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# RFM Analysis to Understand Customer Patterns, Engagement and Retention in E-Commerce

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**Abstract**

Recency, Frequency and Monetary (RFM) analysis is a popular marketing technique that seeks to classify customers according to the frequency and value of their transactions. This article provides an introduction to the RFM analysis process and how it is used to gather crucial information for developing targeted marketing strategies. By using the RFM analysis on our catalogue and analysing sales data, we gain significant insights into the performance of particular products. According to the demand, the Recency dimension reveals which items are selling swiftly or slowly. Frequency dimension shows how well-liked particular goods are. The financial component, sheds information on viability and worth of any offering. RFM analysis gives marketers an opportunity to pinpoint various consumer categories with varied degree of loyalty, engagement and profitability. RFM analysis enables marketers to group customers into categories, like high-value, at-risk or dormant, using a combination of statistical methodologies and data mining. With a deep understanding of catalogue and sales data, we can make better choices on the products for customers. By emphasising top-selling items on the home-page, we may captivate customers and instantly pique their curiosity. In order to increase consumer involvement, we might simultaneously prepare to promote slower moving products with targeted incentives. The messaging, promotions and customer interactions can be modified for specific preferences of each group. High value customers can receive exclusive incentives to strengthen loyalty, and at risk customers receive re-engagement initiatives. By using RFM framework, businesses may develop targeted marketing strategies, enhance client interaction and boost marketing return-on-investment.

**Keywords:** RFM Model, Data Science, E-Commerce, Inventory, Product Marketing, Machine Learning

## Introduction

In the intensely competitive climate of modern business, organisations face a variety of challenges when trying to properly manage client relationships and maximise marketing tactics. Many firms regularly struggle with the problem of identifying and comprehending consumer categories based on their purchasing behaviour. However, RFM analysis has shown to be a brilliant workaround for this problem. Recency, Frequency, and Monetary Value, or RFM, has shown to be a powerful strategy for consumer segmentation and has helped businesses get over the challenges of concentrating on the right clients with the right marketing strategies. This introduction will look at a specific issue that an organisation faced and how the use of RFM analysis assisted in identifying a practical solution.

Then what does RFM stand for? The RFM model is a segmentation technique that categorises customers based on their recent transaction history. Three crucial facets of consumer behaviour are quantified:

- *Recency (R)* – How recently a customer made a purchase or engaged with the company.
- *Frequency (F)* – How often a customer makes purchases or interacts with the company.
- *Monetary Value (M)* – The total amount of money a customer has spent on purchases.

Each of these dimensions is typically assigned a numerical score, with higher values indicating more recent activity, higher frequency, or greater monetary value. These scores are then used to segment customers into distinct groups for targeted marketing.

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## The Components of RFM

### Recency (R)

Recency measures the interval since a customer last made a transaction. By analysing this metric, the business was able to differentiate between clients who had recently made purchases and those who had not interacted with the brand in a while. Because of this, it was simpler for the company to identify customers who had lost favour and required targeted outreach to stimulate their interest and win them back.

### Frequency (F)

Frequency refers to the total number of transactions that each consumer completes within a specific time frame. By looking at this dimension, the business was able to differentiate between loyal customers who made purchases frequently and those who made purchases only sometimes. Because of this, the company was able to tailor marketing campaigns and promotions to the specific needs of different consumer groups, boosting customer engagement and conversion rates.

### Monetary Value (M)

The monetary amount corresponds to an average consumer expense. By carefully examining this factor, the business may be able to distinguish between high-value customers who frequently made large purchases and low-value customers who frequently made lesser purchases. This knowledge was necessary for prioritising customer service activities and effectively allocating resources to satisfy the demands of each group in turn.

An organisation can develop a thorough understanding of its consumer base by implementing RFM analysis. These data enabled them to create targeted marketing efforts that were adapted to the tastes, habits, and purchasing power of various customer groupings. RFM data can be used to create customised loyalty programmes and rewards, reactivate inactive consumers and cultivate long-lasting relationships with their most important clients.

## Literature Review

Wei et al.'s (2014) research offers a comprehensive analysis of how the RFM model has evolved beyond its traditional direct marketing origins to find use in modern E-commerce environments. The flexibility of RFM Analysis as a useful tool for comprehending consumer behaviour, patterns and engagement is highlighted in this review, making it an important subject of research in our investigation of RFM Analysis in the context of E-commerce. The thorough analysis of RFM's applications across sectors by them serves as a fundamental reference, highlighting the lasting importance of this analytical method in today's dynamic business environment.

The main goal of Sabuncu et al.'s (2020) research is to apply RFM analysis to comprehend consumer behaviour in the setting of E-commerce. They demonstrate how RFM metrics, which comprise RFM Value, may be effectively used to divide clients into different categories according to their shopping preferences. This segmentation technique enables businesses to tailor their marketing plans and customer-engagement initiatives to various client segments, thereby enhancing customer satisfaction and retention. The study by them contributes to the growing body of research demonstrating the usefulness of RFM analysis in enhancing client segmentation and engagement tactics in E-commerce.

The RFM (Recency, Frequency, Monetary) technique is highlighted in the study by Cuce and Tiryaki (2020) which digs into its use in consumer segmentation. This study significantly advances our understanding of data-driven client segmentation strategies. They stress the value of data analytics in contemporary corporate settings where copious amounts of customer data are produced and gathered. They discuss how organisations can correctly categorise customers based on recency, frequency of transactions, and monetary worth using the RFM technique, which is based on data analytics concepts. By articulating the connection between data analytics, customer segmentation, and RFM, their work provides crucial insights into the fundamental ideas supporting the adoption of data-driven tactics for enhanced consumer engagement and retention in the E-commerce business.

The bigger theme of employing RFM Analysis to get insights into consumer behaviour and preferences is furthered by Lewaaelhamd's (2023) research. The study examines how consumer segmentation could be enhanced by combining machine learning methods

with the traditional RFM framework. The study gives a fresh viewpoint on optimising consumer engagement and retention methods in the E-commerce sector and attempts to solve the limitations of classic RFM approaches using a data-driven approach. By offering a glimpse into potential synergies between data science and customer segmentation for businesses operating in the digital marketplace, this paper contributes to the body of literature on RFM Analysis.

The research conducted by Chaudhary in 2023 shows a tremendous improvement in this field. Chaudhary's study uses a hybrid machine learning approach that combines RFM Analysis with cutting-edge machine learning techniques to increase the accuracy of consumer segmentation. By fusing data-driven algorithms with conventional RFM indicators, Chaudhary's research pushes the boundaries of client segmentation approaches in the E-commerce space. This article highlights the significance of being at the forefront of technical innovation in order to fully realise RFM Analysis's potential for analysing consumer behaviours and optimising engagement and retention strategies. It also demonstrates the ongoing development of RFM analysis.

## Objective

Therefore, the objective of this study is to apply RFM analysis to a dataset, in order to, segment customers based on their purchasing behaviour and identify valuable customer segments for targeted marketing strategies.

## Implementing the RFM Model

### Data Collection and Preparation

Gather the dataset containing the required columns: ID of the product, Subcategory of the product, Category of the product, Catalogue Creation Date and Inventory Last Modified date. Ensure the dataset is complete and accurate.

**Table 1: The Dataset**

| Gender | Price(INR) | product-Id | Product_sub_category | Product-category | Date_created | Date_modified |
|---|---|---|---|---|---|---|
| Women | 21989 | 1000000001 | Women - Bracelets & Bangles | Accessories | 2021-10-18T13:34:11Z | 2022-08-23T12:05:31.943Z |
| Women | 26834 | 1000000002 | Women - Bracelets & Bangles | Accessories | 2021-10-18T13:34:42Z | 2022-08-23T12:25:26.980Z |
| Women | 24432 | 1000000003 | Women - Bracelets & Bangles | Accessories | 2021-10-18T13:35:20Z | 2022-08-23T12:08:06.692Z |
| Women | 23733 | 1000000004 | Women - Bracelets & Bangles | Accessories | 2021-10-14T11:57:46Z | 2022-08-23T12:01:55.205Z |
| Women | 49250 | 1000000005 | Women - Bracelets & Bangles | Accessories | 2021-10-14T11:56:40Z | 2022-10-15T12:45:02.412Z |
| Women | 36115 | 1000000006 | Women - Bracelets & Bangles | Accessories | 2021-10-14T11:55:36Z | 2022-08-23T12:14:34.446Z |

### Calculating RFM Scores

- Recency Calculation

Calculate the recency value for each product based on the last modified date. And assigning a recency score indicating how recently the product was added to the catalogue, with a higher score indicating more recent additions.

- Frequency Calculation

Determine how frequently the product's inventory information was changed to determine the frequency value for each product. The frequency of the product's inventory changes should be shown by a score, with a higher score suggesting more frequent updates.

- Monetary Calculation

Based on the available data, determine the monetary value for each product. This can be derived by considering factors such as sales revenue generated by the product or the average price of the product. For this study we have used the product price to calculate the monetary value of the product.

After the recency, frequency and monetary values were calculated we merged the recency, frequency, and monetary data frames into an RFM data frame. To normalise the ranks, we converted the recency, frequency, and monetary ranks into percentages, which allows us to compare these measures fairly. To emphasise the relevance of each component, the final RFM score was computed using weighted averages of the normalised ranks.

### Formula to Calculate the RFM Score

0.15*Recency score + 0.28*Frequency score + 0.57 *Monetary score

We divided products into categories based on their RFM scores, which are a full depiction of their purchasing behavior. The segmentation criteria are as follows: Products with an RFM score better than 4.5 have been identified as "Top products," signifying extraordinary value and significant involvement. Those with scores between 4.5 and 4 were classified as "High-Value products," indicating their critical importance to the company. "Medium-Value products" received scores ranging from 4 to 3, indicating a satisfactory level of engagement. In contrast, "Low-Value products" had RFM scores ranging from 3 to 1.6, indicating the opportunity for more nurturing and involvement to raise their value to the organisation. Finally, products with RFM scores less than 1.6 were designated as "low moving products." signalling that they require specific re-engagement activities to regain their loyalty and drive further business prospects.

### Customer Segmentation

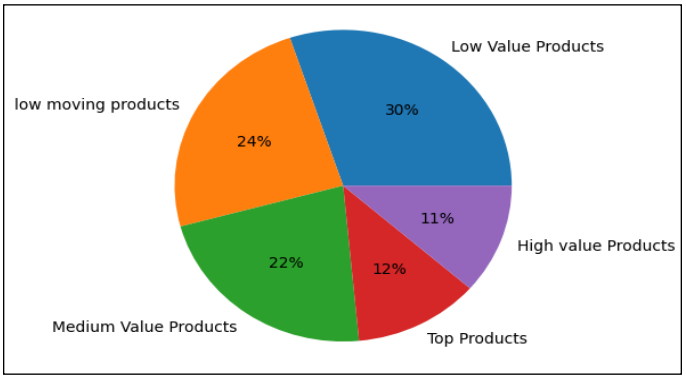


**Fig. 1: Represents a Pie Chart Showing Customer Segmentation with Respect to Their RFM Scores using the Data from Table 1**

This classification, based on the RFM score, allows organisations to focus their attention on the most valuable product groups while also developing tactics to restore connections with less active or lost products. By following this research methodology, you can effectively apply RFM analysis to the appropriate datasets and uncover valuable product segments for targeted marketing efforts.

### Challenges and Considerations

While the RFM model offers significant benefits, businesses should be aware of certain challenges, including data quality issues, selecting appropriate time frames for analysis, and the need for ongoing refinement of segments to adapt to changing customer behaviours.

## Findings and Discussions

Our research stands apart from conventional RFM analysis methodologies by venturing into uncharted territories of inventory data within the E-commerce landscape. We have explored the untapped potential of applying RFM analysis to inventory data, a novel approach aimed at revolutionising product classification and marketing strategies. Unlike traditional RFM analysis that primarily focuses on customer behaviour, our study harnesses the power of RFM analysis to classify products based on updated value, frequency, and recency. By incorporating sales data into this framework, we aim to provide consumers with superior products and services tailored to the ever-evolving trends in the E-commerce fashion industry. While traditional RFM models rely on sales data to segment customers, our research digs into the area of inventory data, where merchants input and extract trends and patterns to achieve a market advantage. This creative method not only benefits businesses by properly mirroring market trends, but it also keeps customers up to date on the latest trendy products. In the dynamic and fast-paced world of E-commerce, our methodology bridges the gap between inventory management and customer pleasure, providing a holistic solution that improves both product offerings and consumer experiences. Through this ground-breaking research, we hope to equip businesses to use inventory data for strategic decision-making, thereby increasing their competitiveness and consumer engagement.

## Conclusion

In this article, a method is presented to apply RFM analysis on inventory data. The RFM research gives significant insights into product patterns—how products are added, value of products, and when products are added, which helps firms to optimise the products display. The conclusion of this study has the potential to greatly

improve product optimisation and help in marketing the products accordingly.

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