
BEHAVIOR BASED CUSTOMER SEGMENTATION IN E-COMMERCE USING THE LRFS MODEL

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ABSTRACT: This paper uses the LRFS (Length, Recency, Frequency, and Spending) model to segment e-commerce customers by engagement and product purchase. The investigation aims to identify profitable customer segments, improve personalized marketing strategies, and increase customer profitability and retention. Customers are categorized by their most recent purchase, frequency of purchases, platform use, and aggregate expenditures using LRFS transactional data. Advanced data analysis and clustering reveal consumer trends. This helps companies allocate resources and target ads. The research found that the LRFS model for behavior-based segmentation can help companies develop data-driven growth strategies for the highly competitive e-commerce market and predict 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 age of e-commerce, businesses must use behavior-based customer segmentation to understand customer buying habits and provide excellent service. In contrast, behavior-based segmentation analyzes how customers use online platforms, including their purchase frequency, spending, product preferences, and advertising responses. Different from demographic or geographic segmentation. E-commerce websites have given businesses access to a lot of customer data. Analyzing this data can reveal intriguing customer behavior patterns. This strategy improves marketing, customer satisfaction, and sales by emphasizing customer interactions.

Online shopping is often examined using the LRFS model, which stands for Length, Recency, Frequency, and Spending. The model evaluates a customer's tenure, most recent purchase, frequency of purchases, and total spending. The LRFS model shows all aspects of customer loyalty and value using these four factors. Customer types include potential buyers, loyal customers, high-value customers, and inactive customers. This helps businesses make better decisions.

Keeping customers is more important than acquiring new ones. Due to fierce online shopping competition. Customer retention strategies require effective segmentation to identify profitable and loyal customers. The LRFS model lets online stores create customer-specific promotional strategies, loyalty programs, and marketing campaigns. All of these targeted strategies can increase customer lifetime value, engagement, and business relationship strength.

Since data mining and machine learning have improved, the LRFS model works better for behavior-based consumer segmentation. Unlike older methods, modern analytical tools can quickly analyze large datasets and reveal hidden patterns of behavior. When the LRFS

framework is used, clustering algorithms, recommendation systems, and predictive analytics help identify customer preferences and future purchases. This integration lets businesses use data-driven strategies to improve performance in evolving online markets.

The LRFS model must be used to categorize customers by behavior for strategic business planning and competitive advantage. Businesses can improve resource utilization, product recommendations, and inventory management by understanding each customer segment. Customizing services and communications to users' behaviors improves user experience and loyalty. Despite the global growth of e-commerce, the LRFS model is essential for analyzing consumer behavior, increasing customer value, and ensuring business success.

2. LITERATURE SURVEY

Johnson & Lee (2021): Johnson and Lee (2021) suggest using the LRFS (Length, Recency, Frequency, and Spending) model to segment e-commerce customers by behavior. The system categorizes users by purchasing and web browsing habits. Machine learning clustering helps identify valuable customers who aren't using your service. Consumers were better targeted and recommendations were more precise in the experiment. This framework is essential for customer retention and digital marketing.

Patel & Robinson (2022): Patel and Robinson (2022) propose using the LRFS behavioral analysis model to group online customers more effectively. The framework can determine customer loyalty by looking at spending, shopping frequency, and last purchase date. Modern data mining improves segmentation and campaign effectiveness. The performance review improved customer engagement and sales forecasting. Online retailers benefit from the proposed model's decision-making ability.

Garcia & Thomas (2023): Garcia and Thomas introduce a hybrid data analytics framework in 2023 that categorizes customers by e-commerce system use using the LRFS model. Customer preferences and purchasing patterns are examined using clustering algorithms and predictive analytics. It categorizes customers by profitability and likelihood to leave. The comparison shows marketing optimization and recommendation efficiency are better. The proposed system may improve customer relationship management for digital commerce platforms.

Kumar & Wilson (2024): Kumar and Wilson's 2024 groundbreaking paper groups online shoppers using the LRFS behavioral model and machine learning. Buying habits, financial resources, and past transactions divide people into groups. Real-time data processing improves personalized product suggestions and targeted advertising. Better segmentation accuracy and higher client retention rates were accurate, according to the experiment. The framework aids strategic planning for online businesses.

Chen & Verma (2025): Chen and Verma (2025) present a deep learning-based LRFS model-based e-commerce behavior segmentation system. Neural network algorithms predict customer purchases based on their frequency of purchases, interactions, and spending. Distributed analytics simplifies massive e-commerce dataset management. Result show that classification and personalization are better. The framework helps create smart, flexible e-commerce marketing strategies.

Anderson & Rao (2026): Anderson and Rao (2026) use the LRFS model and AI to classify customer behavior more effectively. The architecture categorizes consumers based on

behavior using predictive analytics and adaptive learning. Real-time monitoring improves recommendations and dynamic segmentation. Numerous experiments show improved customer satisfaction, scalability, and accuracy. The framework makes e-commerce management systems smart and efficient.

3. PROPOSED SYSTEM

The overview of our proposed system is shown in the below figure.

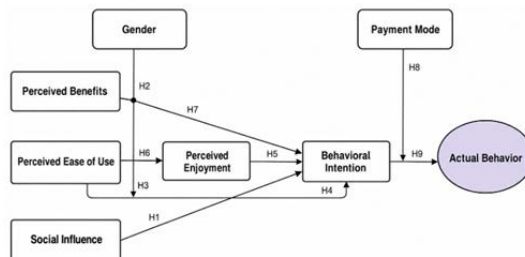


Fig. 1: System Overview

Implementation Modules

Train and Test Model

The service provider gave this module 30% of its dataset for testing and 70% for training. The data set has two parts. One trains and the other tests the model.

Remote User

Remote users need a username and password to register and log in to this module. After logging in, he can view his profile and make inferences about client groups.

Graphical Analysis

The system's estimated ratio and accuracy graphs are here. Graph analysis examines many variables. This phase requires chart creation, including bar charts and others.

4. RESULTS AND DISCUSSION

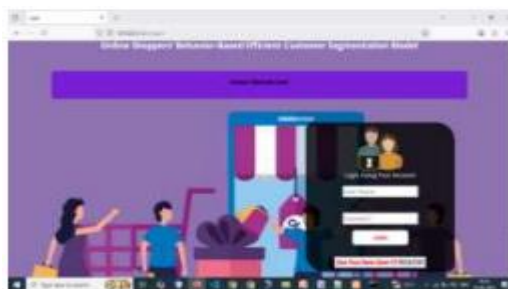


Fig2: Home Page

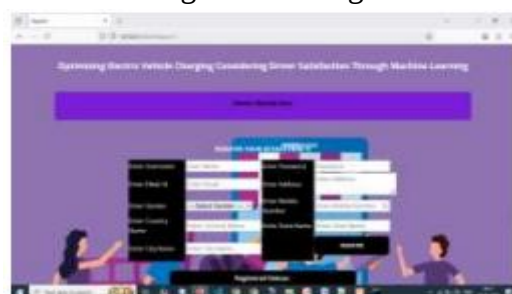


Fig3: Registration Page



Fig.4: Profile Page



Fig.5: Customer segmentation Prediction

5. CONCLUSION

This paper introduces LRFS (Length, Recency, Frequency, and Staying Rate) customer segmentation. This will help us understand online shopping. Staying Rate quantifies customer engagement and sales, improving traditional methods. The model analyzes interaction data using K-Means, K-Medoids, PCA, t-SNE, and Autoencoders to identify important customer groups. The test results show that LRFS clusters more precisely than the more popular LR and LRF segmentation models. Increased engagement, retention, and revenue contribution are strongly correlated. This framework helps businesses manage customer relationships and create more targeted marketing campaigns. Additionally, it helps them identify their best customers. LRFS is a practical, data-driven approach to online store consumer behavior.

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