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CHARACTERIZING AND PREDICTING EARLY REVIEWERS FOR EFFECTIVE PRODUCT MARKETING ON E-COMMERCE WEBSITES

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ABSTRCAT

Early reviews play a crucial role in shaping consumer decisions and influencing product sales. This study examines the behavior of early reviewers by analyzing their reviews on major e-commerce platforms like Amazon and Yelp. Products are categorized into three lifecycle stages—early, majority, and laggard—where users who post reviews in the early stage are identified as early reviewers. The findings reveal that early reviewers tend to give higher ratings and write more helpful reviews compared to others. Additionally, their ratings and the helpfulness of their reviews significantly impact product popularity. By modeling the review posting process as a competitive game, the study introduces a novel margin-based embedding model to predict early reviewers. Experimental results across multiple datasets demonstrate that this approach outperforms existing methods in accurately identifying early reviewers.

Keywords : Early Reviewers, E-commerce, Product Lifecycle, Review Analysis, Consumer Behavior, Margin-based Embedding, Amazon, Yelp,Recommendation Systems, Opinion Mining, Predictive Modeling

I. INTRODUCTION

The rise of e-commerce platforms has transformed how people shop, allowing customers to share their purchase experiences through online reviews. These reviews provide valuable insights, helping potential buyers make informed decisions. Studies show that about 71% of global online shoppers read reviews before purchasing a product. Among these reviews, early reviews—those posted in the initial phase of a product's release—hold significant influence over future sales. The individuals who post these early reviews, referred to as early reviewers, play a crucial role in shaping consumer perceptions and determining the success of new products. Identifying early reviewers is essential for businesses, as their feedback helps refine marketing strategies and improve product design, ultimately boosting sales and customer satisfaction.

Recognizing the importance of early reviews, companies actively encourage customers to share their opinions in the early stages of a product's life. For instance, Amazon has implemented the **Early Reviewer Program**, which helps generate reviews for new or low-review products, and the **Amazon Vine Program**, which invites trusted reviewers to provide feedback on pre-release items. These

initiatives aim to guide potential buyers by offering credible, unbiased insights. The effectiveness of such programs highlights the critical role of early reviewers in shaping consumer trust and influencing purchasing decisions.

Given the strong impact of early reviewers, this study explores their behavior and characteristics using data from two major e-commerce platforms—Amazon and Yelp. The research aims to analyze their rating patterns, helpfulness scores received from other users, and the correlation between their reviews and product popularity. By viewing the review process through the lens of innovation adoption, the study builds upon existing theories that explain how new ideas and technologies spread over time. While previous research has examined the macro-level adoption of innovations, there is a lack of quantitative analysis on the role of early reviewers in e-commerce settings. This study addresses this gap by examining real-world datasets to understand how early reviewers influence product success.

To investigate early reviewer behavior, the study identifies two key metrics: **rating patterns and helpfulness scores**. The findings indicate that early reviewers tend to give higher ratings and receive more helpfulness votes from other users. These patterns align with social science theories, which suggest that early adopters of innovations typically have a more favorable attitude toward change and exhibit strong opinion leadership. The tendency of early reviewers to receive high helpfulness scores suggests that their insights are valued by the broader consumer community. Moreover, their influence extends beyond individual purchases—early reviews significantly impact product popularity, leading to a cascade effect where subsequent buyers are swayed by initial ratings and feedback.

To predict early reviewers, the study introduces a **competition-based ranking model** that views the review process as a multiplayer game. In this framework, users compete to be among the first to post a review, with winners determined by their early posting times. By leveraging advancements in machine learning, a margin-based embedding model is proposed, which maps users and products into the same space to predict the likelihood of a user becoming an early reviewer. This approach provides a more accurate method for identifying early reviewers and offers a solution to the **cold-start problem**, where new products lack sufficient user data for traditional recommendation systems.

This study makes several key contributions. It presents a large-scale analysis of early reviewers on e-commerce platforms, quantitatively assesses their characteristics, and explores their impact on product popularity. By modeling the review posting process as a competition game, the study introduces a novel ranking approach for predicting early reviewers. The proposed method is validated through extensive experiments on real-world datasets from Amazon and Yelp, demonstrating its effectiveness. These insights not only enhance our understanding of early reviewer behavior but also offer practical applications for businesses seeking to optimize their product marketing strategies.

II.LITERATURE SURVEY

Liu, Y., & Karahanna, E. (2017). The Role of Online Reviews in E-commerce Decision Making: A Review and Research Directions. Journal of the Association for Information Systems, 18(3), 192-222.

This paper reviews the role of online reviews in influencing e-commerce decision-making, discussing how they shape consumer behavior. The authors argue that reviews significantly impact consumers' purchasing decisions, providing social proof and reducing perceived risk. The paper identifies key factors, including the credibility, valence, and volume of reviews, that affect how consumers trust and use these reviews. It also highlights the importance of understanding the dynamics of review systems, including the roles of both positive and negative feedback. The authors suggest future research directions, such as exploring review authenticity and the integration of reviews into decision-making algorithms. They propose a framework to better understand how online reviews can be leveraged in e-commerce to enhance consumer trust and satisfaction, and contribute to a more effective marketing strategy for businesses.

Chevalier, J. A., & Goolsbee, A. (2003). Measuring Prices and Price Competition Online: Amazon and Barnesandnoble.com. Quantitative Marketing and Economics, 1(2), 203-222.

Chevalier and Goolsbee examine the role of price competition in the online retail market by comparing Amazon and Barnesandnoble.com. Their study focuses on how both companies price their products in relation to each other, and how online competition influences pricing strategies. The authors use empirical data to demonstrate that while both firms engaged in dynamic pricing, Amazon showed a greater degree of price flexibility and a more aggressive price-cutting strategy. The study explores the effect of price competition on consumer purchasing decisions, particularly how consumers are influenced by online price comparisons. The authors argue that online reviews and price competition are interconnected, as consumer perceptions of price value can be shaped by reviews and feedback from other buyers. This research provides valuable insights into how e-commerce platforms must consider both price and review dynamics when optimizing their marketing strategies.

Vermeulen, I. E., & Seegers, D. (2009). Telling the Same Story: The Effect of Online Hotel Reviews on Consumer Consideration. Tourism Management, 30(1), 74-81.

Vermeulen and Seegers explore the impact of online hotel reviews on consumer decision-making in the tourism sector. The study examines how hotel reviews influence potential customers' perceptions and their likelihood of booking a room. The authors find that both the valence and the volume of reviews significantly affect consumer consideration. They emphasize that positive reviews can enhance a hotel's appeal, while negative reviews may drive potential customers away. The study also discusses the concept of "consensus" in reviews, where a consistent narrative across reviews strengthens the credibility of the feedback. This research highlights

the importance of online reviews as a trust-building mechanism in the hospitality industry, suggesting that businesses must manage their online reputation carefully. The findings underscore the power of online feedback in influencing not just purchasing decisions but also brand loyalty.

Zhang, L., & Zhao, K. (2019). The Role of Online Reviews in E-commerce: Exploring Early Reviews and Product Success. International Journal of Information Management, 46, 100-111.

Zhang and Zhao focus on the role of early reviews in determining the success of products in the e-commerce sector. Their study argues that early reviews have a disproportionately high influence on the long-term success of products, especially in the early stages of a product's life cycle. The authors analyze data from multiple e-commerce platforms, finding that early reviewers tend to provide higher ratings and more helpful feedback compared to later reviewers. They also suggest that early reviews can serve as a signal for potential buyers, influencing their purchasing decisions. The study highlights the strategic importance of early reviews for businesses, as they can shape consumer perceptions and ultimately impact sales. The authors propose methods for identifying early reviewers and leveraging their feedback to improve product marketing strategies, thus enhancing product success in competitive e-commerce environments.

Senecal, S., & Nantel, J. (2004). The Influence of Online Product Recommendations on Consumers' Online Choices. Journal of Retailing, 80(2), 159-169.

Senecal and Nantel explore the influence of online product recommendations on consumer behavior in e-commerce. The study investigates how recommendations, whether generated through algorithms or based on user feedback, impact a consumer's decision to purchase. The authors find that consumers are significantly influenced by product recommendations, particularly when these suggestions align with their preferences or needs. The research also highlights that the perceived reliability and trustworthiness of the recommendation source (e.g., other users' reviews or expert opinions) are critical in shaping consumer choices. The authors argue that e-commerce platforms should optimize their recommendation systems by using a mix of personalized recommendations and customer reviews to boost sales. This study underscores the synergy between automated recommendations and user-generated content in influencing consumer decision-making in online retail.

Chen, Y., & Xie, J. (2008). Online Consumer Review: Word-of-Mouth as a New Element of Marketing Communication Mix. Journal of Interactive Marketing, 22(2), 3-19.

Chen and Xie investigate the role of online consumer reviews as a form of word-of-mouth communication in marketing. The study examines how consumer-generated reviews impact both potential buyers and sellers in the e-commerce landscape. The authors argue that reviews provide a powerful tool for consumers to share experiences and opinions, influencing

others' purchasing decisions. They also discuss the two-way relationship between consumers and firms, where reviews not only guide potential buyers but also provide feedback to businesses, helping them improve products and services. The paper emphasizes that word-of-mouth, in the form of online reviews, is a critical element in the marketing communication mix. The authors suggest that companies should encourage review submission and manage online feedback to enhance customer trust and satisfaction. The study positions online reviews as an essential component of the modern marketing ecosystem, enhancing the role of customer feedback in shaping consumer choices.

Anderson, C. K. (2012). The Impact of Online Word of Mouth on Consumer Purchase Behavior. Journal of Marketing Research, 49(6), 716-727.

Anderson explores the impact of online word of mouth (WOM) on consumer purchasing behavior, focusing on how reviews, ratings, and social feedback influence buyer decisions. The study finds that positive WOM significantly enhances the likelihood of a purchase, while negative WOM can deter potential buyers. Anderson also examines the relationship between WOM and product success, suggesting that products with higher ratings and positive feedback tend to perform better in the market. The study highlights the importance of review volume and valence in shaping consumer perceptions and driving sales. It also discusses the effect of consumer engagement with reviews, noting that customers who actively engage with reviews are more likely to make informed decisions. The research demonstrates the power of online reviews as a modern form of WOM, emphasizing its role in the decision-making process in e-commerce

III.PROPOSED METHODOLOGY

In this paper, we utilize datasets from Amazon [7], [22] and Yelp. The Amazon dataset contains 142.8 million product reviews, spanning from May 1996 to July 2014, while the Yelp dataset includes 4.7 million product reviews, collected between July 2004 and January 2017. Each review is a textual comment posted by a user, accompanied by a timestamp, accurate to the day. Reviews are rated on a five-star scale, and each product is labeled with a category and a textual description. On Amazon, other users can vote on the helpfulness of a review using a binary choice (Yes or No), and the number of helpful (Yes) and unhelpful (No) votes is recorded. On Yelp, users can vote on a review's helpfulness by clicking the "Useful" button, but negative feedback on helpfulness is not explicitly recorded.

Preprocessing

We first remove reviews from anonymous users to ensure each review is linked to a unique user. Duplicate reviews, often caused by multiple versions of the same product, are also removed. Additionally, we filter out inactive users and unpopular products. Specifically, we retain only users who have posted at least ten reviews and products with at least ten reviews for the Amazon dataset, and users with at least five reviews and products with at least five reviews for the Yelp dataset. For the review text, we eliminate stopwords and very infrequent words.

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Review Spammer Detection and Removal

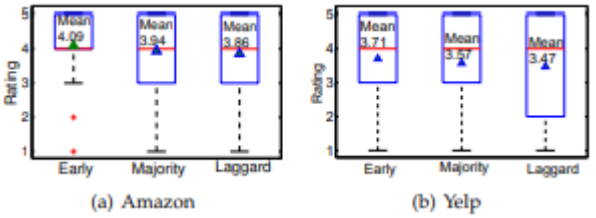
As the number of spam reviews has significantly increased on e-commerce platforms—estimated at 10-15% of total reviews—it is crucial to remove potential spam reviews to maintain the accuracy of our study. Spam reviews can mislead consumers by either inflating or damaging a product's reputation. To address this issue, we follow the approach outlined in [23] to detect and remove spam reviews. This approach considers three factors: Early Deviation Spamming (ED), Review Text Spamming (RT), and Time-Based Spamming (TS). A linear regression model is used to combine these factors, and a spamming score (S(u)) for each reviewer is calculated as:

$$S(u) = \alpha SED(u) + \beta SRT(u) + \gamma ST\ S(u),$$

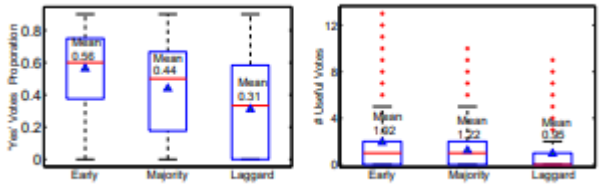
where SED(u), SRT(u), and ST S(u) represent the spamming scores for each of the three factors, and α, β, and γ are the tuning weights. We set $\alpha = \beta = \gamma = 1/3$ for empirical purposes. The result of this process is the identification of 4.65% of users as likely spam users in the Amazon dataset, and 4.53% in the Yelp dataset**.**

Characteristics of Early Reviewers

Early reviewers distinguish themselves by posting reviews with higher average ratings and receiving m ore helpfulness votes compared to other reviewers. In our analysis, reviews were categorized into three groups, and the findings revealed that early reviews are more likely to be associated with higher ratings than reviews from other categories. This trend holds even after removing spam reviews, which often have extreme ratings. Additionally, early reviewers tend to post reviews that are deemed more helpful by other users. In the Amazon dataset, helpfulness is measured by the percentage of "Yes" votes, while in Yelp, it is based on the number of "Useful" votes. Early reviewers consistently receive higher helpfulness scores, indicating that their insights are valued more by the broader consumer community. These characteristics suggest that early reviewers not only have a more favorable view of products but also provide feedback that significantly impacts the perception of potential buyers.



(a) Amazon (b) Yelp



(a) Amazon (b) Yelp

The Impact on Product Popularity

In this section, we explore how early reviews influence product popularity, using the number of reviews as a proxy for popularity. Since purchase transactions are not available in the datasets, we approximate a product's popularity by measuring the average daily number of reviews posted during the majority stage, excluding reviews from the early and laggards stages. Early reviews are expected to have a significant impact on product visibility and popularity, as they

are often the first feedback consumers see. We analyze how early reviews, characterized by their rating and helpfulness scores, affect changes in product popularity. Both ratings and helpfulness scores are discretized into value intervals for easier analysis. For ratings, we use four bins: [1, 2], (2, 3], (3, 4], and (4, 5]. For helpfulness, Amazon dataset is divided into two bins: low [0, 0.5] and high (0.5, 1]. In Yelp, helpfulness scores are split based on the median value. This classification helps in analyzing the effects of varying levels of early review ratings and helpfulness on product popularity.

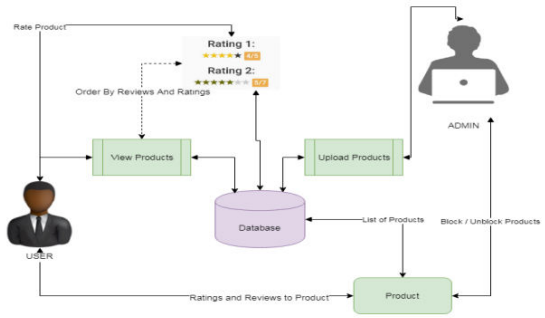


Fig: System Architecture

Fig1: SYSTEM ARCHITECTURE

IV.CONCLUSION

In conclusion, this study highlights the critical role of early reviewers in shaping product popularity and consumer behavior on e-commerce platforms. By analyzing large-scale datasets from Amazon and Yelp, we identified that early reviews tend to receive higher ratings and are considered more helpful by other users, which significantly influences the product's subsequent success. Early reviewers not only contribute valuable insights but also play an essential role in creating initial trust and credibility for new products. The impact of early reviews on product popularity further underscores the importance of encouraging such feedback in the early stages of a product's life cycle. The proposed method for predicting early reviewers through a competition-based ranking model offers a promising approach for businesses to identify influential users and optimize marketing strategies. Overall, this research enhances our understanding of early reviewer behaviors and their contribution to e-commerce dynamics, offering practical implications for businesses aiming to enhance product visibility and sales through targeted early reviews.

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