ENHANCING CUSTOMER SEGMENTATION IN ONLINE TRANSPORTATION SERVICES: A COMPREHENSIVE APPROACH USING K-MEANS CLUSTERING AND RFM MODEL

Rizkita Bagus Perdhana[1]
Universitas Bakrie, Jakarta, Indonesia
rizkitabagus1@gmail.com

Jerry Heikal[2]
Universitas Bakrie, Jakarta, Indonesia
jerry.heikal@bakrie.ac.id

Abstract

In the rapidly evolving landscape of online transportation services, companies face complex challenges to maintain and expand their market positions. Understanding customer dynamics has become crucial for success, extending beyond mere acquisition to encompass retention. This study presents a comprehensive approach to customer segmentation in online transportation services using K-Means Clustering and the RFM Model. K-Means Clustering categorizes customers based on behavioral patterns, while the RFM Model provides a detailed insight into customer engagement in acquisition activities. The integration of these methodologies aims to enable companies to tailor services, enhance customer experiences, and formulate targeted marketing strategies. The analysis identifies 5 diverse customer groups: (1) Urban Luxury Commuters, (2) Non-Motorized Urban Users, (3) Tech-Savvy Urban Commuters, (4) Diverse Urban Commuters, and (5) Budget-Conscious Urban Commuters. Among these groups, the (2) Non-Motorized Urban Users group is the focus due to its high monetary value and the second-highest frequency level. Users in this cluster tend to transact frequently, indicating consistent and recent engagement with transportation services. Factors such as high transaction frequency and total transaction value underscore the importance of this cluster in generating overall revenue. Additionally, the research will consider additional factors such as user demographics, travel purposes, and promotional activities to further understand user behavior patterns in this cluster. The goal is to formulate targeted strategies to enhance user satisfaction, engagement, and potential revenue growth for transportation service providers. This study also introduces an RFM-based marketing program targeting different customer segments, such as (1) Platinum Membership, (2) Rush Hour Bonanza, (3) Bundle Extravaganza, (4) Revive and Thrive Offer, and (5) Back in the Saddle Campaign. Furthermore, the Refer-a-Friend Program encompasses all RFM segments, encouraging users to expand the network of online transportation service users. The seamless integration between customer segmentation and RFM-based initiatives has the potential to enhance customer retention, drive revenue growth, and improve operational efficiency, contributing significantly to adaptive business strategies in the dynamic online transportation services sector.

Keywords: Online Transportation Services, Customer Segmentation, K-Means Clustering, RFM Model, Marketing Strategies

INTRODUCTION

In the rapidly evolving landscape of online transportation services, companies face increasingly complex challenges to maintain and enhance their market foothold. The nuanced understanding of customers has emerged as a strategic linchpin for success in this competitive arena (Toha & Aini, 2022; Nurwakhidah & Musfiroh, 2024).). Customers exhibit diverse inclinations, and a company's ability to respond adeptly to these dynamics is pivotal for the sustained triumph (Faha et al, 2022). For providers of online transportation services, the scope goes beyond mere customer acquisition to encompass the retention of existing clientele. Therefore, the implementation of customer segmentation strategies becomes paramount. By comprehensively understanding customer attributes and behaviors, companies can tailor their services, elevate the overall customer experience, and devise more targeted marketing endeavors (Rufani et al, 2023).

This study focuses on integrating two powerful analytical methodologies: K-Means Clustering and RFM Models. K-Means Clustering empowers companies to categorize customers into homogeneous clusters based on analogous behavioral patterns, while RFM Models provide an exhaustive panorama of the depth to which customers engage in procurement activities. Through this comprehensive approach, it is envisioned that companies can more adeptly discern marketing strategies attuned to the distinct needs of each customer segment. Additionally, RFM analysis can aid in pinpointing customers with latent loyalty and understanding purchase trends ripe for optimization to augment customer worth.

The success of companies in embracing this strategy can have a positive influence not solely on customer retention but also on ancillary facets such as revenue augmentation, operational efficacy, and brand standing. Therefore, this research is not just about a heightened understanding of customers; rather, it is about the seamless integration of this discernment into tangible and enduring business decisions. Consequently, this research is poised to offer a substantial contribution to the evolution of sagacious and adaptable business strategies amid the dynamic currents of the present business milieu. As companies delve into

the amalgamation of K-Means Clustering and RFM Models, they embark on a journey towards a more data-driven and customer-centric approach. By identifying clusters with similar behavioral patterns through K-Means Clustering, businesses can customize their services and marketing strategies to cater to the specific needs and preferences of each segment. Simultaneously, the RFM analysis provides a granular understanding of customer engagement, focusing on recency, frequency, and monetary value of transactions. This insight enables companies to identify high-value customers, assess their loyalty potential, and optimize marketing strategies to nurture and retain these valuable segments.

The seamless integration of these analytical methodologies not only enhances the precision of customer segmentation but also lays the foundation for proactive decision-making. Armed with a comprehensive understanding of customer behavior, companies can anticipate trends, pre-emptively address challenges, and capitalize on opportunities for revenue growth. Moreover, the positive ramifications extend beyond immediate financial gains. Improved customer satisfaction and loyalty contribute to a robust brand image, fostering trust and positive word-of-mouth. Operational efficiency is bolstered as resources are strategically allocated based on the identified needs of different customer segments.

The marriage of K-Means Clustering and RFM Models in the realm of online transportation services is a strategic imperative. The resulting synergy empowers companies to navigate the intricate challenges of the market, foster customer loyalty, and drive sustained business success. This research not only elevates the understanding of customer dynamics but also advocates for the pragmatic incorporation of this knowledge into the fabric of business strategies. As companies embrace this holistic approach, they position themselves to not only survive but thrive amid the dynamic currents of the contemporary business landscape.

REVIEW OF LITERATURE

Customer Segmentation

Customer segmentation is the process of dividing customers into groups based on common characteristics so companies can market to each group effectively and appropriately (PARIS, 2022). Marketing segmentation allows an organization to achieve its highest return on investment (ROI) in turn for its marketing and sales expenses. (Martin, 2011).

Data Mining

Data mining aims to extract knowledge and insight through the analysis of large amounts of data using sophisticated modeling techniques. It converts data into knowledge and actionable information. The Data Mining Methodology for Cross Industry Standard Process for successful data mining implementations consists of the following steps: The process begins with understanding the business goal and assessing the current situation, followed by translating these goals into data mining objectives. Data understanding involves determining data requirements and conducting initial data collection, exploration, and quality assessment. Data preparation includes selecting required data, acquiring it, integrating and formatting it, cleaning, and transforming/enriching it as needed. Modeling entails selecting appropriate techniques, splitting datasets for evaluation, developing and assessing alternative algorithms, and fine-tuning model settings based on performance. Model evaluation is conducted in alignment with business success criteria, leading to model approval. Deployment involves creating a report of findings, planning and executing deployment procedures, distributing model results, integrating them into the organization's CRM system, developing maintenance and update plans, reviewing the project, and planning next steps (Tsiptsis, 2009).

Customer Relationship Management (CRM)

One of the strategies a company uses to retain its customers is Customer Relationship Management (CRM). CRM manages interactions and supports business strategies to build mutually beneficial relationships between companies and customers (Anas Syaifudin, 2023).

CRM is the core business strategy that integrates internal processes and functions, and external networks, to create and deliver value to targeted customers at a profit. It is grounded on high-quality customer-related data and enabled by information technology (Buttle, 2004). Francis Buttle's model, consists of five primary stages and four supporting conditions leading towards the end goal of enhanced customer profitability. The primary stages of customer portfolio analysis, customer intimacy, network development, value proposition development and managing the customer lifecycle are sequenced to ensure that a company, with the support of its network of suppliers, partners and employees, creates and delivers value propositions that acquire and retain profitable customers. The supporting conditions of leadership and culture, data and IT, people and processes enable the CRM strategy to function effectively and efficiently.

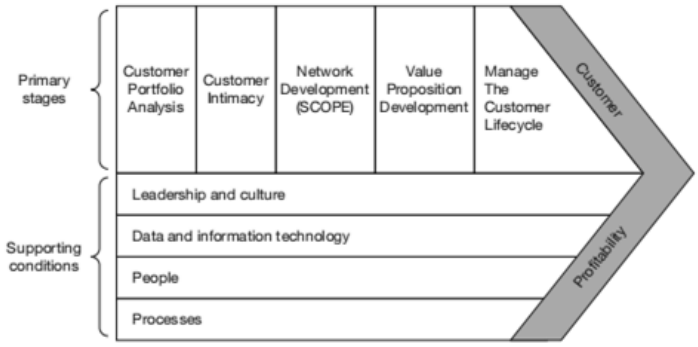

Figure 1.
CRM Strategy

K-Means Clustering

Clustering is a method to divide a set of data into a specific number of groups. It's one of the popular methods is k-means clustering. In k-means clustering, it partitions a collection of data into a k-number group of data (Ahmad, 2004).

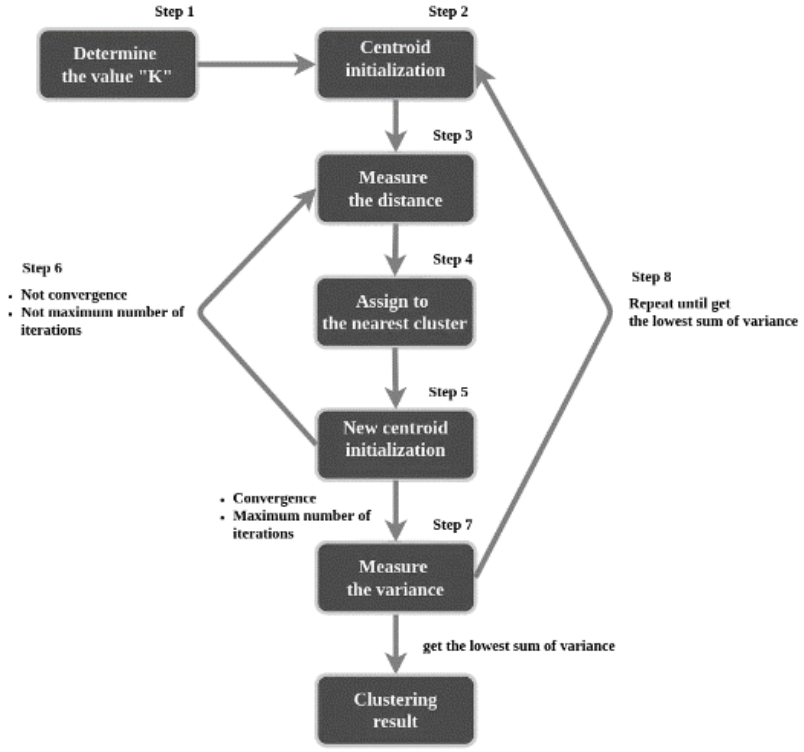

Figure 2.

K-Means Clustering

The step-by-step process for K-means clustering begins by determining the optimal number of clusters, denoted as "K". Next, three distinct centroids are randomly selected as cluster initializations. Subsequently, the Euclidean distance between each data point and the centroids is measured, and each point is assigned to the nearest cluster based on this distance. The mean of each cluster is then calculated to establish new centroids. This process of recalculating centroids and reassigning points to clusters is repeated iteratively until convergence, where the variance of each cluster is minimized. The entire procedure from centroid initialization to convergence is reiterated until the lowest sum of variance is achieved, indicating the optimal clustering solution.

Recency, Frequency, Monetary (RFM) Analysis

RFM stands for Recency, Frequency, and Monetary value. RFM analysis is a marketing technique used for analyzing customer behavior such as how recently a customer has purchased (recency), how often the customer purchases (frequency), and how much the customer spends (monetary).

Table 1.

Recency, Frequency, Monetary (RFM) Analysis

Beginning Data	End Data
Last Transaction Date | (type: date)	Recency (type: number)
Frequency Transaction	Frequency
Total Nominal Transaction	Monetary

It is a useful method to improve customer segmentation by dividing customers into various groups for future personalization services and to identify customers who are more likely to respond to promotions. (Birant). The RFM (Recency, Frequency, and Monetary) model has been widely applied in many practical areas over a long history, particularly in direct marketing. By adopting the RFM model, decision-makers can effectively identify valuable customers and then develop an effective marketing strategy (Jo-Ting Wei, 2010). The implementation steps for the calculation of the RFM components and cells are, transactional data underwent retrieval, audit, cleaning, and preparation for subsequent analysis. The population selected for segmentation comprised only active customers, excluding those deemed irrelevant, such as new customers joining within three months. Data preparation involved aggregating transactional data at the customer (card ID) level through a two-fold aggregation process: initially grouping records by card ID and transaction ID, then further grouping by card ID using IBM SPSS Modeler Aggregate. For each customer, key metrics were derived: the date of the latest purchase transaction to determine recency, the monthly average number of distinct purchase transactions for frequency, and the monthly

average amount spent for monetary analysis. The development of RFM cells involved sorting customers independently by each RFM component and binning them into quintiles, which were then combined to assign RFM cell values. Finally, RFM segments were developed through clustering (Tsiptsis, 2009).

RESEARCH METHOD

The initial stage of this research is identifying problems that occur within online transportation companies, and then collecting customer transaction data for 5 months in 2023. The next stage is conducting a literature study to determine the appropriate basic method for solving the problem. After that, data selection is carried out, at this stage the researcher selects the data that will be used in the RFM (Recency, Frequency, Monetary) method. This is done because not all variables in the data obtained are needed in the research. The variables used are customer ID, date and time of order, and amount of costs incurred by the customer. Next, the data preprocessing stage is carried out, at this stage several processes must be carried out. First, researchers carried out data transformation so that the data format was appropriate to what was needed when managing data using SPSS. After completing data preprocessing, researchers carried out clustering. Researchers used the K-means clustering method and obtained 5 clusters, which then selected 1 potential cluster which would be analyzed using the RFM model. From the research results, a marketing strategy is created that suits the positioning of each customer.

RESULTS AND DISCUSSION

K-Means Clustering

This clustering analysis captures various urban mobility profiles based on transportation choices, device preferences, geographical location, and spending habits among

online transportation service users. Urban Mobility Profiles reflect the wide range of preferences and mobility habits found in urban environments.

Table 2.

K-Means Clustering

Final Cluster Centers					
Category	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
	Urban Luxury Commuters	Non-Motorized Urban Users	Tech-Savvy Urban Commuters	Diverse Urban Commuters	Budget-Conscious Urban Commuters
Car	1.00	1.00	0.90	1.00	1.00
Bike	0.00	0.00	0.10	0.00	0.00
Jakarta	0.91	0.74	0.90	0.65	0.67
Non-Jakarta	0.09	0.26	0.10	0.35	0.33
iOS	0.00	0.27	0.35	0.29	0.25
Android	1.00	0.73	0.65	0.71	0.75
Monetary	1,227,909.1	252,332.1	59,479.5	678,198.4	448,146.1
Total Monetary	13,507,000.0	3,599,770,284.0	2,908,607,491.9	609,022,145.0	2,723,832,200.0

In the analysis of online transportation service usage data, we can identify five groups of users with distinct characteristics. Here is a more detailed summary and clustering name,

1. Cluster 1: Urban Luxury Commuters

   This cluster reflects users who prefer luxury cars, use Android devices, are mainly located in urban centers like Jakarta, and exhibit a tendency for high spending. Characteristics → Car users (Car: 1.00), Predominantly Android users (Android: 1.00), Mainly located in Jakarta (Jakarta: 0.91), High monetary spending (Monetary: 1,227,909.1)

2. Cluster 2: Non-Motorized Urban Users

   This cluster includes users who do not own cars, prefer Android devices, are spread across various urban areas, and have moderate spending patterns. Characteristics → non-Car users (Car: 0.00), Predominantly Android users (Android: 0.73), Spread across Jakarta and Non-Jakarta areas (Jakarta: 0.74), Moderate monetary spending (Monetary: 252,332.1)

3. Cluster 3: Tech-Savvy Urban Commuters

   Users in this cluster prefer using cars, use both Android and iOS devices, are mainly located in urban areas, and exhibit a moderate level of spending. Characteristics → Car users with a preference (Car: 0.90), Balanced use of Android and iOS (Android: 0.65, iOS:

0.35), Mainly located in Jakarta (Jakarta: 0.90), Moderate monetary spending (Monetary: 59,479.5)

4. Cluster 4: Diverse Urban Commuters

   This cluster represents users who prefer cars, use a mix of Android and iOS devices, are spread across urban areas, and exhibit moderate to high spending patterns. Characteristics → Car users (Car: 1.00), Balanced use of Android and iOS (Android: 0.71, iOS: 0.29), Diverse geographical distribution (Jakarta: 0.65, Non-Jakarta: 0.35), Moderate to high monetary spending (Monetary: 678,198.4)

5. Cluster 5: Budget-Conscious Urban Commuters

   Users in this cluster prioritize budget-conscious choices, prefer cars, predominantly use Android devices, are found in both urban areas, and exhibit lower spending compared to other clusters. Characteristics → Car users (Car: 1.00), Predominantly Android users (Android: 0.75), Located in both Jakarta and Non-Jakarta areas (Jakarta: 0.67), Relatively lower monetary spending (Monetary: 448,146.1)

The comprehensive analysis of Cluster 2 (Non-Motorized Urban Users), which demonstrated a substantial total monetary value and the second-highest frequency level, the examination of Recency, Frequency, and Monetary (RFM) metrics provided valuable insights into user behavior and engagement within this cluster.

Recency, the first dimension of the RFM analysis, indicates the time elapsed since the last transaction. In the case of Cluster 2 (Non-Motorized Urban Users), users displayed a noteworthy pattern of frequent transactions, emphasizing a consistent and recent engagement with transportation services. This suggests a high level of user activity and interest within this cluster. Moving on to Frequency, which reflects the number of transactions undertaken by users, Cluster 2 (Non-Motorized Urban Users) emerged as a significant player, with a total of 14,266 transactions. This substantial frequency level signifies a dedicated user base within the cluster, contributing significantly to the overall monetary value. Understanding

the reasons behind this heightened frequency could unveil specific user preferences, habits, or needs that make this cluster stand out.

The Monetary dimension, representing the total value of transactions, revealed that Cluster 2 (Non-Motorized Urban Users) contributed an impressive Rp. 3.59 billion. Although Cluster 1 (Urban Luxury Commuters) boasted the highest average transaction value, the sheer volume of transactions in Cluster 2 (Non-Motorized Urban Users) highlights its importance in terms of overall revenue generation. This prompts further exploration into the specific factors influencing the spending behavior of users in this cluster. To gain a more nuanced understanding, the researcher will now consider additional factors such as user demographics, trip purposes, and potential promotional activities that might be contributing to the observed patterns within Cluster 2 (Non-Motorized Urban Users). By unraveling the intricacies of user behavior in this cluster, the aim is to formulate targeted strategies that enhance user satisfaction, and engagement, and potentially drive further revenue growth for the transportation service provider.

RFM Analysis

When we examine the results of RFM analysis for online transportation usage, we can identify several distinct customer segments. This analysis allows us to develop more targeted marketing strategies to improve customer retention and maximize the value of each segment. Here's a quick overview of each segment based on RFM scores.

Count of RFM_score	Column Labels					
Row Labels	1	2	3	4	5	Grand Total
1	**98**	**102**	**99**	**100**	**99**	**498**
2	61	64	62	62	62	311
4	22	22	22	22	22	110
5	15	16	15	16	15	77
2	**98**	**100**	**101**	**101**	**98**	**498**
1	37	37	38	37	37	186
3	23	24	24	24	23	118
4	23	23	23	23	23	115
5	15	16	16	17	15	79
3	**97**	**101**	**100**	**102**	**99**	**499**
1	24	25	24	25	25	123
2	17	18	17	19	17	88
3	13	14	14	14	13	68
4	25	26	26	26	26	129
5	18	18	19	18	18	91
4	**97**	**102**	**99**	**102**	**98**	**498**
1	16	17	16	17	16	82
2	23	24	23	24	23	117
3	21	22	21	22	21	107
4	17	18	18	18	17	88
5	20	21	21	21	21	104
5	**97**	**101**	**100**	**101**	**99**	**498**
1	16	17	17	17	17	84
2	21	22	22	22	21	108
3	21	22	22	22	22	109
4	20	20	20	20	20	100
5	19	20	19	20	19	97
Grand Total	**487**	**506**	**499**	**506**	**493**	**2491**

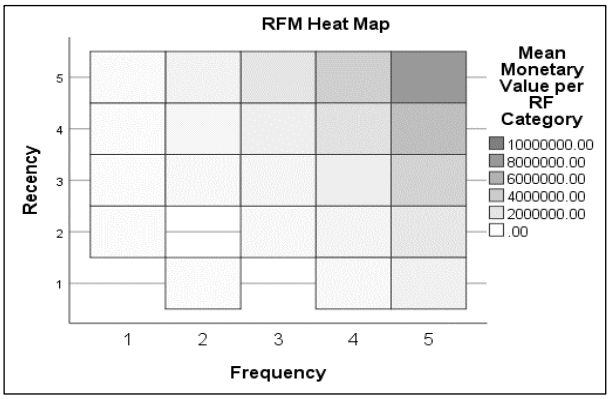

Figure 3.

RFM Analysis

From the data above, RFM scores can be grouped into 5 categories, where RFM scores are typically calculated based on the following criteria: recency, frequency, and monetary value. This categorization allows for a comprehensive analysis of customer or prospect behavior by measuring how recently they interacted with products or services (recency), how often they engage in transactions (frequency), and the monetary value of their transactions (monetary). By understanding these three dimensions, businesses can develop more effective marketing and customer service strategies to enhance customer retention and overall business value.

1. RFM Score 5 - Platinum Membership

   The target audience comprises the most active and high-spending customers who have recently utilized the online transportation service frequently, characterized by their highest recency, frequency, and monetary values. The proposed marketing strategy involves leveraging digital advertising channels such as Facebook, Instagram, and Google Ads to target these users with promotions for an exclusive Platinum Membership. Additionally, personalized email campaigns will be employed to emphasize the benefits of the Platinum Membership and offer early subscribers a limited-time discount. Furthermore, in-app notifications will serve to remind users about the Platinum Membership and its advantages whenever they access the app.

2. RFM Score 4 - Rush Hour Bonanza

   The target group consists of active users who utilize the service frequently, albeit not as consistently or recently as those in RFMScore 5. These users exhibit high recency, frequency, and monetary values, slightly lower than RFM Score 5. The marketing strategy devised for this segment includes geotargeted push notifications sent during rush hours, highlighting an extra 20% discount available at peak times. Additionally, targeted social media campaigns will emphasize the Rush Hour Bonanza, focusing on the time-sensitive discount. In-app banners will also be featured during peak hours to inform and remind users about the ongoing promotion, enhancing engagement and incentivizing purchases.

3. RFM Score 3 - Bundle Extravaganza

   Loyal customers characterized by moderately high recency, frequency, and monetary values are targeted with specific marketing strategies. Monthly promotional emails are sent to users with an RFM score of 3, offering a 15% discount on two rides through the Bundle Extravaganza. Additionally, limited-time pop-ups within the app notify users about the availability of the Bundle Extravaganza for the month. Social media platforms are utilized to tease the Bundle Extravaganza, prompting users to check their app for exclusive monthly offers. These strategies aim to engage and retain loyal customers who

may not have the highest spending or usage frequency but contribute significantly to service utilization.

4. RFM Score 2 - Revive and Thrive Offer

   Customers who have been less active in the last two months exhibit lower recency, frequency, and monetary values compared to those with higher RFM scores. To re-engage this segment, a multi-channel marketing strategy is proposed. This includes setting up an email drip campaign highlighting the Revive and Thrive Offer with a 25% discount, emphasizing its time-sensitive nature. Additionally, personalized messages will be sent through the in-app inbox, encouraging users to redeem their exclusive discounts. Retargeting ads will also be deployed across various digital platforms, reminding inactive users about the offer and urging them to return. This comprehensive approach aims to reignite interest and drive these customers back to active engagement.

5. RFM Score 1 - Back in the Saddle Campaign

   Inactive customers, defined as those who haven't utilized the service for the past three months, exhibit characteristics including the lowest recency, frequency, and monetary values. To re-engage these users, a multifaceted marketing strategy is proposed. This includes SMS marketing, wherein personalized messages offering a 30% discount coupon code are sent to inactive users, encouraging them to utilize the code for their next rides. Additionally, social media retargeting campaigns are initiated, specifically targeting users who received the "Back in the Saddle" SMS, thereby reinforcing the promotional offer across multiple channels. Furthermore, upon returning to the app after the inactive period, users are greeted with a welcoming message featuring the discount code on the app's welcome screen, enhancing the visibility and attractiveness of the promotional offer.

6. RFM All Segmentation - Refer-a-Friend Program

   To encourage users to refer friends and expand the user network, regardless of their RFM scores, a multi-faceted marketing strategy is proposed. This strategy includes implementing an in-app referral feature for seamless sharing of unique referral links,

leveraging social media channels to promote the Refer-a-Friend Program and highlight its benefits, and sending periodic notifications or emails reminding users of the bonus points they can earn through referrals. By employing these approaches, the aim is to maximize user engagement and incentivize active participation in expanding the app's user network.

CONCLUSION

This study delves into the dynamic world of online transportation services, emphasizing the critical importance of customer understanding for businesses seeking to successfully navigate the changing landscape. The combination of K-Means Clustering and RFM Models proves to be a powerful analytical approach, allowing businesses to categorize users into distinct clusters based on behavioral patterns and investigate their engagement depth. The K-Means Clustering analysis identifies five diverse clusters, each representing unique urban mobility profiles. These clusters, such as Urban Luxury Commuters and Budget-Conscious Urban Commuters, offer a comprehensive understanding of customer preferences, device usage, geographical distribution, and spending habits. This segmentation lays the foundation for targeted strategies tailored to meet the specific needs of each cluster.

The subsequent focus on Cluster 2 (Non-Motorized Urban Users) reveals a dedicated user base with significant transaction frequency and monetary contribution. RFM analysis within this cluster exposes a pattern of consistent and recent engagement, indicating a high level of user activity. The exploration of Recency, Frequency, and Monetary dimensions provides valuable insights for crafting targeted strategies to enhance user satisfaction and drive revenue growth. The RFM Analysis broadens the perspective by segmenting users based on their RFM scores. This segmentation facilitates the development of targeted marketing strategies, as evidenced by the implementation of programs such as Platinum Membership, Rush Hour Bonanza, Bundle Extravaganza, Revive and Thrive Offer, and the

Back in the Saddle Campaign. These programs cater to different customer segments, providing personalized incentives to enhance customer retention and overall value.

Furthermore, the inclusion of the Refer-a-Friend Program spanning all RFM segments adds a social element, encouraging users to expand the online transportation user network. This holistic approach, combining cluster-based insights and RFM segmentation, offers companies a nuanced understanding of their customer base, empowering them to make informed decisions for sustained success.

In essence, the seamless integration of customer segmentation strategies and targeted RFM-based initiatives has the potential to not only bolster customer retention but also influence ancillary facets such as revenue growth, operational efficiency, and brand standing. This research contributes significantly to the evolution of adaptive business strategies in the dynamic currents of the online transportation service sector.

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