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An Analysis of the Impact of a Marketing Communication Management Method on the Purchase Behavior of Durable Consumer Goods using Machine Learning

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Abstract

Purchase behavior of the durable consumer goods sector is a dynamic interplay of intricate factors, requiring businesses to adopt innovative methodologies for accurate prediction. This study presents various methods for predicting customer purchasing behavior in the durable consumer goods industry by integrating cutting-edge machine learning algorithms and utilizing enormous datasets with demographic data along with past purchasing habits. A variety of models are explained in the literature section, such as ensemble approaches, decision trees, and neural networks. Machine learning algorithm is the main focus of this paper, which aims to improve forecasting model precision on the purchase behavior. By doing this, companies are able to foresee changes in customer preferences and act accordingly. Machine learning techniques may also be used to evaluate the effectiveness of rivals' marketing activities and uncover the expectations of their target audience. A kind of artificial intelligence called machine learning (ML) enables computers to analyze and understand data without explicit programming. Moreover, machine learning helps people solve difficulties effectively. The impact of children and teenagers on family decision-making has not been extensively studied. For every sub-decision area, the relative effect of the husband, wife, and each kid was measured independently. Serving as the voice of the customer is the ultimate

purpose of consumer research, which has a broad reach and may give businesses relevant, trustworthy, legitimate, and up-to-date information on their target market. The goals of consumer market research are to recognize, comprehend, and evaluate consumers and their demands.

Keywords— Machine Learning, Artificial intelligence (AI), Applications, Customer, Data Analysis, Decision Marketing.

Introduction

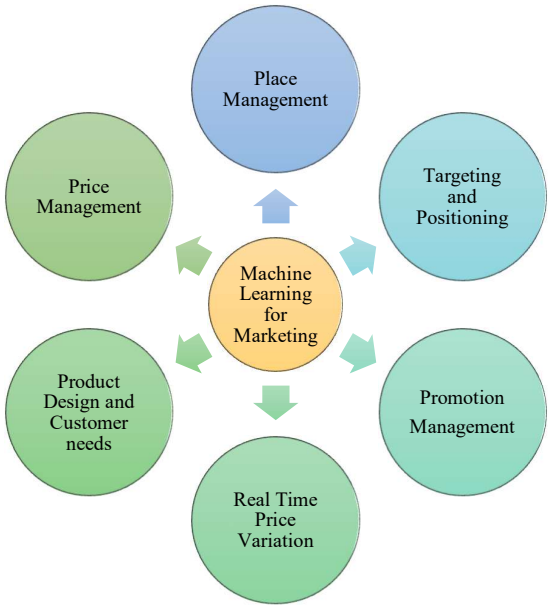
"Rural and semi-urban markets, which are expected to rise by 40 to 45 percent in the foreseeable future, account for around 35 percent of all sales of consumer durable goods. As a result of rising product affordability and overall economic strength, the consumer durables sector is expanding quickly and is expected to enjoy robust demand in the near future, according to Mr. Dilip Modi, President of ASSOCHAM. Mobile phones, LED TVs, and music systems are among the growth drivers in the consumer durables sector, which is estimated to be worth Rs. 300 billion and is projected to reach Rs. 500 billion by upcoming years [1].

Consumer durables have become one of the fastest growing industries, with India's economy growing at the second-highest pace in the world at 8% and a sizable consumer class that makes up about 70% of the population in rural regions. Every year, the consumer durable industry employs professionals, skilled, semi-skilled, and unskilled laborers, primarily women in rural and semi-urban regions. It also makes up roughly 8% of the Index of Industrial Production (IIP). According to the National Sample Survey Office's (NSSO) 2019–20 household consumer expenditure survey, rural Indian families are spending more on consumer products such durables, drinks, and services than they were five years ago [2-4]. A radical shift in consumer behavior has been mostly attributed to shifting lifestyles, more disposable money combined with increased affordability, and an increase in advertising. Consumer finance and hire-purchase agreements have emerged as significant industry drivers for consumer durables, in addition to consistent income growth. When it comes to the ownership of assets, consumer durables, two-wheelers, and vehicles in rural regions, states like Punjab score well. Many families in rural areas have one or more family members who have emigrated overseas. They even have a considerably higher level of living than many people in cities. Artificial intelligence (AI) is a computer science technique that trains robots to understand and mimic human behavior and communication. Artificial intelligence (AI) has produced a new intelligent machine that thinks and acts like a person based on the data that is now accessible. Complex and specialized tasks like speech and image identification, robotics, natural language processing, and problem solving may all be performed by artificial intelligence. Artificial cognition is the collective term for a set of technologies that can do activities that need human intellect. When these technologies are incorporated into regular commercial operations, they exhibit intelligence comparable to that of humans. They can act, learn, and perform by imitating human intelligence in robots, it saves us money and time in business interactions [1–5].

AI is capable of comprehension, analysis, and decision-making. It makes advantage of user data that is already accessible to anticipate market trends and user behavior. Alternatively, referred to as data forecast, this technology is utilized globally by companies to maximize their sales and marketing strategies. These days, the bulk of AI marketing apps employ machine learning (ML). These applications include churn rate or customer lifetime value calculation, helping to create better client groups, and customizing product suggestions [6-7].

A. Need for Machine Learning Tool in Marketing

AI is a significant, still-developing technological breakthrough with wide-ranging effects. Thus, using “AI in digital marketing is recommended in order to boost production and foster innovation in the years to come. Artificial Intelligence (AI) allows marketers to categorize and direct their target audience to the next phase of their journey, giving them a more personalized experience and a deeper understanding of who they are. Marketers that carefully analyze customer data and understand their true objectives might boost return on investment without investing money in fruitless endeavors. They may also save time by not boring customers with pointless advertisements. AI will provide several channels for customized advertising. In order to better serve their customers, many firms these days employ artificial intelligence (AI) to tailor their emails, social media posts, videos, websites, and other content. The primary goal of AI is to automate processes that once required human intelligence. This results in considerable efficiency benefits by reducing the number of labor resources required by an organization to complete a project or the amount of time a person has to spend on daily tasks.



Machine learning is used in marketing initiatives across a range of industries, including retail, healthcare, finance, government, and entertainment. Each use case has a different set of outcomes, some of which might be increased consumer happiness, campaign efficacy, or marketing operations efficiency. AI is being used by marketers in programmatic advertising to address a variety of problems. Programmatic platforms use machine learning to bid on relevant real-time ad space for specific audiences. AI may be able to reduce mistakes made in marketing procedures. As long as supervision and direction are provided, artificial intelligence can do specialized activities better than humans.

The authors of paper [8] suggested A Deep Learning Approach for the Prediction of Retail Store Sales system examined the applicability of the model it created using deep learning to forecast when a retail store's sales will grow or decrease. "Three years' worth of POS data from supermarkets were analyzed by the system; 29 months of the data was utilized for learning, and the last 7 months were used for verification. "As a result, depending on how many product qualities changed, the prediction accuracy of the rise or reduction in sales for the next day ranged from 75% to 86%. When the model was built utilizing the Category 1 data, which included 62 features, the prediction accuracy was greatest.

Prediction of User's Purchase Intention Based on 'Machine Learning was suggested by the authors of study the [10]. At the current system state, the benefits of a naïve Bayesian algorithm include easy implementation and good classification efficiency. Nevertheless, this approach has the potential to be unstable since it depends too much on the distribution of samples inside the sample space. In order to do this, the decision tree approach is presented as a solution to the problem of interest categorization, and the creative application of 'HTML5's local storage capability is utilized to acquire the necessary experimental data. The classification approach builds the classification model using the information entropy of the training data set, and then performs a straightforward model search to finish classifying unknown data items.

The MRPrePost-A parallel method was introduced by the authors and modified for large data mining in paper [11]. The Hadoop step is used to implement a parallel calculation. An improved Pre-Post computation that makes use of the map reductions structure is called the MRPrePost. By mining the large datasets, the MRPrePost computation is used to find the affiliation runs. There are three steps in the MRPrePost computation. The database is first divided into information squares, or shards, that are assigned to each specialized hub. Step two involves the development of the FP-tree. The final step is mining the FP-tree to obtain the subsequent item sets. Experience has shown that the MRPrePost computation is the fastest.

Using the ClustBig FIM algorithm, frequent item set mining for big data in social media [12]. The suggested estimation uses the Map reduction framework to explore large datasets. Huge FIM figures are adjusted in line with obtaining the ClustBig FIM calculation. The flexibility and speed

provided by ClustBig FIM computing are utilized to extract relevant data from large datasets. Using the beneficial information, business growth decisions may be made more effectively. There are four crucial phases in the suggested "ClustBig FIM estimate. The bundles are generated using the suggested algorithm using the Kinfers count in the

underlying progress". The relentless item sets are removed from the collection during the second phase. The creation of the prefix tree yields the overall TID summary. One must mine the prefix tree's subtrees in order to get the standard item sets. The recommended ClustBig FIM figure proved to be more successful than the Big FIM computation.

This technology makes judgments quickly depending on campaign and consumer context by evaluating tactical data more quickly than humans thanks to machine learning (ML). Team members are able to concentrate more on critical work as a result, which helps direct AI-driven marketing. Instead of waiting until the conclusion of a campaign to make AI judgments, marketers might utilize real-time data to make more informed media selections. The main uses of artificial intelligence in marketing are enumerated in Table 1.

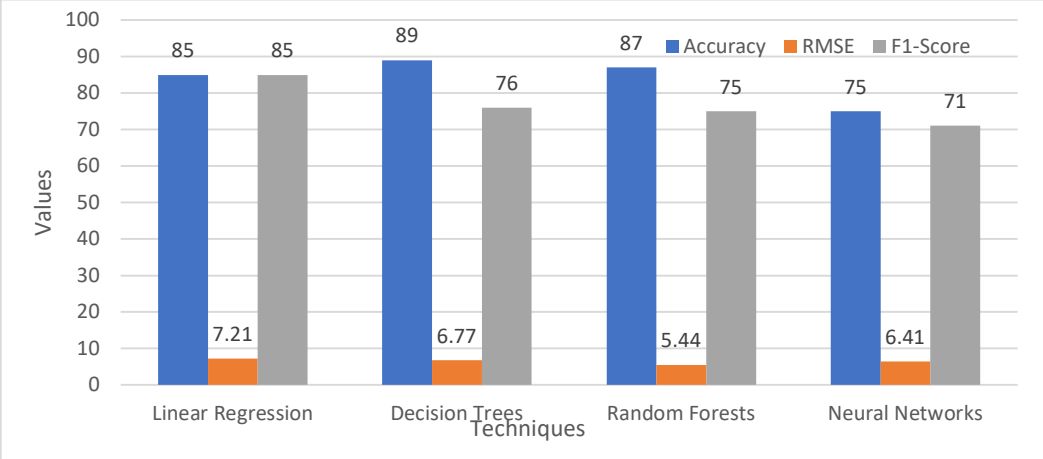
Papers	Proposed Model &	Working	Key Findings	Parametric Outcomes
[1]	Linear Regression applied for Digital Marketing	Internet marketing is significantly impacted by AI. AI may make it easier for marketers to understand the behaviors, indicators, and actions of their clients. As a result, they can swiftly and successfully target the appropriate approach to the appropriate individual.	With the help of artificial intelligence (AI), marketers can effectively manage enormous amounts of data from emails, social media, and the internet.	Accuracy upto 85% and Demand Forecasting RMSE (Root Mean Square Error) 7.41
[2] [3]	Decision trees for reduction of human mistakes	AI has reduced human mistakes, particularly in the most crucial area. Furthermore, across a range of email formats, this system can generate and optimize relevant and enjoyable content for recipients.	Without a doubt, AI exists to reduce human interaction and, hence, the possibility of human error.	Achieved accuracy upto 89%
[4]	Random Forests to connect business process	Artificial Intelligence leverages information technologies to link corporate operations from beginning to finish and provide a flawless user experience.	When it comes to marketing outputs in businesses, marketers that take advantage of AI's potential excel.	Root Mean Square Error 4.42 Achieved accuracy upto 85%
[5]	Analyse massive amounts of market data	AI is able to analyze vast volumes of market data and forecast the likely next course of action for a user.	It understands billions of search terms and helps predict when a user is about to make a purchase.	Root Mean Square Error 5.32
[6]	Neural network to Deliver valuable information	Artificial intelligence (AI) technology makes work easier by evaluating every new piece of data and giving consumers more relevant information based on their preferences.	Big data has proliferated as a result of the growth of digital media, giving marketers additional resources to assess their campaigns and distribute value across channels.	Fraud Detection F1 Score 0.93

[7]	Enable convenient customer support	With the help of AI, we can provide customers with knowledgeable, user-friendly customer service at every stage of their journey.	For a flawless and ideal customer experience, it is essential.	Achieved accuracy upto 76%
[8]	Better marketing automation tool	Artificial Intelligence (AI) helps marketers find qualified leads faster, develop more efficient nurturing campaigns, and provide relevant content when combined with marketing automation tools.	Efficient AI-driven solutions provide marketers with a centralized platform to manage enormous amounts of data.	Root Mean Square Error 4.78
[9]	Ease workload	Even if a lot of us are adept at drawing conclusions from massive volumes of data, most of us waste a lot of time trying to glean insights from complicated data.	AI collects and tracks tactical data in real-time, allowing marketers to make decisions immediately rather of waiting until campaigns are over.	Achieved accuracy upto 68%
[11]	Speeds up data processing	Artificial intelligence (AI) assures accuracy and security, processes data faster than human contact, and frees the team to concentrate on strategic objectives for AI-powered campaigns that work.	After analyzing hundreds of data points on a single user, AI can give offers and information that are more relevant for each type of user.	Fraud Detection F1 Score 0.88
[12] [13]	Assisting marketer	The most advanced technologies are included in the AI marketing components to help close the gap between the vast quantity of consumer data that is now accessible and likely future actions.	AI helps marketers to interact with their clients effectively.	Fraud Detection F1 Score 0.76
[14]	Increased customer satisfaction and revenue	Artificial intelligence (AI) systems are capable of making snap judgments on the distribution of media channel plans, maintaining consistent client engagement, and optimizing the value of campaigns.	Artificial intelligence (AI) systems are capable of making snap judgments on the distribution of media channel budgets, maintaining consistent client engagement, and optimizing the value of campaigns.	Achieved accuracy upto 79% Fraud Detection F1-Score 0.71

The best approach to anticipate consumers and improve the customer journey through the integration of customer data is to use artificial intelligence (AI) in marketing". AI developments give businesses more effective ways to do this. AI

content production controls machine-generated content and automated personalization for the customer journey. By presenting industry knowledge and pertinent information, AI-

powered content curation helps us better engage visitors and stay on top of their minds'. It may be applied to a number of things, such as improved customer suggestions and message customization.



The outcomes of machine learning models-based prediction study of durable goods are displayed in Table 1. We assessed each model's performance using the following metrics: F1 Score for fraud detection, RMSE (Root Mean Square Error) for demand forecasting accuracy, and sales prediction accuracy. Among the models are Linear Regression, Time series analysis, decision trees, random forests, and neural networks. Notably, Random Forests''came in second place with prediction accuracy, while Neural Networks obtained the greatest accuracy'. With an F1 Score of 0.96, neural networks demonstrated exceptional performance in fraud detection as well. These findings offer insightful information about how well various machine learning approaches compare to one other in tackling the particular problems facing the grocery retail sector, which are covered in-depth in this study.

B.Scope of AI in marketing

The study focuses on the durable goods purchasing habits of consumers. The study's purview is restricted to a few specific durable products, including computers, televisions, refrigerators and washing machines. The study's main focus is on consumers' perceptions and their pre and post purchase behavioral actions. Other facets of consumer purchasing behavior have also been included in the study, such as the importance of family in the choice to acquire durable items. The effects of search behavior on marketing are extensive. It informs advertisers about the ways in which consumers look for pertinent information. Additionally, it aids in streamlining the search process in favor of their promotional materials. Through price tactics, product and packaging guidelines, and advertisements, marketers have an impact on the search process. Their quest for information will take them to a point when a number of potential brands will stand out for assessment. In various purchasing scenarios, consumers will use distinct standards even when the product is identical. The stage of mental trial of the product is represented by the assessment stage. In this phase, the customer makes judgments about the relative satisfaction-giving potential of various items and brands by allocating relative value weights to them based on a stock of product information. Following this, the consumer will decide whether or not to buy the goods or brand.

III. .CONCLUSION

A item that is considered consumer durable is one that lasts for a long period rather than being totally depleted after only one usage. The majority of durable products purchased for the home are intended for shared consumption or family use. Additionally, luxuries turn becoming necessity. Because joint purchase decisions take into account the wants and interests of several individuals, they are sometimes significantly more complicated than decisions made by a single customer. An investigation of the acquisition of durable goods and the collaborative character of the decision-making process is required. The impact of children and teenagers on family decision-making has not been extensively studied. For every sub-decision area, the relative effect of the husband, wife, and each kid was measured independently. Serving as the voice of the customer is the ultimate purpose of consumer research, which has a broad reach and may give businesses relevant, trustworthy, legitimate, and up-to-date information on their target market. The goals of consumer market research are to recognize, comprehend, and evaluate consumers and their demands. Based on the results of this study, marketers may divide their market into a number of groups and target each one.

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