ENHANCING FESTIVE RETAIL STRATEGIES: A DATA-ENABLED GROCERY RECOMMENDATION SYSTEM

Prof. Mayura Nagar
Assistant Professor
Department of Data Science and Techonology
K. J. Somaiya Institute Of Management
Mumbai

Abstract - **The retail landscape during festive seasons in India presents unique challenges and opportunities due to diverse cultural practices and heightened consumer activity. The significance of retail strategies during festive seasons in India, characterized by unique cultural practices and traditions, calls for specialized systems to enhance customer experience and optimize retail operations. This study explores the development and implementation of a data-enabled grocery recommendation system tailored to Indian festive contexts. Our research addresses this gap by analysing transactional data from various Indian festivals to identify common purchasing patterns and associations between items. This analysis helps to uncover frequent item sets and generate rules that inform more effective stocking and promotional strategies. The necessity of this research is underscored by the recurring issues of stockouts, and mismanaged inventory faced by retailers during high-demand periods. Our contributions include the creation of a dynamic recommendation model that enhances inventory management, optimizes product placement, and provides personalized shopping experiences. The uniqueness of this study lies in its integration of cultural and seasonal data, offering a comprehensive solution that aligns retail strategies with festive consumer behaviour, thereby significantly improving both retailer efficiency and customer satisfaction.**

Keywords— Festive Retail Strategies, Grocery Recommendation System, Transactional Data Analysis, Consumer Behavior, Indian Festivals, Inventory Management, Personalized Shopping Experience, Market Basket Analysis, Retail Optimization, Cultural-Specific Recommendations, Seasonal Shopping Patterns, Data-Driven Retail, Association Rules, Stockout Reduction, Festive Consumer Preferences

I. INTRODUCTION

Systems for making recommendations are crucial in supermarkets. Recommender systems are clever tools that learn about the products a consumer has previously viewed or purchased in order to provide personalised recommendations for undiscovered goods that are likely to catch their attention. [1] It evaluates client wants and offers the best shopping list it can. The majority of consumers prefer suggestion systems since they may learn about the comments provided by other

customers. The things that customers specifically purchased and rated are used by several apps to represent their preferences. Three well-known algorithms are used by the recommendation systems. They are collaborative filtering, cluster modelling, and association rule mining. The association rule is one of the most important data mining techniques used in market basket research. In a supermarket, all the fruits are organised in one aisle, while the dairy products are spread out in another. As a result, organising the most necessary products in an ordered fashion not only cuts down on customers' shopping time but also helps customers purchase the most appropriate items they would be interested in grouping in their market basket. [2] The Apriori algorithm is the most important and essential technique for mining frequent items. [3] The Apriori and association rules can be used to analyse customer purchase patterns. Using this information business can gain insights into which products are frequently purchased together [4] by identifying frequently occurring items in transactions. Business can adjust their stocking strategies and ensuring that commonly associated items are readily available, business can minimize stock outs, reduce excess inventory and improve operational efficiency. The suggestion system can therefore be useful to retailers.

II. RESEARCH PROBLEM

The absence of grocery recommendation systems that are particularly designed for Indian festivals is the research issue this study addresses. Indian holidays are of great cultural significance, and they feature special foods and household goods that are customarily connected with them. However, the special requirements and preferences that emerge during these festive times are not taken into consideration by the current supermarket recommendation algorithms. As a result, it is essential to develop a supermarket recommendation system that delivers appropriate, custom, and festively themed grocery ideas while also taking into consideration the current month's Indian festivities.

The goal of this study is to investigate the feasibility of utilizing the "Apriori algorithm" to develop a grocery recommendation system tailored to the cultural context of Indian festivals. By leveraging transactional data collected during these festivals, the algorithm aims to identify frequent item groups and association rules that can guide retailers in stocking the appropriate products. Additionally, the study incorporates metrics of association rule evaluation to assess the significance and reliability of the generated recommendations. Closing the knowledge gap between customized grocery suggestions and the cultural background of Indian festivals holds significant advantages for retailers.

III. LITERATURE REVIEW

Transaction data is used in the research paper [5] for market basket analysis to determine consumer behaviours. Created a desktop-based programme that processed and re-logged existing transaction data using data mining techniques. The outcomes demonstrated that the market basket analysis tool may function well when used with commercial transaction data. However, the

association studies performed on the data utilised in the analysis were not adequately supported, which resulted in weak association tendencies in the data retrieval transaction rule.

You may learn more about the popular data mining technique known as "Market Basket Analysis" in the article [6], which helps to analyse customer purchasing habits and discover commodities that are frequently purchased together. Association laws, such as "Ninety percent of people who buy Milk also buy Bread," offer suggestions for product placement and cross-selling. WEKA 3.6.9 software was used to pre-process the data in order to get it ready for analysis.

For a new user, the study report [7] makes product recommendations. Product recommendations are based on past customers' purchasing trends that are similar to those of new customers. In order to execute the association rule, the system employs the "vector space model and Single Cycle Multiple Attractor Cellular Automata (SMACA)" to determine which user profile is closest to the profiles of all other users.

In the report [8],The clients are divided into many groups using the K-Apriori method. Then, such categories are discovered to have frequent item sets and association rules. The K-Apriori algorithm looks for groups of individuals who make similar purchases so that those groups of people may be successfully fulfilled. Related products are grouped together so that clients may identify the items they are most likely to purchase among the other items, increasing customer satisfaction.

The research study [9] suggests a system that makes product recommendations to a brand-new user. A recommendation is based on past users' purchasing trends that are like the person requesting the recommendation. The algorithm employed a weighted cosine similarity metric to identify the closest user profile among all the user profiles in the database. The "association rule mining" rule is also used for the product recommendations.

In the paper [10], a collaborative filtering-based recommendation system is created for e-commerce websites. The suggested solution examines consumer behaviour patterns, determines a customer's preference levels for goods that are clicked but not purchased, and uses the preference levels in collaborative filtering to provide suggestions.

The research work [11] proposes a method to reduce the cold-start problem, "data sparsity," and other scaling concerns by combining "entropy-based algorithms, clustering, and Bayesian interference". The method represents the dynamic environment of a supermarket, where customers frequently alter their preferences. This is accomplished via a traditional collaborative filtering process.

This study [12] is focused on analysing consumer buying behaviour in grocery shops using huge transaction data, notably point-of-sale (POS) data. A direct email-based suggestion system and a two-step process are both suggested as recommended solutions based on POS data that has been stored, respectively. Techniques like user-based collaborative filtering (CF) and singular value decomposition (SVD) are used to solve the issue of data sparsity. The outcomes of the numerical

trials demonstrate that CF performs well for product category recommendations, whereas SVD-based reconstruction is good for direct product item suggestions.

Yen's study explores how sustainable experience designs influence consumer behavior during festive seasons. It emphasizes the importance of culturally relevant and environmentally conscious designs in retail spaces to enhance consumer satisfaction and engagement during festive shopping periods. [10]

Hafez et al. discuss the development of multi-criteria recommendation systems aimed at fostering personalized shopping experiences. Their research highlights the effectiveness of integrating various criteria such as user preferences, past purchases, and real-time data to improve recommendation accuracy, which is crucial for managing diverse consumer needs during festive seasons.[11]

Habib and Hamadneh investigate the impact of perceived risk on consumers' technology adoption, specifically in the context of e-commerce. They find that reducing perceived risk through transparent and reliable recommendation systems can significantly enhance consumer trust and willingness to engage in online shopping, which is particularly relevant during high-demand festive periods.[12]

Piernas et al. examine the effects of product availability, positioning, and promotions on consumer purchasing decisions. Their study indicates that strategic placement and targeted promotions can significantly boost sales, particularly during festive seasons when consumers are more inclined to make impulse purchases. [13]

Chabane et al. focus on intelligent personalized shopping recommendations using advanced algorithms. Their findings suggest that personalized recommendations not only enhance user satisfaction but also increase sales by suggesting relevant products based on individual consumer behaviour and preferences. [14]

Bogomolova et al. explore strategies to encourage healthier choices in supermarkets through behavioural nudges and strategic product placements. Their research provides insights into how supermarkets can promote healthier eating habits among consumers, which can be integrated into festive retail strategies to cater to health-conscious shoppers.[15]

Hiremath et al. provide an empirical investigation into customer characteristics in the grocery retail sector. Their study identifies key demographic and psychographic factors that influence shopping behaviour, offering valuable data for tailoring recommendation systems to different consumer segments during festive seasons. [16]

Kalawapudi et al. analyse the effects of the COVID-19 pandemic on festival celebrations and consumer behaviour. They highlight the shift towards online shopping and the need for retailers to adapt to changing consumer preferences and safety concerns, which can be addressed through robust and adaptive recommendation systems [17]

Godefroit-Winkel et al. examine the role of environmental corporate social responsibility (ECSR) in consumer decision-making. Their study suggests that consumers are increasingly favouring retailers that demonstrate a commitment to environmental sustainability, an aspect that can be leveraged in festive retail strategies to attract eco-conscious shoppers. [18]

Agarwal discusses the unique business environment in India and the challenges and opportunities it presents for retailers. His insights into local consumer behaviour and market dynamics are crucial for developing effective grocery recommendation systems tailored to the Indian festive context. [19]

Analysing consumer purchasing patterns and formulating product suggestions have been the main areas of attention in earlier work on grocery recommendation systems. However, these studies frequently fail to consider a crucial factor: the impact of festivals and holidays on customer preferences and buying habits.

IV. METHODOLOGY

The algorithm's initial stage accepts a precise date that represents the intended date for which grocery recommendations are sought. An extensive database of Indian festivals and their associated dates is used. The names of festivals and the associated dates are included in this database. A date range that spans five days before and after the chosen date is computed using the supplied date. This time frame made it possible to take into account more festivals that could have an influence on consumer preferences and spending habits during that time. To find the festivals that fall within the estimated date range, the calculated date range was compared to the festival database. Festivals that took place in the five-day period before and following the input date were regarded as pertinent.

The algorithm's next stage required using a fresh dataset made up of transactional data. This dataset concentrated on the same time period that was calculated using the input date and related festivals at the initial stage. Only the transactions that took place within the previously determined date range were included in the transactional dataset. This made sure that the study was limited to those transactions that were affected by the particular festivals that had been previously recognised. The filtered dataset is subjected to the Apriori algorithm. This algorithm successfully recognises frequent item groups that clients frequently buy together during festival-influenced times. This knowledge might aid merchants in streamlining their inventory control procedures, maintaining the availability of well-liked goods, and preventing stock outs of frequently needed commodities.

The programme then uses the metrics of the association rule to examine the co-occurrence of items bought at the same time. These metrics are taken from the outcomes of the preceding stage, which gave us the often occurring item sets. The recommendation method helps retailers determine which item combinations are frequently purchased together during the festivals by looking at co-occurrence patterns. With the use of this information, businesses can manage their inventories

more effectively and provide customers with personalised suggestions based on their tastes and purchasing patterns over the festive period.

V. RESULTS & DISCUSSION

In this study, we analysed transactional data throughout the holiday season. In order to give grocery shops useful information, our goal is to discover the frequently bought item groups and their correlation. To capture the buying habits and preferences of consumers during this holiday season, we chose a period range surrounding Eid that included the five days before and after the celebration.

We have discovered the common item sets that were often bought during this festival time based on the specified date of April 6 and the matching date range, which includes Eid. The support criterion was established at a minimum of 0.01, and the analysis was done on transactional data

Table I : Presents a sample of frequent item sets discovered during the analysis for Eid:

Item set	Support
Sugar	0.031949
Milk	0.023962
Ghee	0.017572
Flour	0.015974
Cardamom	0.014377
Spices	0.014377
Bowls	0.012780

The algorithm was successful in locating common item sets, or groups of products, which were commonly bought together on Eid.

TABLE II. PRESENTS A SAMPLE OF COMBINATION OF FREQUENT ITEMSETS DISCOVERED

Item set	Confidence
Flour, Sugar	0.5
Cardamom, Saffron	0.5
Dates, Vermicelli	0.5
Bowls, Tissue	0.5
Milk, Rice	0.5

The examination of festivals and the commonly purchased item sets that are linked with them offers important insights into consumer behaviour at certain times. The analysis of the data reveals

1692

that certain celebrations are related to various buying trends. Customers frequently buy particular goods that are frequently connected to each event. These results can help merchants better understand consumer preferences and adapt their inventory and marketing plans to meet customer expectations over the holiday season. Retailers may improve consumer happiness and increase sales potential by matching their product lines to the goods that are typically purchased during festivals.

TABLE III. FESTIVALS VS ITEMSETS FREQUENTLY BOUGHT

Festival	Frequent Item	Support
Diwali	Sugar	0.3
	Cashews	0.3
	Flour	0.3
	Milk	0.2
	Sesame seeds	0.2
Onam	Rice	0.3
	Dried Coconut	0.2
	Mustard Seeds	0.2
Eid	Milk	0.3
	Sugar	0.3
	Dates	0.3
	Rice	0.3
	Clove	0.2
Durga Pooja	Rice	0.3
	Moong Dal	0.3
	Milk	0.2
	Sugar	0.2
Christmas	Flour	0.3
	Milk	0.2
	Essence	0.2

We found interesting trends in our investigation of the correlation between purchases made during five major festivals. We discovered that several things were commonly bought in pairs,

1693

indicating a close connection between them at happy times. Retailers may greatly benefit from these insights by using them to improve their methods for managing their inventories and selecting the best locations for their products. Retailers may better understand client preferences during different festivals by utilising these results, and they can modify their products to improve the shopping experience. Increased client happiness, better sales results, and ultimately business success may all be attributed to this information.

TABLE IV. FESTIVALS VS ITEMSETS ASSOCIATED

Festival	Associated Items	Confidence
Diwali	{Sugar, Flour}	0.5
	{Flour, Milk}	0.5
	{Coconut, Jaggery}	0.3
	{Gram Flour, Elaichi}	0.3
	{Sented Candles, Match Box}	0.2
	{Ghee, Rice}	0.2
	{Sugar, Rice}	0.2
	{Flour, Sesame seeds}	0.2
Onam	{Dried Coconut, Mustard Seeds}	0.5
	{Tamarind, Mustard Seeds}	0.3
	{Mustard seeds, Turmeric}	0.3
	{Coconut Oil, Jaggery}	0.2
Eid	{Milk, Sugar}	0.5
	{Rice, Milk }	0.3
	{Dates, Saffron}	0.3
	{Yogurt, Cashew}	0.3
	{Rice, Saffron}	0.3

1694

	{Cloves, Rice}	0.3
	{Bread, Yogurt}	0.2
Durga Pooja	{Rice, Moong Dal}	0.5
	{Mustard Paste, Poppy Seeds}	0.3
	{Sugar, Milk}	0.3
	{Wheat Flour, Oil}	0.3
	{Curry Powder, Rice}	0.2
Christmas	{Milk, Essence}	0.5
	{Eggs, Milk}	0.5
	{Flour, Custard Powder}	0.3
	{Balloons, Candles}	0.3
	{Lights, Perfumes}	0.2
	{Curry Powder, Rice}	0.2

Further Findings-

According to the data, typical goods like Milk and sugar are regularly present at many celebrations. This discovery can help merchants manage their inventory throughout the holiday season, making sure they have enough of these in-demand products on hand to match customer demand and take advantage of sales possibilities. The existence of items with very little support is shown in Table I. Retailers may use this information to strategically place these products close to frequently purchased and well-liked goods. Combining them may improve their exposure and draw more customers, which might boost sales and improve customer satisfaction. Retailers may optimise their inventory management techniques and shop layout using the practical implications of these studies to increase sales and consumer engagement during festival seasons.

These results provide merchants with the knowledge to make wise choices regarding product placement, inventory management, and targeted advertising campaigns, eventually improving client happiness and fostering business expansion.

VI. CONCLUSION

A grocery suggestion algorithm based on Indian festivals was provided in this study. The algorithm detected common item sets and co-occurrence patterns of products purchased at particular festivals by utilising festival data and transactional information. The findings showed that the approach might give shops useful information on popular and coupled item groupings during festive times. The grocery retail business will be significantly impacted by the study's conclusions. Retailers may optimise their inventory management, marketing plans, and product positioning by analysing customer preferences and purchase behaviour during festivals. Retailers may find and promote appropriate product combinations with the help of the recommendation system, improving consumer happiness and boosting sales. Future studies may focus on improving the system's usability by including customization techniques, outside data sources, and dynamic adaptation to changing festival patterns. The recommendation system's applicability in real-world applications will be tested, along with its accuracy, scalability, and real-time implementation. Overall, this study opens the door for better decisions and customer-focused business methods in the grocery retail sector.

REFERENCES

[1] K. C. A. S. A. Panayiotis Christodoulou, "A Real-Time Targeted Recommender System for Supermarkets," 19th International Conference on Enterprise Information Systems.

[2] S. Gurudath, "Market Basket Analysis & Recommendation System Using Association Rules," June, 2020 .

[3] P. Agarwal , M. L. Yadav, N. Anand , "Study on Apriori Algorithm and its Application in Grocery Store ,"International Journal of Computer Applications (0975 – 8887)

[4] M.Kavitha, Dr. S. Subbaiah, "Association Rule Mining using Apriori Algorithm for Extracting Product Sales Patterns in Groceries," ICATCT - 2020

[5] F. Kurniawan , B. Umayah, J. Hammad , S. M. S. Nugroho, M. Hariadi , "Market Basket Analysis To Identify Customer Behaviors by Way of Transaction Data," Knowledge Engineering and Data Science (KEDS) , Vol 1, No 1, January 2018.

[6] Najafgarh, "Market Basket Analysis by Using Apriori Algorithm in Terms of Their Effectiveness Against Various Food Product".

[7] R. D. A. K. R. D. Debajyoti Mukhopadhyay, "A Product Recommendation System using Vector Space Model and Association Rule," International Conference on Information Technology.

[8] A. K. D. Loraine Charlet Annie M.C, "Market Basket Analysis for a Supermarket based on Frequent Itemset Mining," International Journal of Computer Science Issues, vol. 9, 2012

[9] D. M. Ruma Dutta, "Offering A Product Recommendation System in E-commerce," 2011.

[10] B.-J. Y. J. S. S. M. K. Yong Soo Kim, "Development of a recommender system based on navigational and behavioral patterns of customers in e-commerce sites," Korea Advanced Institute of S cience and Technology.

[11] K. C. A. S. A. P. Christodoulou, "A Real-Time Targeted Recommender System," 19th International Conference on Enterprise Information Systems, vol. 2.

[12] N. Sano, N. Machino, K. Yada, T. Suzuki , "Recommendation system for grocery store considering data sparsity," 19th International Conference on Knowledge Based and Intelligent Information and Engineering Systems, Procedia Computer Science 60 (2015) 1406 – 1413

[13] Hui-Yun Yen, "How the Experience Designs of Sustainable Festive Events Affect Cultural Emotion, Travel Motivation, and Behavioral Intention," Sustainability, vol. 14, no. 19, pp. 11807-11822, Oct. 2022. [Online].

[14] Manar Mohamed Hafez, R. Redondo, Ana Fernández Vilas, H. Pazó, "Multi-Criteria Recommendation Systems to Foster Online Grocery," Sensors (Basel, Switzerland), vol. 21, no. 11, pp. 3747, Jun. 2021.

[15] Sufyan Habib, Nawaf N. Hamadneh, "Impact of Perceived Risk on Consumers Technology Acceptance in Online Grocery Adoption amid COVID-19 Pandemic," Sustainability, vol. 13, no. 18, pp. 10221-10241, Sep. 2021.

[16] C. Piernas, Georgina Harmer, S. Jebb, "Testing availability, positioning, promotions, and signage of healthier food options and purchasing behaviour within major UK supermarkets: Evaluation of 6 nonrandomised controlled intervention studies," PLoS Medicine, vol. 19, no. 1, pp. e1003952, Jan. 2022.

[17]. Komal Kalawapudi, T. Singh, R. Vijay, Nitin Goyal, Rakesh Kumar, "Effects of COVID-19 pandemic on festival celebrations and noise pollution levels," Noise Mapping, vol. 1, no. 1, pp. 1-10, Mar. 2021.

[18] Delphine Godefroit-Winkel, Marie Schill, Fatou Diop-Sall, "Does environmental corporate social responsibility increase consumer loyalty?," International Journal of Retail & Distribution Management, vol. 50, no. 1, pp. 1-18, Jan. 2021.

[19] Anurag K. Agarwal, "Doing Business in India," Management for Professionals, John Wiley & Sons, Inc., 2022. .