

Research Article

Analysis of Influencing Factors and Enterprise Strategy of Online Consumer Behavior Decision Based on Association Rules and Mobile Computing

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Consumers are constantly generating a large amount of data, thanks to the arrival of the big data era and the advancement of mobile edge computing capabilities. Massive behavioral data points to the need to mine and analyze potentially valuable information. The commonality and individuality of customer groups' consumption behaviors must be researched before marketing decisions and strategies can be implemented. Because of the unique advantages of mobile edge computing technology, the Internet's application has become more and more widespread, and businesses are increasingly paying attention to network marketing. With the system's long-term use, decision-makers began to wonder if useful information could be extracted from vast amounts of historical data to help them summarize or even predict changes in customer demand and purchasing behavior. This assumption is possible thanks to the rise and development of data mining technology. Association rules are increasingly being applied to customer behavior analysis as the most active branch of data mining in the last ten years. The majority of association rule research currently focuses on one-dimensional data association analysis of a user's package using classical algorithms. The use of association rules mining on multidimensional data with multiple attributes in the telecom service industry is limited due to the complexity of the data structure and algorithm.

1. Introduction

With the rapid development of the Internet and e-commerce, more and more people begin to recognize and accept online shopping. As a new shopping method, online shopping has gradually become an indispensable part of people's lives [1]. Some studies suggest that personality and environmental factors such as gender, age, education level, income level, online experience, and satisfaction with previous purchase experience are considered to be the main influencing factors of consumers' online purchase intention [2]. In the traditional micro demand theory, consumer behavior is affected by various external and internal factors, resulting in obvious differences in the consumption behavior of different customer groups, and the consumption preferences of each customer are

also undergoing periodic changes [3]. It is difficult to grasp user behavior by experience, and the same, with some implicit regular consumption behavior, must be discovered through data mining to find valuable behaviors [4]. In this case, providing detailed information, choosing appropriate information transmission channels, allowing users to obtain valuable information as easily as possible, and promoting the two-way transmission of information are important factors for the success of enterprise network marketing methods [5].

Traditional purchasing decisions are influenced by price, after-sales service, quality, and other factors, while online purchasing has brand-new influencing factors because of its new characteristics and new situation [6]. Enterprises have different network marketing capabilities, different network marketing orientations, and different emphasis on

the choice of marketing strategies, but all of them are information transmission [7]. At different decision-making stages, consumers will tend to accept information transmission from different channels, and information searching and processing behavior will also affect consumers' decision-making [8]. If an enterprise wants to be invincible in the competition of network marketing, it must know something about the behavior characteristics of network consumers, the choice of information transmission channels by network consumers in different decision-making stages, and the influence of channels on consumers' decision-making and pass on the information needed by consumers to them in an appropriate way [9]. Data mining can use classification, clustering, association analysis, prediction, sequence analysis, and other technologies to analyze and process data. Association rule mining corresponding to association analysis is an important branch of data mining research.

The association rule algorithm has been continuously improved, and the efficiency has been continually improved after the combined efforts of many scholars for more than ten years. Some data mining products in other countries use association rule technology to make it more practical and decision-making [10]. The purpose of association rules was to find the purchasing mode of customers in commodity sales [11]. They were first used to solve the shopping basket problem. Many experts have since worked to improve the mining efficiency, adaptability, availability, and application of association rules, including theoretical exploration of association rule mining, optimization and improvement of the original association rule mining algorithm, and the expansion of association rule mining, among other things [12]. The customer purchase behavior model can be used to investigate customer behavior. Economic model, traditional psychological model, and social psychological model [13] are the three main consumer purchase behavior models. This paper examines customer behavior and summarizes the current state of research. In light of current issues with massive high-dimensional data processing methods, such as the inability to accurately extract effective customer group samples and accurately reduce the dimension, proposing a processing method for massive high-dimensional data and using the model of association rules to study customer group consumption behavior will be a new perspective. Thus, we can analyze the consumption behavior trend of key customers by identifying common behavior of customer groups and cross behavior characteristics of key customers from massive high-dimensional data.

2. Related Work

The literature [14] focuses on the relationship between customer satisfaction and various customer loyalty, discusses the factors that influence customer loyalty in service-oriented businesses, and finally draws the relationship between customer satisfaction and various customer loyalty. Under the weighted support importance framework, reference [15] proposed a weighted association rule with downward closure properties. A probability-based algorithm for mining weighted association rules in small probability events

is described in reference [16]. The mechanism of customer satisfaction and switching cost on customer loyalty is studied in the literature [17], primarily from two perspectives of customer satisfaction and switching cost, in which switching cost is divided into three types: procedural, financial, and relational. The mining efficiency of weighted association rules was demonstrated using the Lucene index in reference [18].

Literature [19] emphasizes the establishment of long-term stable relationship between enterprises and customers, enhances customer loyalty and satisfaction, and changes from passive purchase of customers to participation in product development and production. Literature [20] holds that data mining is a process of discovering meaningful new relationships, patterns and trends in a large amount of data by using pattern recognition technology, statistics, and mathematical technology. It is considered that data mining is an important process to determine effective, new, possibly useful, and finally understandable patterns in data. Literature [21] holds that willingness is the root cause of decision-making, and consumers give up buying because consumers' willingness to buy is not enough to make purchasing decisions. Literature [22] analysis shows that in large data sets containing a large number of irrelevant features, the nonlinear problem can be transformed into a linear problem, and then, the learning process of feature relevance under the maximum interval can be used. The whole process is completed by machine learning and numerical analysis technology, which is used for the selection of classification features, and has a good inspiration for the extraction of classification features from large data sets. Literature pointed out that "Stable customer relationship is an effective tool for marketing, and establishing a balance of interests between enterprises and consumers can further improve the marketing effect."

3. Methodology

3.1. Big Data Analysis Method. The data in the big data era has the following main characteristics: (1) huge quantity, (2) there are many data types, (3) fast generation speed, (4) low value density, (5) high storage requirements, and (6) complex management. When analyzing the data, we should first conduct descriptive statistical analysis on the data; analyze the quantity and percentage of the basic information of the sample; such as age, education, income status, and proportion of online shopping expenditure; explain the basic characteristics of the sample; and further judge the rationality of sampling. In the initial selection stage, consumers are most vulnerable to business led factors, followed by website factors. Although in the online shopping environment, consumers have great autonomy in their shopping methods, the commodity information and necessary services provided by merchants are still the content concerned by consumers.

The pace of the era of big data is getting faster and faster. In the past, data mining tools and algorithms encountered many problems when dealing with large data sets and high-dimensional data mining, such as low algorithm running speed, high time complexity, and unsatisfactory mining effect. The advantage of Apriori algorithm is that it is simple,

fast, and easy to identify, and it is suitable for compact result set with small data volume [23]. In order to deal with these complex data, we need some new and better methods to analyze and establish models. At the same time, it also involves some time-consuming and complex data preparation tools and software for dealing with these complex or unique data. However, it has obvious limitations when it comes to large data volume, diversified data forms, and high-dimensional data set, because it needs many iterative calculations, and the newly obtained clustering center consumes a lot of time, and the effect cannot achieve the expected results. Therefore, according to the application of the algorithm, we should explore a clustering method for big data processing to better serve the big data clustering. Based on the above theories and practices, some scholars began to combine customer behavior with data mining in changing environment and began to apply data mining tools to study the change of customer behavior from a dynamic perspective. The influence of website factors on consumers is greater in the initial selection stage and the final purchase stage than in the evaluation selection stage, which shows that consumers pay more attention to the website when they start to collect product information and finally decide to buy products than when they compare products, because the usability and other experience of the website are the key to whether consumers can collect satisfactory information, and the after-sales rights protection measures of the website for consumers are the key to whether consumers can buy with confidence. See Figure 1 for the hit rate of the prediction of valuable customers' purchasing tendency.

The hit rate of low value customers' purchase intention prediction is shown in Figure 2.

3.2. Association Rule Algorithm. Association rule mining represents the possible association and connection between itemsets in a large number of data. It is applied to commodity sales prediction. By analyzing the types and quantity of commodities purchased by consumers, we can predict the behavior of smiling consumers and thus determine the purchase quantity. Businesses can obtain general rules about customer purchase patterns through intelligent data analysis, which can be used to guide businesses in scientifically arranging purchase, inventory, and commodity placement [24]. Association rules are classified as either Boolean or numerical depending on the category of variables processed by the rules. It can be divided into single-layer association rules and multilayer association rules based on the abstract level of data in rules. Association rules can be classified as single-dimensional or multidimensional depending on the data dimension involved. In a relational table, a dimension is an attribute. Only one attribute is mined in single-dimensional association rule mining. For example, we perform single-dimensional association rule mining in common transactional databases. Multidimensional association rule mining is a cross-attribute method of obtaining multidimensional association rules by mining multiple attributes or dimensions [25]. The goal of association rule

mining algorithm is to find out what meets the user specified support threshold and confidence threshold. Mining customer consumption behavior by association rules is shown in Figure 3.

The understanding of association rules needs to be familiar with the business background, and rich business experience has sufficient understanding of the data. Association rules can be used not only to test long-term knowledge patterns in the industry but also to discover hidden new rules. The purpose of association rule mining technology is to find associations or strong association rules between attributes from massive data sets, which are used to discover the characteristics of potential intersecting behaviors and guide practice. Association rule mining research also faces the following challenges and of course its development direction and trend: (1) develop more efficient mining and (2) mining of various unstructured data. Especially the idea of establishing data mining server, cooperate with database server to realize data mining. First, connect the data and prepare the data; secondly, given the minimum support and minimum reliability, association rules are found by using the algorithm provided by data mining tools; finally, the association rules are visualized, understood, and evaluated. Assume that x and y are the corresponding features and n is the dimension of the feature.

$$d(x, y) = \left[\sum_i^n |x_i - y_i|^t \right]^{1/t}. \quad (1)$$

Quadratic distance is as follows:

$$d(x, y) = \left((x - y)^T A (x - y) \right)^{1/2}. \quad (2)$$

Simple matching system SMC is as follows:

$$S_{\text{smc}}(x, y) = \frac{a + b}{a + b + c + d}. \quad (3)$$

Cosine included angle is as follows:

$$\cos \theta = \frac{a \cdot b}{|a| |b|}. \quad (4)$$

The formula for defining the correlation distance between two variables is as follows:

$$D_{xy} = 1 - \rho_{xy}. \quad (5)$$

The square error criterion function used by Apriori algorithm is defined as follows:

$$E_i = \sum_{i=1}^k \sum_{p \in C_i} |p - a_i|^2. \quad (6)$$

Apriori algorithm is a classic association rule mining algorithm. It is the first algorithm that uses pruning

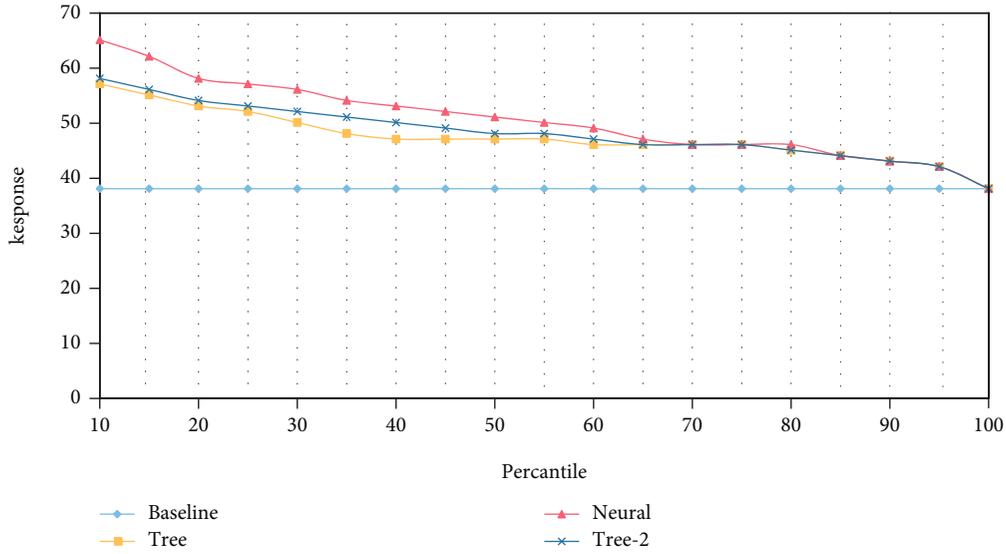


FIGURE 1: Hit rate of prediction of purchase tendency of valuable customers.

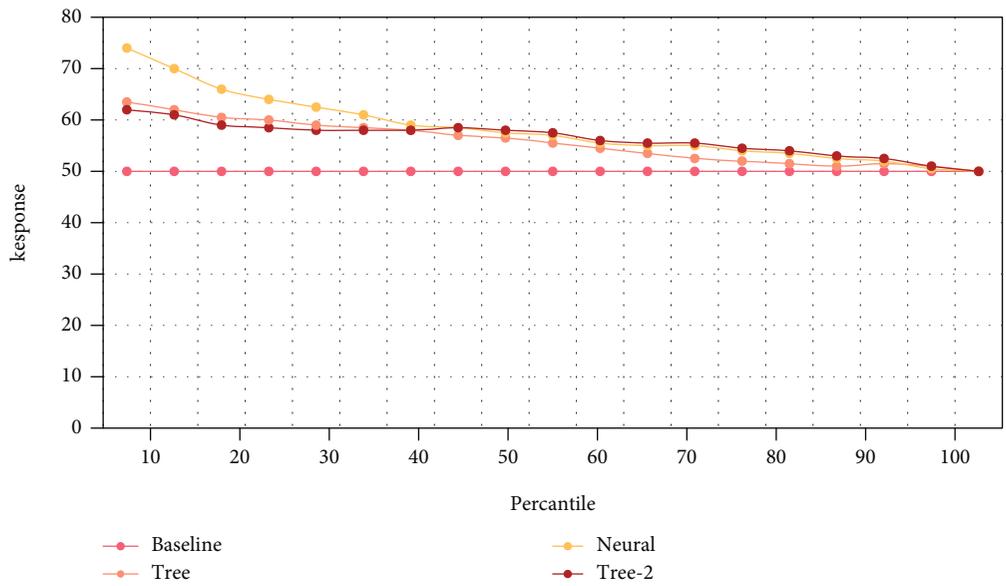


FIGURE 2: Hit rate of prediction of purchase tendency of low value customers.

technology based on support to improve the efficiency of frequent itemset generation in the process of mining association rules. Figure 4 shows the change of algorithm running time with minimum support.

The comparison diagram of the number of frequent itemsets varying with the minimum support is shown in Figure 5.

Apriori algorithm can be divided into two steps according to its function: first, generate all frequent item sets and then mine trusted association rules. The traditional algorithm and the improved algorithm are shown in Figure 6.

4. Influencing Factors of Online Consumer Behavior Decision-Making and Corporate Strategy

4.1. Factors Influencing Consumer Decisions. From the perspective of “marketing,” network marketing is defined as network marketing is an integral part of the overall marketing activities and refers to the use of the Internet to find, meet, and create customer needs, market development, product innovation, pricing promotion, promotion, etc. The general term for the activity. Traditional marketing refers to a series of marketing activities conducted by

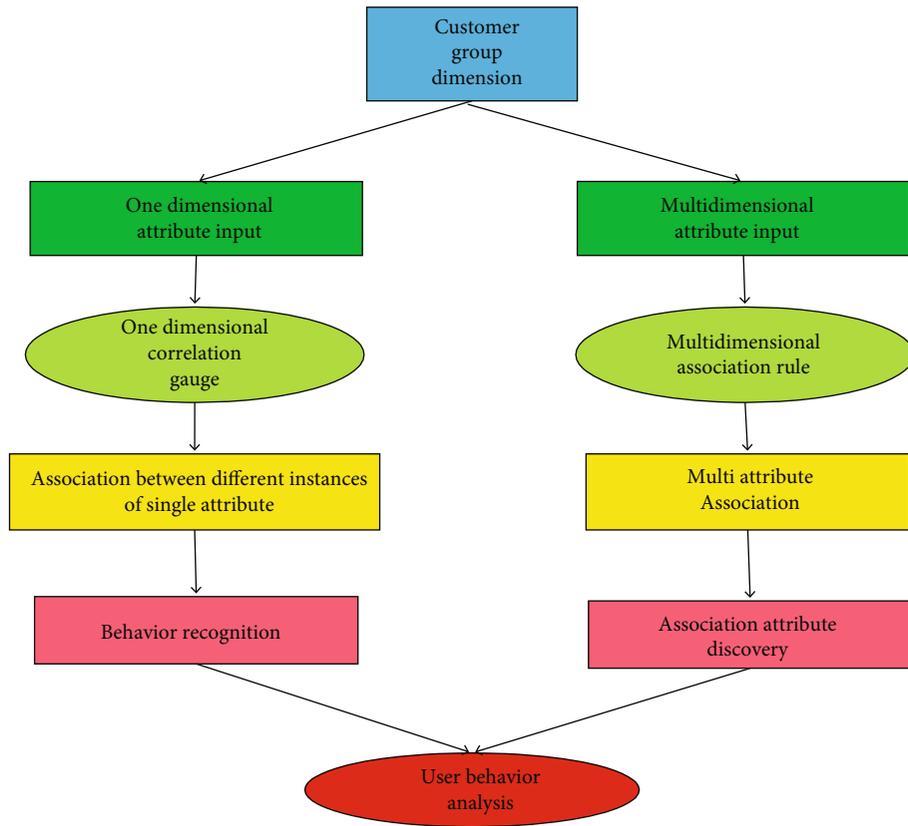


FIGURE 3: Association rule mining customer consumption behavior model.

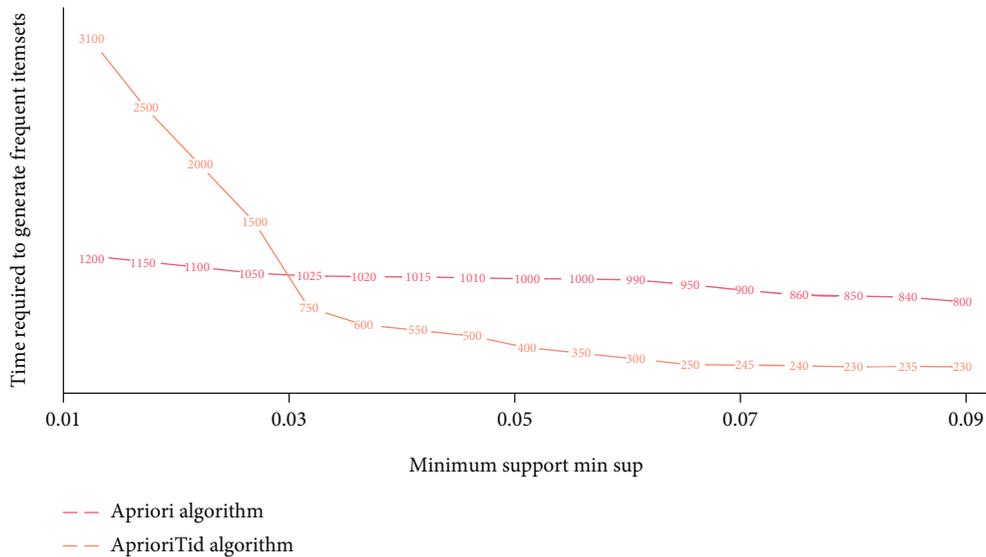


FIGURE 4: Comparison of algorithm running time with minimum support.

enterprises or other organizations to meet the needs of consumers in the changing market environment. Customer consumption behavior analysis can also be used to subdivide customer consumption behavior and then analyze and manage the consumption behavior of various customers, so as to grasp business opportunities. The characteristics of online

consumers' purchasing decisions are as follows: (1) purpose, (2) procedural, (3) hysteresis of consumption, (4) boundless space and time of online consumption, (5) individualization of consumer demand, (6) consumer loyalty declines, and (7) consumer initiative increases. The consumer decision-making process is shown in Figure 7.

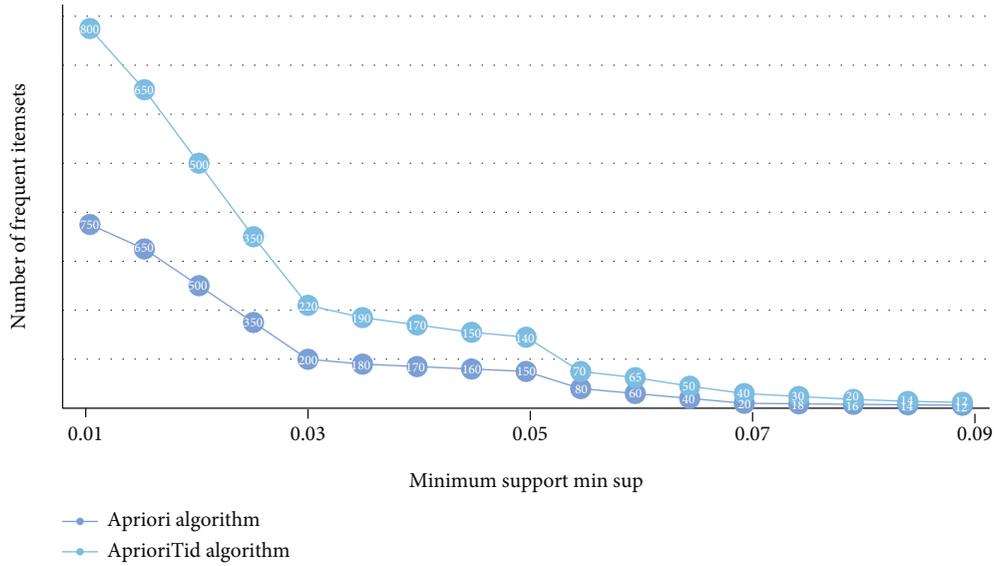


FIGURE 5: Comparison of the number of frequent itemsets varying with the minimum support.

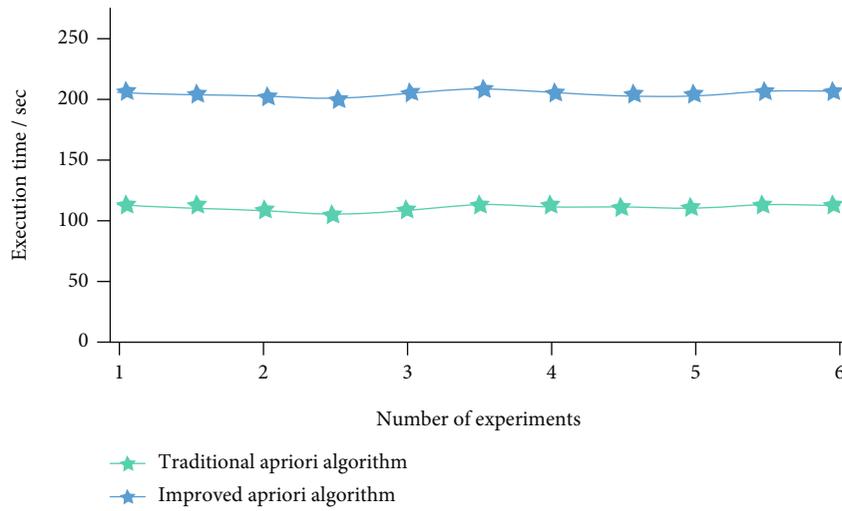


FIGURE 6: Comparison of execution time.

The purchase decision-making process of online consumers can be roughly divided into five stages: arousing demand, collecting information, comparing and choosing, purchase decision-making, and post purchase evaluation. According to the different subjects of influencing factors, the factors affecting consumers' decision-making are divided into five categories, namely, logistics factors, network evaluation, merchant leading factors, shopping website factors, and consumers' shopping experience. The difference between network marketing and traditional marketing is mainly different from the marketing carrier. The carrier of traditional marketing operation is the traditional entity market. The carrier of Internet marketing is different from Internet marketing objects. The traditional marketing objects are traditional consumers. The marketing objects of network marketing are different marketing strategies of online consumers. The traditional marketing strategy is based on the

combination marketing strategy. Network marketing is based on different marketing strategies and different marketing concepts. Network marketing pays more attention to the satisfaction of consumers. Logistics factors include logistics cost, logistics speed, and logistics service. Network evaluation is a typical way of word-of-mouth communication, including the quantity, praise rate, and content of commodity evaluation. Consumer satisfaction is affected by the commodity itself, consumer expectations, and commodity prices. Factors dominated by merchants include promotional activities, commodity information, and services. In the online shopping mode, consumers can not really contact products but can only identify, compare, and select products through product information. Website factors include website user experience, after-sales rights protection and personal information security. Online shopping experience includes consumers' familiar brands or stores, familiar shopping

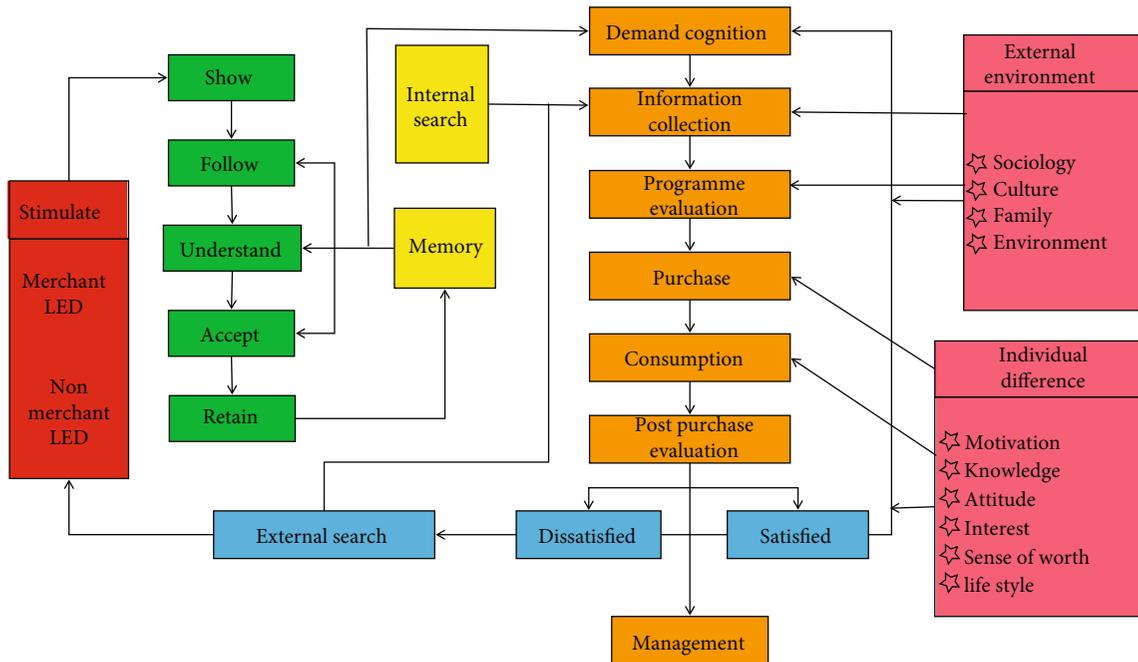


FIGURE 7: Model of consumer decision-making process.

websites, and their own online shopping experience. The advantages of network marketing are difficult to replace by traditional marketing, but the disadvantages of network marketing can not be ignored.

The so-called network marketing ability refers to the ability of enterprises to create an online business environment by taking the Internet as the basic means. It is an integral part of enterprise ability and serves to achieve the business objectives of enterprises. Network marketing capability mainly includes eight aspects: website promotion capability, resource integration capability, information management capability, customer relationship management capability, network service capability, market expansion capability, market adaptability, and cost control capability. It is the integration capability of resources and means shown by enterprises in the process of network marketing. It can increase the value of the enterprise to obtain sustainable competitiveness. On the one hand, information sources are limited, and authenticity is diminished; on the other hand, marketing communication is limited and lacking in authenticity; logistics distribution is backward, and valuable tangible products and services are not suitable for network marketing. The security of online payment has a lot of hidden dangers. Potential customers usually refer to new high-value customers; cross selling is primarily a marketing strategy for businesses to provide products and new services to existing customers, and incremental sales is primarily about changing customer consumption of a product or service while maintaining customer loyalty. In today's network marketing environment, consumers are becoming increasingly dominant in the market, and their ability to process, transmit, and use information transmitted by businesses is improving. Enterprises must pay more attention than ever before to the transmission of network marketing informa-

tion. The essence of information transmission, as the core content of network marketing, is to make it easier for businesses to transmit information to consumers, as well as for consumers to obtain useful information.

4.2. Corporate Strategy. Whether the enterprise's network marketing orientation is product publicity or the strengthening and deepening of brand image, the key of marketing lies in information transmission. However, the difference of enterprises' network marketing ability means that their website promotion ability, resource integration ability, information management ability, customer relationship management ability, network service ability, market expansion ability, market adaptability, and cost control ability are different. On the basis of enterprise network marketing, they will also pay different attention to the selection of other information transmission channels. However, the choice of channels needs to grasp the trend of consumers. The analysis of customers' consumption behavior not only brings profits to enterprises themselves but also provides targeted services and creates value for customers. This is a win-win strategy, which is highly valued by enterprises. Value-based customer segmentation takes cost data as a relevant index to measure customer segmentation. Therefore, different marketing strategies and measures will be formulated from different consumption behavior characteristics of high-value customers, medium-high-value customers, medium-low-value customers, and low-value customers. The basic principles of channel information management in enterprise network marketing activities are as follows: First, improve the credibility of information. To build consumers' trust in enterprise information, as far as the content is concerned, as the publisher of information, enterprises should follow the principle of seeking truth from facts; otherwise, they will lose their

trust in their own consumer groups. Second, reduce information redundancy. Reducing information redundancy and improving information quality can improve the utilization efficiency of information resources for enterprises, which is a practical topic. Third, increase the cost of information supply to reduce consumers' information search cost. If enterprises always deliver reliable information to consumers and reduce information redundancy, they can obtain consumers' recognition and improve consumers' loyalty. Fourth, only by enhancing quality awareness and paying attention to information quality can network marketing enterprises not shield information from consumers, improve information click through rate, and enhance the effect of publicity.

Suggestions for enterprise marketing strategy are as follows: first, we should recognize that online customers have more autonomy and changeable behavior characteristics, make good use of media advertising, and formulate appropriate enterprise marketing methods for target customers; second, we should understand that online customers have more autonomy and changeable behavior characteristics, make good use of media advertising, and formulate appropriate enterprise marketing methods for target customers; and third, we should understand that online customers have greater autonomy and changeable behavior characteristics. Second, we should improve our information security system; provide easy order tracking and high-quality, quick return, and exchange services; alleviate customer concerns; and increase potential customers; third, we should make good use of customer queries and complaints to improve customer loyalty. Fourth, it is appropriate to use a marketing strategy that combines traditional and online sales. The following factors are critical for business growth in the future. Businesses must choose to provide more targeted information to effectively influence consumers' choices during the initial selection, evaluation selection, and finally purchase decision processes. Incorporate the network marketing information channel positioning strategy. Enterprise network marketing has shifted its focus to the integration and utilization of various network resources. As a result, businesses can no longer rely on a single marketing strategy but must instead integrate multiple marketing strategies and implement an integration strategy based on a combination of online consumer information behavior and online marketing enterprise information behavior in order to maximize communication benefits. The model of network integrated marketing entails customer-centered products and services, cost pricing that is acceptable to customers, product distribution that is convenient for customers, and improved customer communication. The material basis for implementing integrated network marketing is the network's timely interaction. Internally, network integrated marketing is driven by the return of personalized consumption by consumers. The needs of consumers are the starting point for network integrated marketing, with the ultimate goal of meeting those needs while increasing enterprise profits. For periodic consumer goods, businesses should pay a return visit to consumers within a certain period and confirm whether customers are willing to buy again. If customers

choose to buy again, they should pay attention to customers as long-term service objects. If customers give up buying, they should understand the reasons why customers give up buying and recommend other products to customers. The self-built online community for marketing is mainly to establish a forum or blog channel on the enterprise website to make up for the lack of only customer feedback system on the enterprise website. It can not only effectively guide consumers but also provide the function of discussion among users, effectively interact with the target market, realize precision marketing, and precipitate brand influence.

5. Conclusion

This paper studies the algorithms related to association rules under data mining. At the beginning, it expounds the research of data mining and association rules. Consumers' decision-making behavior is staged, and the influencing factors that influence them differ at different stages of the decision-making process. Enterprises are not only the source of information in their network marketing activities, but they also have a significant impact on the information transmission channels. They are members of the information-gathering group. Consumers, on the other hand, can use the Internet to better understand information about businesses and their products or services. Each company aspires to provide as much information to customers as possible while also maintaining customer loyalty. Consumers' original driving force to buy is interest motivation, which reflects their consumption motivation, willingness, and satisfaction level. To summarize, the Internet and online purchasing behavior are becoming an increasingly important part of people's lives, and the Internet market's growth potential is enormous. People, on the other hand, still have the psychology of cautious decision-making when it comes to online consumption because of concerns about payment, product quality and safety risks, and service quality. Enterprise marketing is a multidirectional, interactive, and point-to-point marketing model based on consumer behavior in a network situation. Through network marketing, businesses can send product information to consumers, who can then feed that information back to businesses in real time, lowering transaction costs, and promoting real-time marketing. Through the research of this paper, the following conclusions are drawn: Although the ability and marketing orientation of enterprise network marketing may be different, the core of its marketing is information transmission. This requires enterprises to maximize the use of the network platform to carry out all-round integrated network marketing, transmit valuable information to consumers, and affect consumers' behavior according to their own situation.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors do not have any possible conflicts of interest.

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