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Research Article

Transforming Market Segmentation and Targeting with AI: Insights and Applications

Anandkumar Brahmabhatt^{1*}, S. Sudheer², Purnendu Kumar Patra³, Kannadasan B⁴, Priyanka Sidharth Patil⁵ and Harshal Patil⁶

¹Assistant Professor, Silver Oak Institute of Management - Silver Oak University, India

²Department of Management Studies, Vignan's Foundation for Science, Technology and Research, Guntur, Andhra Pradesh, India

³Assistant Professor, School of Management, Birla Global University Bhubaneswar, India

⁴Assistant Professor, School of Commerce, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, India

⁵Assistant Professor, DKTE Society's Textile and Engineering Institute, Ichalkaranji, Department of Management Studies, Shivaji University, Kolhapur, India

⁶Assistant Professor, Yashaswi's International Institute of Management Science Chinchwad Pune, India

*Corresponding Author

Dr. Anandkumar Brahmabhatt

(dranandkumarbrahmabhatt@gmail.com)

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Abstract: In a period of quick mechanical turn of events, AI (Artificial intelligence) is changing focusing on and market division strategies. To give more individualized client encounters and better business results, this article research how simulated intelligence works on the exactness, viability, and effectiveness of different methods. Through an assessment of assorted artificial intelligence approaches and their executions in market division, we highlight the progressive prospects of AI fuelled bits of knowledge in understanding shopper conduct, refining promoting strategies, and ultimately producing upper hand. Client division has turned into an exceptionally well-known strategy for organizations to isolate their client base to hold clients and bring in cash from them. In the review that follows, clients of different associations are classified in view of their spending and pay designs. By considering conduct factors, these strategies are more successful than others. Clients are classified utilizing a machine technique called the k means clustering calculation, which depends on their conduct qualities. Through showcasing efforts and web-based entertainment stages that they are genuinely keen on, shaped clusters help the business in zeroing in on unambiguous clients and elevating content to them.

Keywords: Market Segmentation, Customer Segmentation, Artificial Intelligence, Machine Learning

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INTRODUCTION

In the ever-expanding world of today, the market needs to use a range of business strategies to generate profits and consistently please customers. This cannot be accomplished by merely monitoring sales or client data. For the company to make money, a thorough understanding of both consumer behaviour and product demand is necessary. To assess the market using historical data, we currently have several visualization tools, such as different Python libraries and business intelligence tools like Power BI. We then use a variety of predictive algorithms to anticipate the market's future. The market industry now relies heavily on data analysis tools to

identify trends in the available data, forecast market trends, and make informed, profitable judgments Janardhanan and Muthalagu [1].

Grouping clients according to marketing groups that share characteristics is known as customer segmentation. More specifically, it implies dividing up the consumer base based on shared traits, which is the most effective marketing strategy. The process of collecting and analysing data about individual consumers in order to find distinct trends for segmentation is known as customer segmentation. The fundamental data, such as billing and shipping details, the items bought, coupon codes, and the mode of payment, in addition to this, some businesses also gather data such as the customer's age, gender, cause of purchase, and the advertising channel that prompted the purchase Harini and Priyadharshini, [2]. In order to establish enduring partnerships and maximize the company's financial performance, customer relationship management, or CRM, focuses on identifying the most lucrative clients. These CRM programs have become more important in recent years because of an environment of competition that combined the sociodemographic traits of retail consumers with the specialization of buyers and sellers. This forced the business to secure a dynamic management of clients in order to outperform its rivals in terms of profits and market share. Several steps must be taken in order to create a comprehensive CRM program. Despite several limits regarding their development, the initial client segmentation and the creation of measures for gauging the CRM program's effectiveness are particularly crucial Florez and Ramon [3].

Focusing on and market separation are key components of showcasing technique that empower organizations to pinpoint specific client portions and change their items likewise. By and large, these methods relied upon conduct, psychographic, and segment data. However, the ascent of man-made reasoning (artificial intelligence) has brought new methodologies that give greater granularity and more profound experiences. While giving an intensive outline of its objectives and impacts, this study means to investigate how AI is changing the business area with an emphasis on division. Estimating and anticipating the market's future is fundamental for any firm that need to figure out the idea of the market and the progression of product regarding deals. For this situation, utilized Clustering methods to anticipate future incomes.

Literature Review

Several techniques, including k means, hierarchical, and density-based algorithms, are used to categorize customers in the Instacart grocery dataset Bhade *et al.* [4]. In order to segment the consumer, it is determined that K means clustering offers the maximum accuracy. In Kansal *et al.* [5], it is suggested to segment customers based on features using datasets that have 200 tuples with two features. They employ the mean shift algorithm, agglomerative clustering, and k means clustering. Additionally, they have taken into account two internal clustering measures: The Calinski-Harabasz index and the silhouette score. Using data mining tools, customer behaviour is suggested Janardhanan and Muthalagu [1]. They have examined the significance of different data mining methods in identifying and determining market and consumer trends.

Dhandayudam and Krishnamurthi [6] proposes the clustering technique for customer segmentation. They contrasted their performance since it demonstrated that different clustering techniques produce different cluster outputs. Performance evaluation criteria were chosen with the idea that an effective clustering algorithm should have customers in the cluster act more similarly to those in the other clusters. It also demonstrated that, in comparison to single link, k means, and complete link algorithms, the created clustering algorithm yields good results.

According to Casabayó *et al.* [7], artificial intelligence (AI) may eventually have capabilities that will enable machines to learn and behave more like people. Putting artificial intelligence (AI) into practice at the corporate level may increase the efficiency and efficacy of important decision-making. The application of AI technologies presents additional challenges. One issue is that businesses need to understand exactly where and how to use AI into their business activities [8]. According to He *et al.* [9], another potential is that companies will not successfully execute their business plan for AI adoption if they do not do analysis of principal components at the management level. Therefore, it is crucial to take into account the situation's basic elements before choosing a place for corporate technology integration.

MATERIALS AND METHODS

The consumer segmentation model in the suggested system incorporates both hierarchical and Centro centric clustering. From the literature review, three clustering techniques were chosen: K means, Minibatch K means, and the hierarchical algorithm. The three distinct algorithms are used to build and analyse the clusters, accordingly. By comparing and assessing the precision rate of the three algorithms, the most successful and cost-effective algorithm is identified. System architecture is shown in Figure 1.

Dataset and Data Collection

Datasets were gathered from Kaggle notebooks. It has five columns and 250 rows. Typically, there are two categories of data: structured and unstructured. A.xls or.csv file, in which each column represents a data attribute, is the simplest

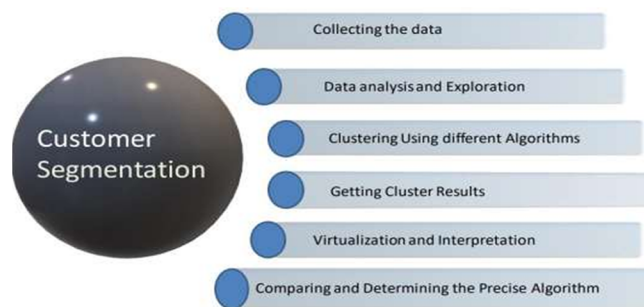


Figure 1: System Architecture; adapted from Narayana *et al.* [10]

illustration of structured data. Unstructured data may be represented by a group of text, picture, or video files. Businesses often decide how to organize the collection and storage of data.

Algorithms

K-means Clustering: The unlabelled dataset is broken down into distinct clusters using K-means clustering is a type of unsupervised partition-based clustering technique. In order to discover the 'K' centroids, the algorithms first determine the proper K value -no of clusters. As a result, every point of data is assigned to its nearest k-centre to create clusters.

Hierarchical Clustering

In contrast to partition-based clustering, agglomerative hierarchical clustering creates a binary merge tree with the root holding the entire data set and leaves holding data pieces. A dendrogram is a visual representation of a tree that places the nodes on the plane.

Minibatch k-Means Algorithm

Due to its efficiency and cheap time cost, K-means is unquestionably one of the most popular clustering algorithms; nonetheless, its computation time increases with the amount of the datasets that are being studied. To circumvent this, an alternative approach—the Minibatch k-means algorithm—is proposed. The main concept is to divide the entire dataset across small, fixed-size batches, and then update the clusters using a new, randomly selected mini batch. After that, this cycle is continued until convergence is achieved.

The Elbow Method

Determining the optimal no. of clusters per the dataset is the first step in any unsupervised technique. The Elbow technique can be used to determine the optimal value of k. The k number is selected at the point where the data point starts to flatten out and create an elbow in the graph that uses the total number of squared distances among each point of data and the corresponding assigned cluster centroids. Consequently, the optimal no. of clusters is determined.

Dataset Training and Testing

In order for training the dataset, we employed three clustering algorithms: mini-batch K-means, hierarchical clustering, and K-means clustering. We examined the model after training and discovered its clusters, Davies Boulding score, and silhouette score.

Data Exploration and Analysis

In order to better comprehend the nature of the data, data analysts use statistical techniques and visualization of data to identify dataset properties such as size, quantity, and accuracy during the initial stage of data analysis, known as data exploration. Data exploration, often known as exploratory data analysis (EDA), is the process by which users analyze and understand their data utilizing statistical and visual techniques.

RESULTS AND DISCUSSION

In contrast to supervised algorithms like there is an objective to forecast using a linear regression model, and metrics like RMSE, MAPE, MAE, etc., can be used to gauge accuracy. When a clustering model is implemented without a target to aim for, the accuracy score cannot be determined. From now on, the goal is to form clusters with distinctive or special

Table 1: Performance Comparison Score

Algorithm	The silhouette coefficient	Davies-Bouldin Index
K-Means	0.555175	0.932767
Minibatch K-Means	0.550078	0.932583
Hierarchical Clustering	0.4646	1.038833

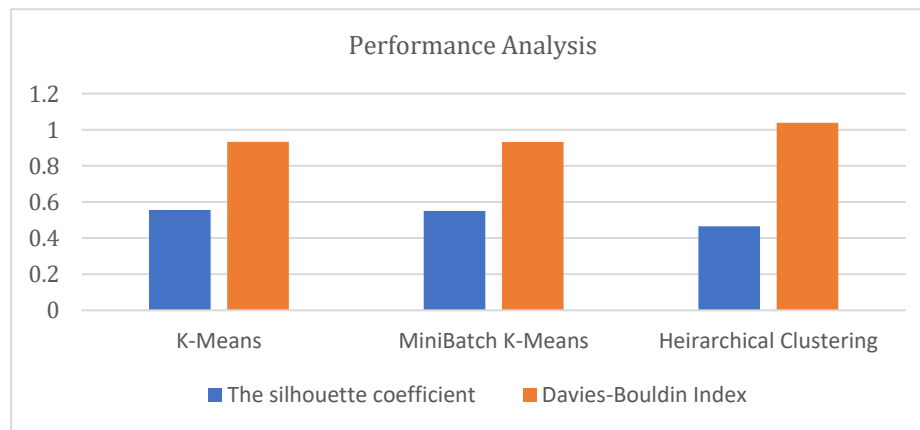


Figure 2: Comparison of Performance Score Analysis

qualities. The two most used metrics for determining a cluster's degree of differentiation are: The silhouette coefficient and the Davies-Bouldin Index. The silhouette score quantifies how similar each item in a cluster are on average and how different they are from the elements in the other clusters. Clusters with higher scores are more distinct and well-defined; the score goes from -1 to 1.

CONCLUSION

Due to a competitive environment that forces businesses to implement dynamic client management in order to generate revenues and get a larger market share than their rivals, the significance of customer relationship management, or CRM, has grown in recent years. When a new product or service is introduced to the market, designing an effective direct marketing strategy is one of the most crucial CRM decisions for merchants. A CRM program must go through a number of phases in its development, two of the most important ones being client segmentation and program success measurement. Applying the three different clustering algorithms with the customers' data and comparing the clusters using metrics that evaluate the uniqueness and distinctiveness of each cluster. The K means algorithm is determined to yield the best clusters, achieving the lowest Davies Bouldin score and the greatest Silhouette score. Following that are minibatch k mean clustering and hierarchical clustering. It is impossible to assert that the K means is the optimal clustering technique in every situation. Numerous factors, including the data's quantity and characteristics, determine this. The inclusion of various clustering methods that might demonstrate greater skill and the consideration of vast datasets, which boosts efficiency, can further improve this research.

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