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A Study on Product Evaluation Models Based on Correlation Analysis and Linear Fitting

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Abstract: In this study, we commence by thoroughly preprocessing the data, a crucial step that involves cleansing, normalizing, and structuring the dataset to ensure its integrity and readiness for in-depth analysis. This meticulous preprocessing phase is essential to eliminate noise and inconsistencies, thereby enhancing the accuracy and reliability of the subsequent analytical processes. Following the preprocessing, we engage in a comprehensive analysis aimed at uncovering the intricate relationships within the data. Through this analysis, we successfully derive a sophisticated relational model that interlinks Star Ratings, Reviews, and Helpfulness Ratings. This model provides a nuanced understanding of how these elements interact, offering valuable insights into consumer behavior and preferences. Leveraging the insights gained from the relational models, we proceed to develop a robust framework for product evaluation. This framework is designed to be both flexible and scalable, allowing for its application across various product categories and user groups. It integrates multiple dimensions of consumer feedback, enabling a more holistic assessment of product quality and user satisfaction. The framework's effectiveness is further validated through rigorous testing, demonstrating its potential to serve as a reliable tool for businesses seeking to optimize their product offerings and enhance customer engagement.

Keywords: Correlation analysis, Linear fitting.

1. Introduction

In recent years, the success of many companies' products has increasingly relied on positive reviews as a key component of their marketing and promotion strategies. As consumers often base their purchasing decisions on the feedback provided by other users, it has become crucial for companies to ensure that new products receive favorable evaluations from the outset. This initial perception can significantly influence the product's market acceptance and long-term success.

Consequently, the relationship between customer reviews and product performance has emerged as a critical area of research. Understanding how these reviews impact consumer behavior and product reputation is essential for businesses aiming to optimize their marketing efforts. This growing focus has highlighted the need to develop a systematic product evaluation mechanism that leverages objective data from reviews. Such a mechanism would allow companies to analyze and interpret customer feedback more effectively, identifying key factors that contribute to positive evaluations and enabling them to make data-driven decisions in product development, marketing, and customer engagement strategies.

In light of this, there is an urgent demand to explore and establish methodologies that can accurately assess and quantify the influence of reviews on product success. By integrating various objective data points from customer feedback, companies can build a more comprehensive and reliable product evaluation framework. This approach not only enhances the accuracy of product

assessments but also provides actionable insights that can drive improvements in product quality, customer satisfaction, and overall brand reputation. As a result, research in this area is expected to play a pivotal role in shaping future marketing strategies and product development processes.

2. Product Evaluation model

2.1. The Data Processing

However, in the data category of each product, due to the different base of comment, the number of votes of helpful_votes and total_votes cannot well represent the relationship between the evaluation and these votes. Therefore, we use the percentage of helpful_votes in total_votes as the data of helpful_votes to explore the relationship between the factors affecting the evaluation and the evaluation.In addition we also found that different star helpful_votes total_votes percentage is different also, in response to better star and the percentage of relationship, we will be 1 to 3 star rating as the poor, will be 4-5 star rating as a good rating, and respectively calculate travel good ratings and ratings helpful_votes total_votes of percentage, so that we can better to reflect the relationship.We will each product all comments after star_rating weighted average for each product the final rating, and use statistical methods to find the verified_purchase amount of data, because we know the general review good basic will buy the products, so we are expressed as a percentage of the total number of comments and verified_purchase review, hair dryer, the pacifier, microwave oven is obtained that 3 kinds of products of the data processing results are as follows:

2.2. Relationship Analysis

Next, we need to analyze the relationship between star_rating and verified_purchase (%), helpful_star_rating (%), helpful_votes of good star_rating (%), and helpful_votes of bad star_rating (%).

We first carried out correlation analysis of the four data types of microwave oven, and obtained the following results:

Table 1. Processing of microwave data

star_rating	verified_purchase	helpful_votes of good star_rating	helpful_votes of bad star_rating
3.75	90.27%	90.27	89.92%
3.55	60.81%	60.81	86.69%
4.50	98.65%	98.65	92.63%
2.53	55.10%	55.10	73.33%
4.27	82.22%	82.22	95.50%
3.93	60.00%	60.00	87.74%
2.82	45.45%	45.45	81.17%
3.90	66.67%	66.67	100.00%
2.07	25.93%	25.93	94.46%
1.69	3.85%	3.85	69.57%
1.56	8.00%	8.00	87.42%
1.96	20.83%	20.83	0.00%
1.05	0.00%	0.00	61.11%

Correlation Matrix

		star_rating	verified_purchase (%)	helpful_votes of good star_rating (%)	helpful_votes of bad star_rating (%)
Correlation	star_rating	1.000	.953	.513	-.271
	verified_purchase (%)	.953	1.000	.481	-.233
	helpful_votes of good star_rating (%)	.513	.481	1.000	-.406
	helpful_votes of bad star_rating (%)	-.271	-.233	-.406	1.000
Sig. (1-tailed)	star_rating		.000	.037	.185
	verified_purchase (%)	.000		.048	.222
	helpful_votes of good star_rating (%)	.037	.048		.084
	helpful_votes of bad star_rating (%)	.185	.222	.084	

Fig 1. Microwave oven correlation matrix

As you can see from the figure, star_Rating has a significant correlation with verified_purchase (%), as well as with the other two types of data.The analysis of the other two products was similar to that of microwave ovens.

3. Simulation and Experiments

Then, we used various models to fit the relationship between the four types of data. First, we fitted the relationship between star_Rating and Verified_Purchase (%). The fitting results are as follows:

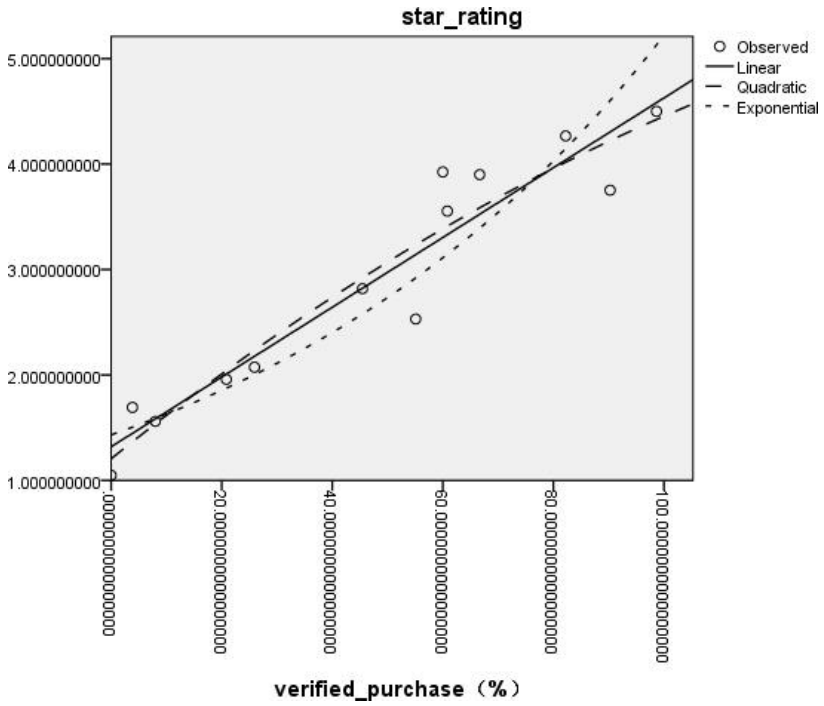


Figure 2. A fitting image of the relationship between the Star_Rating and verified_Purchase (%) of the microwave oven

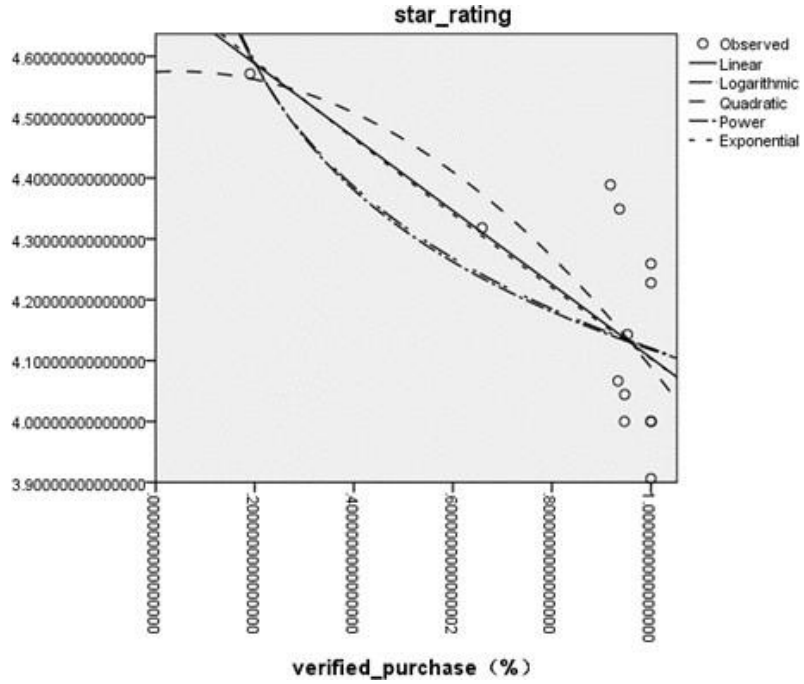


Figure 3. A fitting image of the relationship between star_Rating and Verified_Purchase (%) for a hair dryer

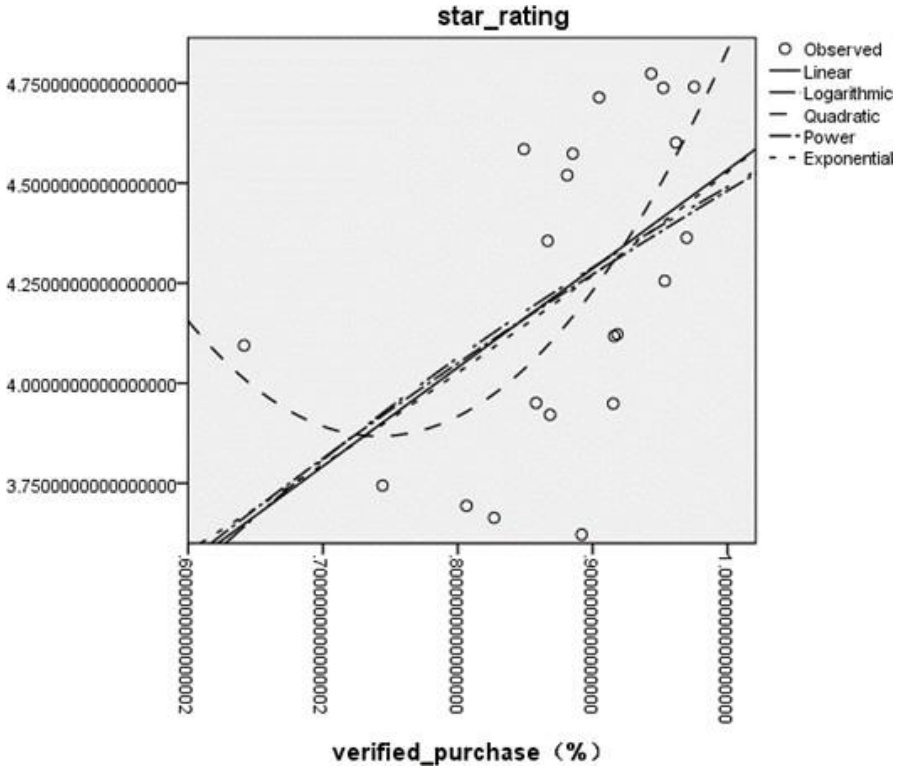


Figure 4. A fitting image of the relationship between the Star_Rating and the verified_Purchase (%) of the pacifier

4. Conclusion

Finally, through our detailed calculations and analysis, we have successfully determined the

relationships between the microwave oven, pacifier, hair dryer, and two other critical factors. These relationships are characterized by various mathematical forms, including three cubic relations, two quadratic relations, and one power relation. Each of these relationships provides valuable insights into how these products interact with specific variables, allowing for a deeper understanding of their performance and behavior under different conditions.Building on these findings, we can now explore ways to optimize these functions further. By refining the parameters and adjusting the models, it is possible to enhance the accuracy and efficiency of the predictive relationships we have established. Future research could focus on fine-tuning these functions, exploring their potential applications in different contexts, and integrating them into broader frameworks for product development and evaluation.Additionally, these relationships offer a foundation for developing advanced algorithms that can predict product performance more precisely. By leveraging these models, businesses can make more informed decisions regarding product design, manufacturing processes, and market strategies. As we continue to refine and optimize these functions, they hold the potential to significantly improve product quality, customer satisfaction, and overall market competitiveness. In this way, our study not only contributes to the current understanding of these relationships but also opens new avenues for future research and practical application.

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