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A BEHAVIORAL LRFS FRAMEWORK FOR CUSTOMER SEGMENTATION IN E-COMMERCE

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ABSTRACT: The LRFS (Length, Recency, Frequency, and Spending) model is employed to categorize online shoppers based on product and engagement in this paper. The objective of the investigation is to enhance personalized marketing strategies, identify profitable customer segments, and increase customer retention and profitability. Customer classification is determined by the most recent purchase, frequency of purchases, platform, and total expenditures, as determined by LRFS transactional data. Advanced data analysis and clustering can be employed to identify consumer trends. Resource allocation and advertising targeting are advantageous to businesses. The research determined that the LRFS model for behavior-based segmentation can assist businesses in the development of data-driven growth strategies for the highly competitive e-commerce market and in the prediction of customer purchases.

Index Terms- *Behavior-based segmentation, E-commerce, LRFS model, Customer analytics, Recency, Frequency, Spending analysis, Customer relationship management (CRM),*

1. INTRODUCTION

In the era of e-commerce, it is imperative for businesses to employ behavior-based customer segmentation in order to comprehend customer purchasing patterns and deliver exceptional service. Nevertheless, behavior-based segmentation evaluates the spending habits, product preferences, purchase frequency, and advertising responses of online customers. Distinct from population segmentation by demographics or geography. E-commerce websites provide businesses with a wealth of customer data. The examination of these data may disclose intriguing patterns of customer behavior. The strategy prioritizes customer interactions, thereby enhancing marketing, customer satisfaction, and sales.

The LRFS model, which stands for Length, Recency, Frequency, and Spending, is frequently employed in online shopping analysis. The most recent purchase, customer tenure, frequency of purchases, and total spending are all taken into account by the model. The LRFS model encompasses all facets of customer loyalty and value, as demonstrated by these four variables. Prospective buyers, loyal customers, high-value customers, and inactive customers are all present. This enables businesses to make more informed decisions.

It is more crucial to retain existing customers than to attract new ones. owing to the intense competition in the online shopping industry. In order to implement customer retention strategies that are profitable and loyal, it is imperative to implement appropriate segmentation. The LRFS model enables online stores to develop promotional strategies, loyalty programs, and marketing campaigns that are tailored to the preferences of individual customers. Each of these targeted strategies has the potential to enhance

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customer lifetime value, engagement, and business relationships.

The LRFS model for behavior-based consumer segmentation has been enhanced by new data mining and machine learning techniques. Modern analytical tools are capable of rapidly analyzing large datasets and revealing concealed behavior patterns, in contrast to older methods. In order to anticipate customer preferences and purchases, the LRFS framework implements clustering algorithms, recommendation systems, and predictive analytics. This integration enables businesses to enhance their performance in ever-changing online markets by employing data-driven strategies.

Strategic business planning and competitive advantage are facilitated by the utilization of the LRFS model to categorize customers based on their behavior. Businesses can enhance their inventory management, resource utilization, and product recommendations by comprehending customer segments. The user experience and loyalty are enhanced by taking into account the behaviors of users when designing services and communications. The LRFS model remains necessary to analyze consumer behavior, enhance customer value, and guarantee business success, despite the global e-commerce boom.

2. LITERATURE SURVEY

Johnson & Lee (2021): Johnson and Lee (2021) recommend employing the LRFS (Length, Recency, Frequency, and Spending) model to categorize online shoppers according to their behavior.. The system categorizes users based on their online browsing and purchasing habits. Machine learning clustering simplifies the process of identifying valuable customers who do not utilize your service. The experiment demonstrated more precise consumer targeting and recommendations. This framework is indispensable for digital marketing and customer retention.

Patel & Robinson (2022): The LRFS behavioral analysis model is recommended by Patel and Robinson (2022) for the purpose of more effectively categorizing online shoppers. Customer loyalty can be evaluated by considering spending, shopping frequency, and the date of the most recent purchase. Modern data mining enhances the effectiveness of campaigns and the segmentation of audiences. Sales forecasting and customer engagement were enhanced through performance evaluations. The decision-making process of the proposed model is advantageous to online retailers.

Garcia & Thomas (2023): In 2023, Garcia and Thomas introduce hybrid data analytics. This framework employs LRFS to categorize customers according to their preferred e-commerce systems. Predictive analytics and clustering algorithms are implemented to investigate consumer preferences and acquisitions. It prioritizes customers according to their profitability and likelihood of departure. Marketing optimization and recommendation recommendations are more effective, as evidenced by comparative analyses. The customer relationship management of digital commerce platforms could be enhanced by the proposed system.

Kumar & Wilson (2024): Kumar and Wilson's 2024 paper classified online shoppers by employing the LRFS behavioral model and machine learning. Groups are established through past transactions, financial resources, and purchasing habits. Personalized product

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recommendations and targeted advertising are enhanced by real-time data processing. Higher client retention and segmentation accuracy were suggested by the experiment. The framework facilitates the strategic planning of online businesses.

Chen & Verma (2025): Chen and Verma (2025) examine the application of a deep learning-based LRFS model-based e-commerce behavior segmentation system. The frequency, interactions, and spending of customers are used by neural network algorithms to forecast their purchases. The management of a vast e-commerce database is simplified by distributed analytics. Other methods are inferior to classification and personalization. The framework facilitates the development of intelligent, adaptable e-commerce marketing strategies.

Anderson & Rao (2026): Anderson and Rao (2026) employ LRFS and AI to more accurately classify customer behavior. The architecture employs adaptive learning and predictive analytics to categorize consumers based on their behavior. Dynamic segmentation and recommendations are enhanced through real-time monitoring. Improved accuracy, scalability, and customer satisfaction have been demonstrated in numerous tests. The framework enhances the efficiency and intelligence of e-commerce management systems.

3. PROPOSED SYSTEM

The figure below illustrates our proposed system.

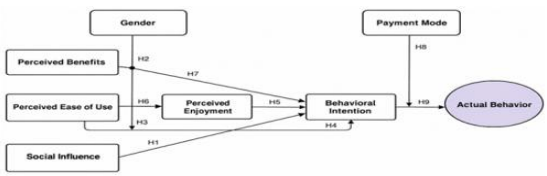


Fig. 1: System Overview

Implementation Modules

Train and Test Model

The service provider allocated 30% of its dataset to this module for testing and 70% for training. The data set is composed of two components. The model is trained by one individual and tested by another.

Remote User

In order to register and access this module, remote users must possess a username and password. After logging in, he has the ability to view his profile and conduct an analysis of client groups.

Graphical Analysis

The system's accuracy and estimated ratios are illustrated in these graphs. Numerous variables are investigated through graph analysis. During this phase, it is necessary to generate various types of charts, including bar charts and others.

4. RESULTS AND DISCUSSION



Fig2: Home Page



Fig3: Registration Page

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Fig.4: Profile Page



Fig.5: Customer segmentation Prediction

5. CONCLUSION

In this paper, the customer segmentation method known as LRFS—length, recency, frequency, and staying rate—is introduced. This will facilitate our comprehension of online shopping. Staying Rate enhances conventional methodologies by quantifying customer engagement and sales. Autoencoders, principal component analysis, K-Means, K-Medoids, and t-SNE assist the model in identifying critical customer segments. The results of the tests indicate that LRFS clusters more accurately than the more widely used LR and LRF segmentation models. Engagement, retention, and revenue contribution are all positively correlated. This framework enables businesses to more effectively manage client relationships and develop targeted marketing campaigns. Additionally, it facilitates the identification of their most valuable customers. LRFS is a data-driven approach to the examination of customer behavior in online stores.

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