - based retrieval strategy was adopted.

- Initially, the metadata dataset was processed to isolate camera - related entries using the keyword "camera", and the extracted data was stored in *myMetaSub*. Subsequently, the values of the variable *parent_asin* were extracted from *myMetaSub* and stored in *myMetaSubASIN*, laying a solid foundation for the subsequent integration with the reviews dataset.
- The sub - dataset then underwent a meticulous variable selection process. Irrelevant variables were systematically filtered out, while those essential for the research

were retained. Notably, variables such as *'parent_asin'* played a pivotal role. They served as a critical link between the review dataset and the item metadata. For instance, it allowed for the correlation of user reviews with various product features, including sensor type, megapixel count, and price information gleaned from the metadata.

- Leveraging the *myMetaSubASIN*, the corresponding data entries were retrieved from the reviews dataset and merged with *myMetaSub*, effectively excluding extraneous information and ensuring the dataset's relevance and focus for the study.

For sentiment analysis of camera reviews, the 'text' field is of utmost importance as it contains the reviewers' descriptions and opinions. The 'rating' variable, which ranges from 1.0 to 5.0, serves as an objective measure of the reviewers' overall satisfaction with the camera.

2.2 Data pre-processing

In the data preprocessing phase, a series of operations were carried out to enhance data quality. Duplicate entries were identified and removed, as emphasized by previous research (Bishop, 2006; Hastie et al., 2009). Bishop (2006) noted that redundant data can introduce biases in analysis, and eliminating duplicates is fundamental for accurate results. Similarly, Hastie et al. (2009) pointed out the importance of data integrity at the preprocessing stage.

Subsequently, missing values were detected and removed. The dataset's integrity was thus maintained to prevent potential inaccuracies in subsequent analyses.

For text data within the reviews, NLTK (Natural Language Toolkit), as described by Bird et al. (2009) in *Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit*, was utilized. Stop words, which are common words with minimal semantic value for sentiment analysis, were retrieved from NLTK and removed from the text corpus (Bird et al., 2009). To standardize the text format, all characters were converted to lowercase, following the general practices in text preprocessing. Punctuation marks and numerical digits were eliminated, allowing the focus to be on the semantic content of the text. After these cleaning procedures, the text was tokenized. This tokenization process, as per the principles of NLP, facilitated subsequent analyses such as calculating word frequencies and identifying relevant phrases related to user experiences of cameras. It is worth mentioning that a total of 73,528 'price' variables were missing during the capture, which means there was not enough data for price research.

3. Data visualization and interpretation

3.1 Overall

The dataset is composed of two parts: Reviews and Meta. After data preprocessing, there are 144,388 records in the reviews part and 2,129 records in the meta part. As can be seen from the following Table.1, the Camera_reviews part has a total of 12 variables, while the

Camera_meta part has 11 variables.

Table 3.1 Variable description

	<i>Variables</i>	<i>Description</i>	<i>Used (Y/N)</i>	<i>Notes on usage</i>
<i>Camera_Reviews</i>	rating	Rating of the product(1/worst-5/best)	Y	to study user satisfaction
	asin	The ID of product	Y	identify the corresponding product information
	title_x	Title of reviews	N	
	text	Text message	Y	to study user satisfaction
	user_id	ID of the users	N	
	timestamp	Timestamp of reviews	N	
	helpful_vote	Helpful number of votes	Y	to select the most worthy comments for study
	verified_purchase	Whether to verify the purchase	N	
	sentiment	Emotional analysis results (positive/negative)	Y	to study user satisfaction
	images_x	The picture uploaded by the user	N	
	subtitle	The subheading of reviews	N	
	author	The name of reviewers (Null)	N	
	parent_asin	The ID of product	Y	identify the corresponding reviews
	main_category	List of product categories	N	
<i>Camera_Meta</i>	bought_together	Products purchased together (Null)	N	
	title_y	The brand of the products (Brand)	Y	research the differences between different brands
	average_rating	The average rank of the product	Y	The average number of users' ratings of the product
	rating_number	The number of rankings for the product	N	
	features	Features of the product	N	
	description	A description of the product	N	
	price	The price of the product	Y	research the impact of price on the product
	categories	The kind of product	N	
	details	A detailed description of the product	N	
	store	Shops that sell this product	N	
	images_y	A physical image of the product	N	
	videos	Product introduction video	N	

As the Table.1, only a few variables were used in this study, such as ‘text’ in reviews and

‘brand’ in meta.

As Figure 3.1 showing, there are 95,351 Positive Reviews, accounting for 66% of the total,

Sentiment Distribution of Camera Reviews

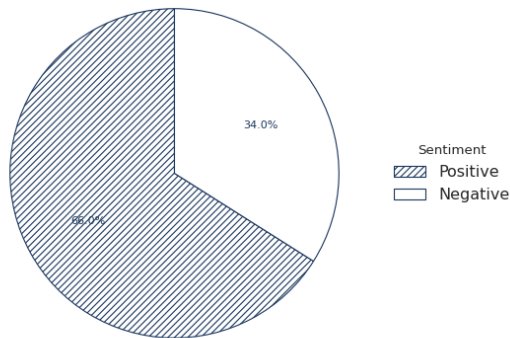


Figure 3. 1 Sentiment Distribution of Camera Reviews

The median rating is 5.0, meaning 50% of the reviews have a rating of 5.0 or above, and the other 50% have 5.0 or below. However, the mean rating is 3.74, lower than both the mode (which is 5.0) and the median. This shows that although 5.0 is the most common rating, enough lower ratings

exist to bring down the average. It indicates that reviewers have a somewhat varied set of opinions, even with the high number of top - tier ratings.

and 49,037 Negative Reviews, making up 34% of the total.

Figure 3.2 depicts the number distribution across various rating intervals. It can be seen that the numbers in the 2.0 - 3.0 rating range don't differ much. The 5.0 rating has the largest number of occurrences, resulting in an overall right - skewed distribution, with over 70,000 ratings at 5.0.

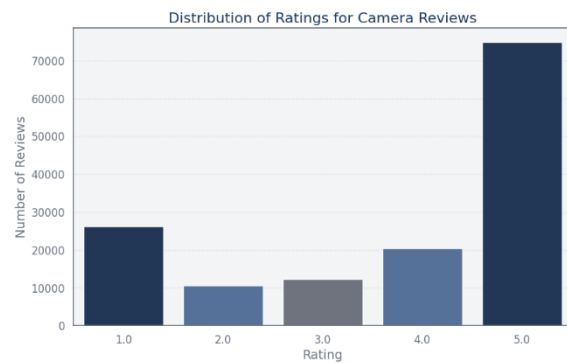


Figure 3. 2 Distribution of ratings for Camera Reviews

3.2 Question 1 The relationship between the number of reviews and ratings

3.2.1 Analysis

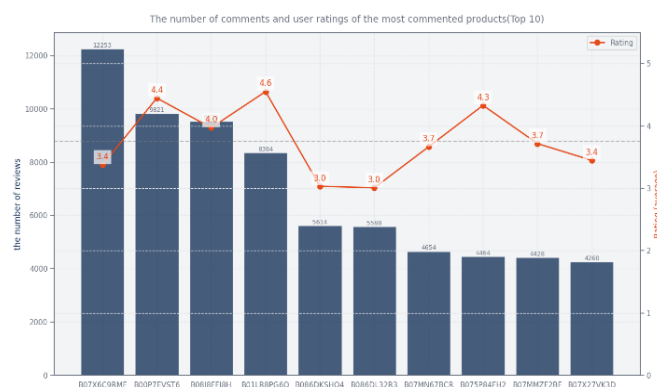


Figure3. 3 The number of comments and user ratings of the most commented products (Top 10)

To gain a more comprehensive understanding of the current state of the camera product market and enable camera - manufacturing companies to better chart their future development paths, Figure 3.3 is of great significance. Figure 3.3 shows the top 10 camera products on the Amazon platform

in terms of the number of reviews, along with the average ratings given by users.

Obviously, B07X6C9RMF, despite having the highest number of reviews, received an average rating of only 3.4—falling short of the overall average score of 3.7. Conversely, B01LR8PG6Q, ranked 4th in terms of reviews, achieved an impressive average rating of 4.6.

Upon further analysis of the top ten products in terms of the number of reviews, the *Arlo Pro-wireless Home Security Camera System with Siren* has the highest number of reviews among all camera products. Its average user rating is 4.55, which exceeds the overall average score of 3.7. In the case of product B01LR8PG6Q, the proportion of positive reviews among all user reviews is as high as 0.94.

Table 3. 2 Detailed information of the top 10 most reviewed products

Asin	Brand	Price(\$)	Rating	Positive Ratio
B01LR8PG6Q	Arlo Pro - Wireless Home Security Camera System with Siren Rechargeable, Night vision, Indoor/Outdoor, HD Video, 2-Way Audio, Wall Mount Cloud Storage Included 1 camera kit (VMS4130)	/	4.551530	0.940937
B00P7EVST6	Arlo - Wireless Home Security Camera System Indoor/Outdoor 2 camera kit (Discontinued)	/	4.447510	0.909480
B075P84FH2	Arlo VMS4120P-100NAS Pro 2 - Wire-Free Home Security Camera Rechargeable Battery, Night Vision, 2-Way Audio, Wall Mount 1 camera kit	/	4.330421	0.856183
B08J8FFJ8H	Echo Show 5 (2nd Gen, 2021 release) Smart display with Alexa and 2 MP camera Charcoal	/	3.971351	0.707944
B07MMZF2BF	Blink XT2 Outdoor/Indoor Smart Security Camera with cloud storage included, 2-way audio, 2-year battery life - 1 camera kit	99.99	3.717254	0.649503
B07MN67BCR	Blink XT2 Outdoor/Indoor Smart Security Camera with cloud storage included, 2-way audio, 2-year battery life - 2 camera kit	/	3.666094	0.635153
B07X27VK3D	Blink Mini - Compact indoor plug-in smart security camera, 1080p HD video, night vision, motion detection, two-way audio, easy set up , Works with Alexa - 3 cameras (Black)	99.98	3.448826	0.563850
B07X6C9RMF	Blink Mini - Compact indoor plug-in smart security camera, 1080p HD video, night vision, motion detection, two-way audio, easy set up , Works with Alexa - 3 cameras (Black)	99.98	3.374194	0.539623
B086DKSHQ4	Blink Whole Home Bundle Video Doorbell System, Outdoor camera, and Mini camera HD video, motion detection, Works with Alexa	219.96	3.033131	0.450125
B086DL32R3	Blink Whole Home Bundle Video Doorbell System, Outdoor camera, and Mini camera HD video, motion detection, Works with Alexa	219.96	3.007695	0.434681

When examining the top 3 products, all of them are *Arlo's wireless Home Security Camera Systems* (As shown in Table 3.2). The product ranked 2nd lacks certain features compared to the 1st ranked one, such as *Rechargeable functionality, Night vision, the ability to be used Indoor/Outdoor, HD Video quality, 2-Way Audio capability, Wall Mount option, and the inclusion of Cloud Storage*. For other

products of the same brand, it is evident that those with more features tend to receive a larger number of reviews and higher ratings.

In the data analysis, the ratings of products from the same brand tend to cluster closely together. This shows that the brand is a key factor in customers' purchasing decisions and serves as one of the important references for them.

A meticulous comparison of the top 10 products reveals that there are duplicate entries for products of the same brand but with different models or styles. For instance, products B086DKSHQ4 and B086DL32R3 fall into this category. It is considerable to consider combining such duplicate entries in subsequent analyses.

3.2.2 Conclusion

Empirical analysis suggests no significant direct correlation between review and rating. Camera products featuring comprehensive functionality are more likely to gain users' attention and higher ratings. Furthermore, brand equity emerges as a critical factor, with consumers demonstrating greater satisfaction towards brands they perceive as trustworthy. This dual influence underscores the importance of both product innovation and brand management in enhancing user satisfaction.

3.3 Question 2 The distribution of sentiment among the top 10 most reviewed products

3.3.1 Analysis

As illustrated in Figure 3.4, among the top 10 products with the highest number of reviews, the majority have more positive reviews than negative ones, with the exception of B086DKSHQ4 and B086DL32R3. Notably, the three *Arlo*-branded products in this group significantly outperform in positive reviews compared to negative ones, suggesting that the *Arlo* brand enjoys high acclaim among users. This indicates that a positive user experience effectively contributes to building a favorable brand image.

And cross-referencing with Table 3.2, it becomes evident that both B086DKSHQ4 and

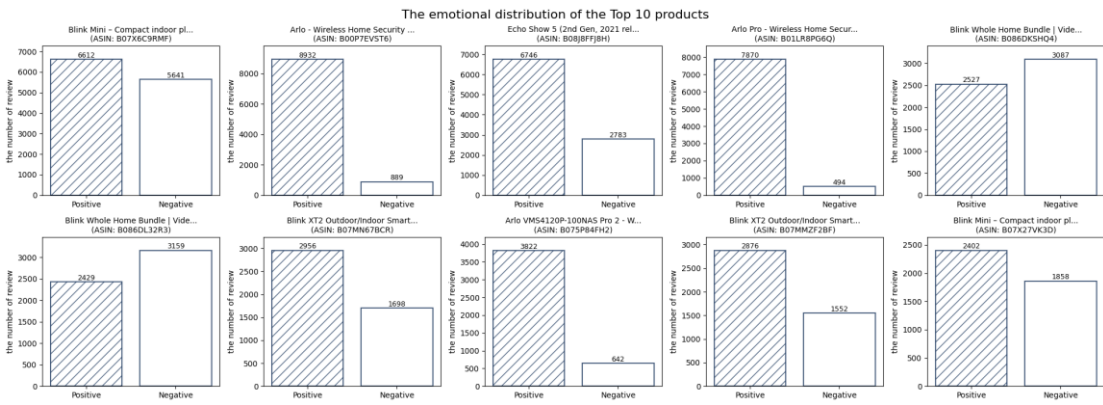
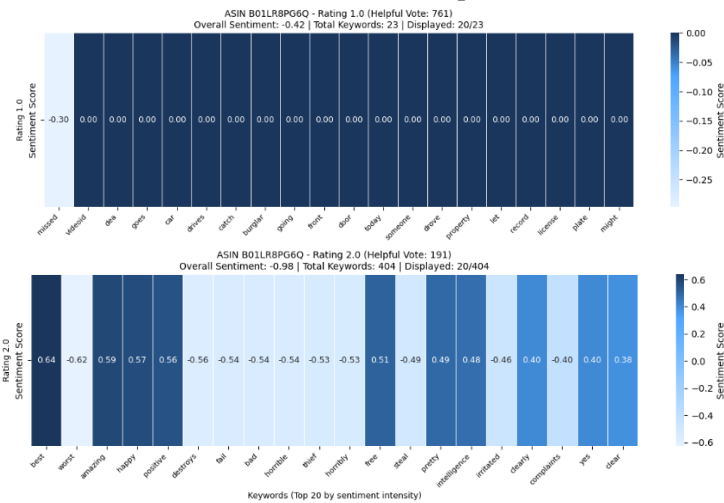


Figure3. 4 the sentiment distribution of Top 10 reviewed camera product

B086DL32R3 have average ratings lower than the overall average of all products (3.7), standing at approximately 3.03. It is also worth noting that these two products belong to the same brand and are priced at a relatively high \$219.96 (given that some price data are missing, the impact of price on these products' ratings remains speculative).

To conduct a further in-depth analysis of the sentiment distribution, it is necessary to examine the sentiment scores of each product across different rating segments from 1.0 to



5.0. In this report, the product with the highest number of reviews (B01LR8PG6Q) will be used as a case study. The review selected for each rating segment consists of the reviews that users deemed most helpful.

In the 1.0 rating category,

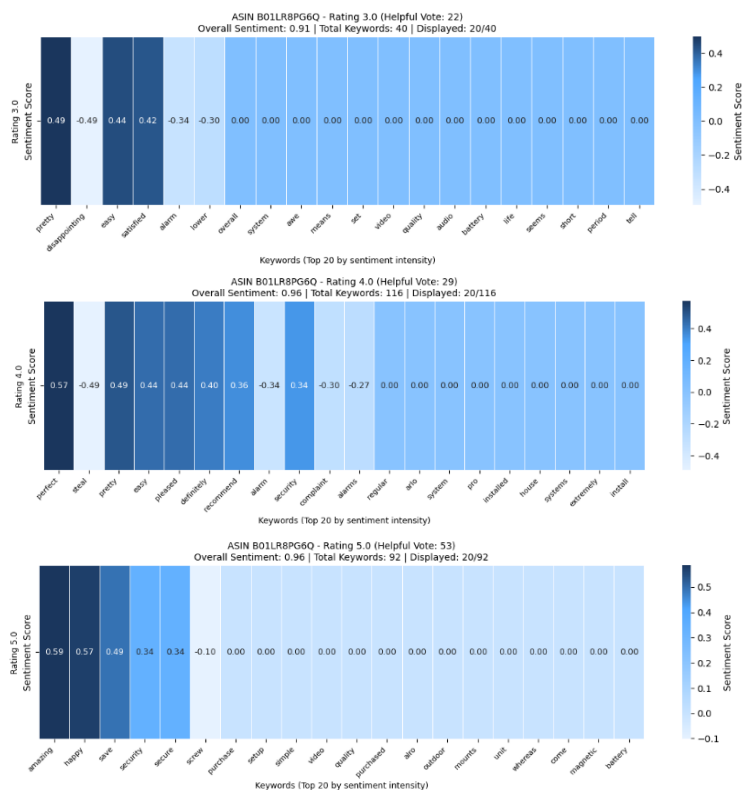


Figure3. 5 the sentiment scores of B01LR8PG6Q across different rating segments from 1.0 to 5.0

the review "Goes off when a car drives by but didn't catch a burglar going into the front door" received an overall sentiment score of -0.42, clearly indicating a negative sentiment. What's striking is that 761 users found this comment helpful, which shows that the product's intelligent recognition function really needs improvement. It seems that the camera often gives false alarms when cars pass by, yet fails to capture actual security threats, falling short of

users' expectations. This feedback points to a key area that manufacturers should focus on to enhance product performance and user satisfaction.

3.2.3 Conclusion

In summary, there are significant differences in user satisfaction among various camera brands. A positive brand reputation and excellent product features contribute to higher ratings, as demonstrated by Arlo products. However, functional flaws, such as Arlo's intelligent recognition issues, should not be overlooked. Improving core functions and managing user expectations are crucial for enhancing satisfaction.

3.4 Question 3 The function that users care about the most

3.4.1 Analysis

When seeking to determine the features that users prioritize most when purchasing camera



Figure3. 6 Word cloud of the most commonly used words for positive reviews

reflect users' core concerns and expectations.

From the positive reviews depicted in Figure 3.6, words such as "system", "set", "easy",

products, an effective starting point is to analyze user reviews. By carefully identifying the words with the highest frequency of occurrence in these reviews, key insights can be obtained. These frequently mentioned terms typically

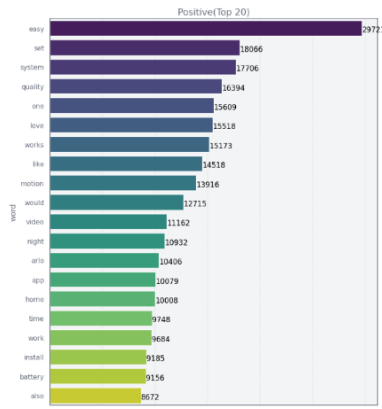


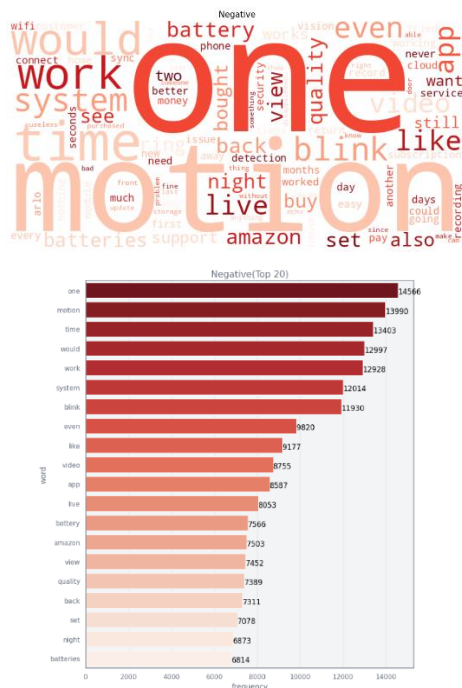
Figure3. 7 The 20 most frequently occurring words in positive reviews

and "*install*" stand out conspicuously. In conjunction with Figure 3.7, the word "*easy*" was mentioned 29,721 times, which is even twice the frequency of the second - ranked word, "*set*". This strong emphasis on these words indicates that, in the eyes of users, an excellent camera product should possess the characteristics of effortless installation and setup procedures. A straightforward installation process saves users valuable time and effort,

eliminating the frustration and confusion that might otherwise accompany the initial setup of a complex device.

Moreover, the prominence of the word "*system*" was also mentioned 17,706 times, which suggests that users highly value a camera with a user-friendly operating system. A user friendly system implies intuitive navigation, easily accessible functions, and seamless interaction, enabling users, regardless of their technical proficiency, to operate the camera with ease and confidence. This not only enhances the overall user experience but also increases the likelihood of users recommending the product to others.

Compared with positive reviews, negative reviews are often more effective in revealing the most pressing areas for product improvement.



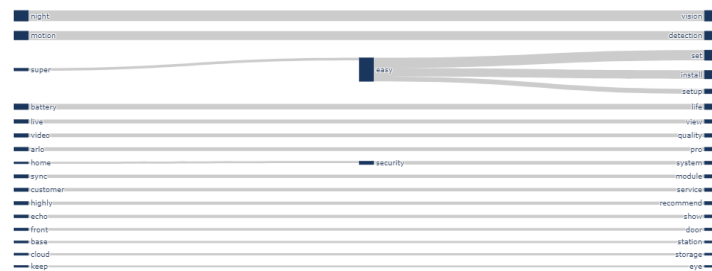
In the word cloud, words such as "one", "view", "work", and "quality" are displayed in relatively large fonts, indicating that these terms are frequently mentioned in negative reviews. The term "*one*" may refer to a specific aspect or model of the product; "*view*" is likely associated with the product's display effect or viewing experience; "*work*" may pertain to the product's operational status or performance; and "*quality*" evidently points to the product's quality. The high frequency of these words suggests user dissatisfaction in these areas.

Turning to the bar chart, the word "*motion*" appears most frequently, reaching 13,990 times, followed by "*time*" (13,403 times), "*would*" (12,997 times), and so on. This indicates that in

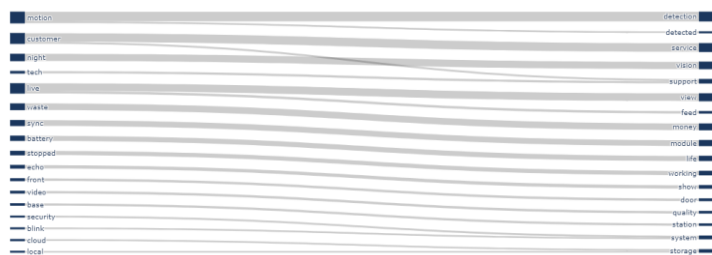
negative reviews, users frequently complain about the product's dynamic performance

("motion") and time - related factors ("time"), which may include aspects such as battery life and operational response time.

Positive Conditional Bigrams Sankey Diagram



Negative Conditional Bigrams Sankey Diagram



3. 9Conditional Bigrams Sankey Diagram

The evident associations between "easy" and "set", "initial", "setup" in the positive reviews indicate that users frequently describe the simplicity of the camera's installation and setup procedures. This further validates the significance users attach to installation convenience, as previously analyzed.

The strong connections between "night" and "vision", as well as "motion" and "detection", suggest that the camera has gained user approval for its night - time shooting visual effects and motion detection capabilities.

The link between "super" and "easy" emphasizes that the product's installation and setup are even more straightforward than expected. The connections between "home", "security", and "system" imply that the product performs well in the context of home security systems. Considering Question 2, it is speculated that the product might be a home surveillance camera or similar, equipped with system functions that meet home security requirements. In the negative reviews, the prominent association between "motion" and "detection" suggests that there may be issues with the product's motion detection function, contrasting with the positive feedback on this feature. The connections between "customer", "service", and "support" indicate that users have had negative experiences regarding customer service and technical support, possibly due to slow response times or insufficient problem solving capabilities.

The associations between "battery", "life", and "money" imply that the product may suffer from poor battery life or high battery replacement costs. The link between "stopped" and "working" indicates that the product may experience sudden breakdowns during operation, disrupting normal user usage.

3.4.2 Conclusion

For product manufacturers and relevant enterprises, these high frequency words pinpoint

the key areas for product improvement. A camera that offers simple installation and a user - friendly system can significantly contribute to user satisfaction and loyalty in the camera market.

Technical upgrades and optimizations can be carried out in terms of lens imaging quality, autofocus speed, and continuous shooting performance. Regarding feedback on "quality", quality control during the production process needs to be strengthened.

4. Conclusion

As the largest overseas online shopping platform, Amazon's user reviews are of significant research value.

- In Question 1, the relationship between the number of reviews and the rating was explored. It was found that a higher number of reviews does not necessarily imply that a product is more favored by users. To achieve a high rating, enhancing brand credibility and enriching product functionality should be the top priorities.
- Question 2 further analyzed the sentiment distribution of product reviews. Even products with high ratings still have room for improvement. Paying attention to the issues raised in negative reviews and making improvements is an effective means of retaining users.
- Question 3 investigated the camera features that users care about most. Excellent features such as *night vision* should continue to be optimized. Meanwhile, functions should be improved and innovated while maintaining high quality.

Regarding the future development directions of camera product functions, the simplicity of installation and setup is highly favored by users and should be continuously optimized, for example, by developing more intelligent installation wizards. Night vision and motion detection functions have a certain foundation, but negative reviews indicate problems with the motion detection function. Subsequent efforts should focus on technical research to enhance its accuracy and stability. Given the advantages in functions related to home security system applications, further in - depth integration can be explored to strengthen the integration with the smart home ecosystem. For aspects with concentrated negative feedback, such as customer service and technical support, battery life and cost, and product operational stability, it is necessary to establish a comprehensive service system, develop new battery technologies, and strengthen quality control and stability testing to comprehensively enhance product functionality and user experience.

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