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Research Article

Predictive Modeling of Customer Satisfaction in Computer Hardware Product Returns: A Case Study in Bengaluru, India

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ABSTRACT

Reverse logistics, particularly in the realm of computer product returns, has become a critical factor in modern business operations. With the rapid expansion of e-commerce, businesses must navigate the complexities of return policies to maintain both customer satisfaction and operational efficiency. This study examines the impact of consumer satisfaction with return policies for computer products in Bengaluru, India, a major technology hub. By employing a quantitative research approach, data from 223 customers were collected and analyzed using various machine learning models, including Random Forest, K-Nearest Neighbors, Logistic Regression, and Support Vector Machines. The study identifies key factors influencing customer satisfaction and determines the best-performing model for predicting consumer behavior related to product returns. Findings highlight significant influences such as ease of return, processing time, payment methods, and competition from alternative providers. The research provides actionable insights for businesses to optimize their reverse logistics strategies, enhance customer satisfaction, and foster long-term loyalty in the competitive e-commerce landscape.

Keywords: Reverse logistics, Computer Product Returns, Customer Satisfaction, e-commerce, Return Policies, Machine learning, Predictive Modeling.

Introduction

Reverse logistics, particularly in the realm of computer product returns, has become an increasingly crucial aspect of business operations. The proliferation of e-commerce has thrust consumer return policies into the spotlight, as retailers grapple with balancing customer satisfaction and operational efficiency (Wang & Qu, 2017). Effective management of product returns is crucial to this growth, as it can present both opportunities and challenges for businesses (Agrawal et al., 2014)(Ramanathan, 2011)(2006). The increasing integration of technology into daily life has made the purpose of computer usage among consumers an increasingly important area of study, as businesses seek to better understand and cater to the evolving needs and behavior of their customers (Taleizadeh et al., 2021). Recent studies have provided valuable insights into the intricacies of product returns, exploring the factors that drive customers to return goods, the impact of return policies on customer engagement and revenue, and the broader implications for e-commerce businesses navigating this evolving landscape (Mukhopadhyay & Setoputro, 2004) (2006) (Kedia et al., 2019). This research paper aims to analyze the impact of consumer satisfaction with the

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return policy of computer products in Bengaluru, India. The study evaluates models predicting customer satisfaction and behavior patterns in specific scenarios related to product returns, using performance metrics to identify the best-performing model for various customer experience factors.

In Bengaluru, a major technology hub in India, this dynamic is particularly pronounced. Reverse logistics programs, which encompass the processes for handling product returns, have been shown to have significant effects on customer relationship management and online purchasing behavior. The perceived risk or complexity associated with a product can also shape customer expectations and tolerance around return policy issues – for instance, customers may be more forgiving of return policy problems for lower-stakes, simpler computer products compared to more sophisticated or high-cost technology purchases that carry greater personal or financial risk for the buyer.

Effectively managing computer product returns is a critical competency for businesses to cultivate, as product returns can have significant implications for profitability, customer satisfaction, and brand reputation. By understanding the various factors that influence customer perceptions and experiences around computer product returns in Bengaluru, companies can optimize their reverse logistics systems to enhance overall customer satisfaction and loyalty. (Ramanathan, 2011)(Ramanathan, 2011)(2011)(2006)(n.d.)(2023). Enhancing customer satisfaction during product returns is a significant challenge. Issues like long processing times, inconvenient procedures, and competition from alternative providers hinder loyalty and satisfaction. By leveraging machine learning models, this study aims to predict and understand customer behaviors, enabling businesses to take targeted actions to improve processes and experiences.

The existing literature on reverse logistics and product returns offers valuable insights into the importance of effective management of this critical aspect of business operations. Previous studies have explored the influence of risk on the relationship between product return handling and customer loyalty (Ramanathan, 2011), the challenges of forecasting product returns for recycling in the Indian electronics industry (Agrawal et al., 2014), the benefits of supply chain integration in the retail product returns process (Bernon et al., 2013), and the effects of reverse logistics programs on customer relationship management and online behavior. These studies highlight the need for a comprehensive understanding of customer preferences and behaviors to optimize reverse logistics and improve the customer experience. As such, there remains a need for continued research to address the gaps in our understanding of how these technological advancements and the changing e-commerce landscape are influencing consumer return behavior, particularly with regards to computer and electronic product purchases.(Barnes et al., 2004; Bernon et al., 2016; Hu et al., 2020; Robertson et al., 2020; Ülkü et al., 2013; Wang & Qu, 2017; Xia et al., 2016; Yan & Pei, 2018)

To address the research objectives, this study employed a quantitative research approach, utilizing a structured questionnaire to collect primary data from 223 customers in Bengaluru, India. The data was then analyzed using various statistical and machine learning techniques, including random forest, K-nearest neighbors, logistic regression, and support vector machines, to identify the best-performing model for predicting customer satisfaction and behavior patterns related to computer hardware product returns. (The Challenge of Reverse Logistics in Catalog Retailing, n.d.) (Lin, 2020). The questionnaire was designed to gather information on customer demographics, usage patterns, and satisfaction with various aspects of the product return process, such as the ease of initiating a return, the time taken for the return to be processed, return frequency, convenience, payment methods, return process and competition from alternative provider and the overall experience with the return policy. The survey data was then analyzed using the aforementioned machine learning models, with the goal of identifying the key factors that influence customer satisfaction and behavior in the context of computer hardware product returns. The findings of this study provide valuable insights that can inform decision-making and strategic planning for businesses operating in the computer hardware industry in Bengaluru, India, enabling them to develop targeted initiatives to improve customer return experiences and enhance loyalty in the competitive e-commerce landscape. Thus considering the same, the following objectives were considered in the study namely:

1. Analyze factors Influencing Customer Satisfaction with Computer Product Return Policies.
2. To identify the best-performing model for various customer experience factors.

Thus, the hypothesis of the study was to come up with a classification model which would help in prediction of satisfaction levels obtained in return policies.

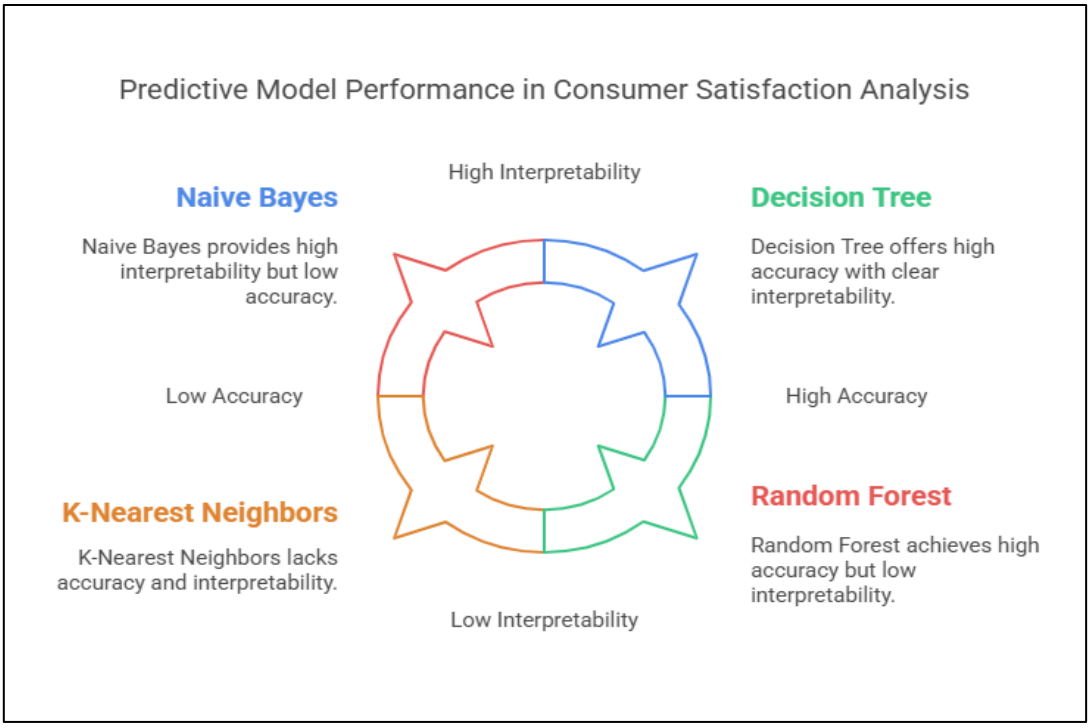
Data Collection and Methodology

The study employs various classification based supervised learning methods including decision tree method, random forest, logistic regression, support vector machines and k-nearest neighbors to examine the key factors influencing consumer satisfaction with computer product return policies. With the increasing prevalence of computers in consumers' daily lives, the reasons behind their usage and the factors that shape their experience with these products, particularly the return policies, have become a subject of significant interest and importance.

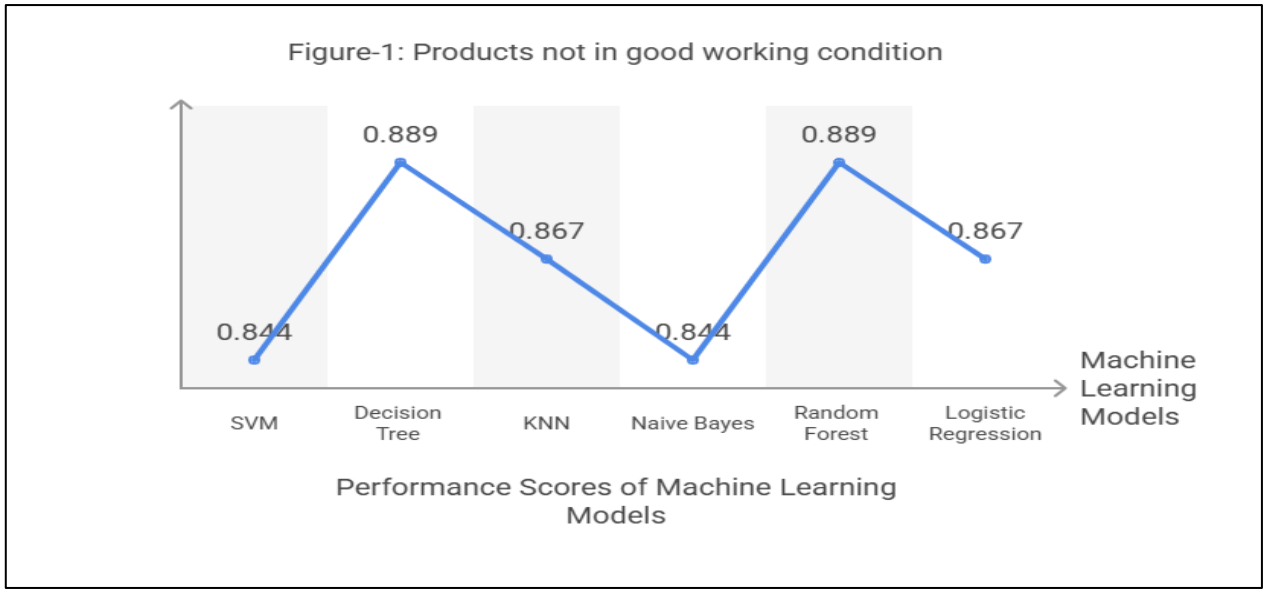
This study employed a quantitative research approach, utilizing a structured questionnaire to collect primary data from 223 customers in Bengaluru, India. The questionnaire was designed to gather information on customer demographics, usage patterns, and satisfaction with various aspects of the product return process, such as the ease of initiating a return, the time taken for the return to be processed, and the overall experience with the return policy. The primary objectives of using these models were to identify the key factors that influence customer satisfaction and behavior in the context of computer hardware product returns, as well as to determine the best-performing model for predicting these outcomes. The random forest model emerged as the top-performing model in terms of its ability to accurately predict customer satisfaction with computer hardware product returns. The key demographic variables considered were Gender, frequency of purchase, return frequency, job type, occupation, computer usage purpose, preferred payment, computer product and peripheral characteristics. The assessment of return experience was obtained using statements.

Results and Findings

The research study aimed to analyze the impact of consumer satisfaction with the return policy of computer products in Bengaluru, India. It evaluated models predicting customer satisfaction and behavior patterns in specific scenarios related to product returns. The models used included Support Vector Machine (SVM), Decision Tree, K-Nearest Neighbors (KNN), Naive Bayes, Random Forest, and Logistic Regression.

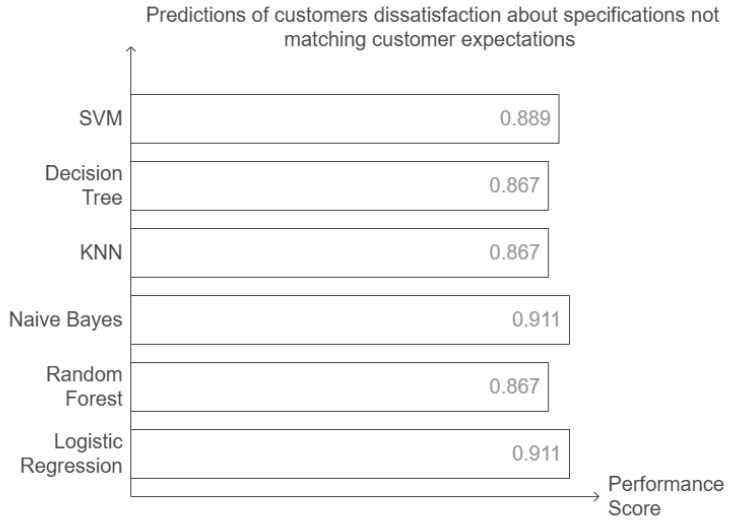


For products not in good working condition as shown in figure-1, Decision Tree and Random Forest models provided the highest accuracy, indicating their effectiveness in identifying customer satisfaction issues related to defective products.



Likewise, as shown in figure-2, Naive Bayes and Logistic Regression models performed best for returns due to specifications not matching customer expectations. These models are adept at processing categorical data, making them suitable for this scenario.

In the study of reverse logistics focusing on computer product returns in Bengaluru, India, several variables were



identified as key factors influencing consumer satisfaction and return behaviors. The study evaluated the performance of different machine learning models in predicting customer satisfaction and behavior patterns. The findings and the performance is evaluated in detail. Considering the Product Conditions and Specifications: Customers often return products due to functional issues. Future research could explore deeper correlations between specific types of defects and return rates, as well as how pre-emptive quality control can mitigate such returns. Returns caused by mismatched specifications highlight the need for clearer product descriptions and customer education. Researchers can investigate the effectiveness of various educational tools and detailed product listings in reducing such returns. Thus considering the variables under this construct, we were able to come up with the best prediction for each variable using various ML models. The best ML model for prediction of customers response as Not in good working condition was found to be Decision Tree and Random Forest. Similarly for Specification mismatch complaint prediction, Naive Bayes and Logistic Regression were found to be the best models. In the realm of reverse logistics for computer product returns in Bengaluru, India, effective management

of product returns is pivotal. The study highlighted several critical variables that influence consumer satisfaction and return behaviors. Machine learning models played a crucial role in predicting these patterns.

Variables related to the convenience of product usage showed that products no longer in use were best predicted by Random Forest, highlighting the evolving consumer needs and lifecycle patterns of tech products. Similarly, for the doorstep pick-up option, the Random Forest model again proved to be the most effective, emphasizing the need for convenient return processes. Complexities in the return process were critical factors, with Random Forest being the best model for scenarios where time taken to return is high and for lengthy and complicated return processes. The KNN model was optimal for dropping products at physical stores, indicating the importance of accessible return points.

Consumer behavior patterns revealed that the Logistic Regression model was effective for customers who wait a few days before returning products, while KNN and Random Forest models were best for those lazy to return until the last date. These insights suggest the potential of behavioral nudges to encourage timely returns. Preferences for refunds and replacements showed that KNN was the best model for customers who prefer refunds, and a combination of KNN, Decision Tree, and Random Forest models were optimal for those who prefer replacements. This indicates the need for flexible return policies to cater to diverse customer preferences. For processing time and company response, the importance of quick and efficient service was evident. Logistic Regression was best for customers satisfied with return time duration, while KNN was effective for those preferring shorter processing times.

The combination of KNN and Logistic Regression models was optimal for quick company response, and Logistic Regression for shorter reimbursement/refund times. SVM was identified as the best model for convenient payment processes, emphasizing the need for seamless financial transactions. The KNN model was effective for no questions asked returns, suggesting a preference for hassle-free returns. Variables related to shipping and reimbursement indicated that SVM and Logistic Regression models were best for free shipping, highlighting the significant impact of cost-free returns on customer satisfaction. Lastly, customer loyalty and purchase behaviors showed that the Random Forest model was optimal for predicting repeat purchases and buying refurbished products, suggesting the potential for remarketing and promoting sustainability through refurbished items.

These findings underscore the importance of leveraging machine learning models to optimize various aspects of reverse logistics. By understanding and predicting customer satisfaction and behavior patterns, businesses can enhance their return policies, ultimately leading to improved customer loyalty and sustained growth in the e-commerce sector as shown in Figure -4

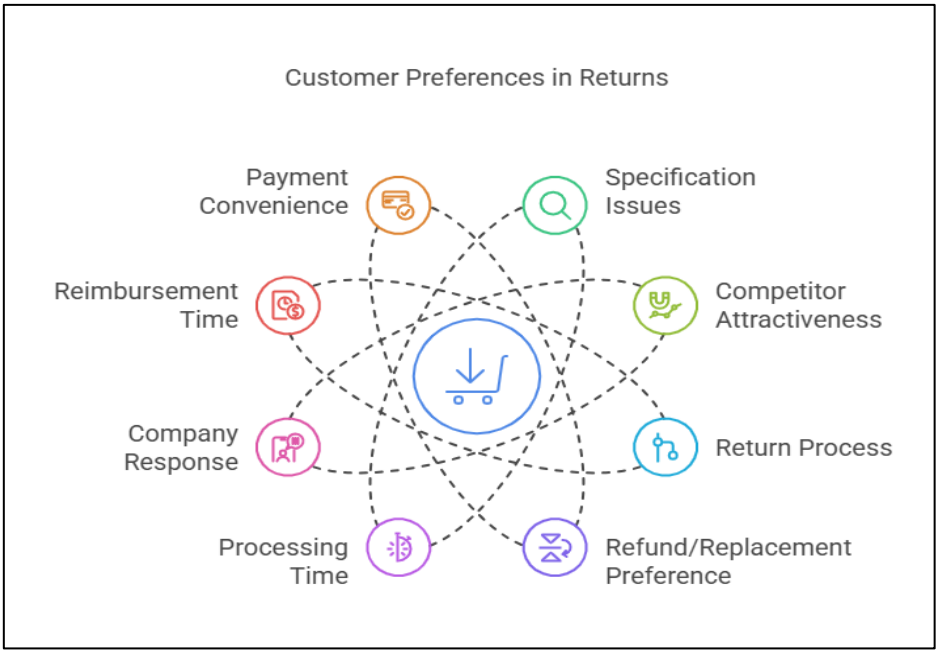


Figure 4: Choices found critically important in customer satisfaction in return choices

Conclusion

The current study provides valuable insights into the factors that influence customer satisfaction and behavior patterns related to computer hardware product returns in the rapidly evolving Bengaluru market. The findings of this research can enable businesses operating in the computer hardware industry to develop targeted initiatives and strategies to improve customer experiences, enhance loyalty, and ultimately drive growth in this competitive e-commerce landscape. (The Impact of Online Product Reviews on Product Returns, n.d.) (Hjort et al., 2013) (2006) While the present study offers a comprehensive understanding of the current landscape, further research is needed to explore the impact of emerging technologies, such as artificial intelligence and machine learning, on the management of product returns and customer experiences in the Indian market. (Yang et al., 2020) (Ambilkar et al., 2021)(2019)(2016)(2015)(Yang et al., 2020)

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