Precision Marketing Prediction Model Based on Artificial Intelligence Recommendation Technology

Shijiao Yuan

Hebi Polytechnic, HeBi, Henan, China.

Abstract

Artificial intelligence technology is widely used in data processing of industrial Internet and intelligent manufacturing. Aiming at the problem of insufficient accuracy of marketing prediction model, this paper studies an algorithm model based on combined artificial intelligence technology which is suitable for sales prediction. In this paper, the application example of sales is compared with BP network prediction model. This paper describes the content-based recommendation algorithm, model-based recommendation algorithm, rule-based recommendation algorithm and collaborative filtering algorithm. After optimizing the algorithm, this paper constructs the retail value customer churn model and product recommendation model. The model achieves the goal of digging customer characteristics, continuously optimizing marketing strategy and improving product and service innovation ability. The experimental results show that the combined model can make up for the defect that BP network converges to the local optimal solution. Its advanced solution mechanism and thought can inspire the application of artificial intelligence in other market forecasting.

Keywords: *Artificial intelligence, intelligent recommendation, precision marketing, prediction model, industry 4.0*

I. Introduction

Marketization of enterprises is the direction of reform and development of enterprises [1-2]. With China's entry into WTO, enterprises not only need to face the domestic market competition, but also need to participate in the fierce international market competition [3]. Almost all enterprises feel the cruelty of the fierce market competition. In order to gain a foothold in the cruel competition, we must strive for customers with efficient service and conquer the market with high-quality products. However, striving for customers and conquering the market is by no means a simple slogan. Enterprises must grasp the opportunity and do a good job of effective market forecasting, which is based on the careful study of various market factors [4]. Therefore, enterprises must do a good job in early research and data collection, and make scientific market forecast on the basis of complete data system, so as to ensure the accuracy of forecast. In this paper, we mainly study the sales forecast to help enterprises make a reasonable sales plan, mainly including sales forecast, new product market prospect forecast, enterprise profit forecast and so on. Based on these forecast indicators, we explore the future status of enterprise sales. Based on the complete data system in the early stage, computer technology and image simulation technology can help enterprises better predict the future development trend of product sales.

II. An analysis of the factors affecting the sales of enterprises' products

2.1 The whole concept of enterprise product
There are many definitions of products in marketing, which can be summarized as follows:
1. The product is refers to in the national economy, through the labor causes the material to transform in the market may flow, has the independent use value goods [5-7].

2. Products are tangible or intangible things that can face the market to meet people's various needs. Their ultimate goal is to meet people's certain desires and needs.

3. Product refers to anything that can be provided to the market and meet people's needs, including tangible objects, intangible services, places, organizations, ideas, plans, concepts, etc.

From the above definition, we can see that:

(1) the extension of product concept is further expanding, in addition to the traditional tangible objects, ideas, planning, ideas, information resources can also be used as an important form of product. According to modern marketing theory, the concept of product as a whole includes three levels: core product, tangible product and additional product. Core product refers to the interests that customers pursue when they purchase a certain product. It is what customers really want to buy, so it is the most basic and important part of the overall concept of product. Tangible product is the form by which the core product is realized, that is, the image of the entity and service provided to the market [8]. If a tangible product is a physical object, it usually displays in the market as product appearance, style, brand name, quality level and packaging, etc; Additional products are all the additional services and benefits customers get when they buy tangible products, including credit, free delivery guarantee, installation, after-sales service, etc.

(2) Product definition is expressed from the perspective of customer demand, that is, product is anything that satisfies a certain need or desire of human beings. The importance of physical goods is to use them to meet the needs of customers, not only to have them. People buy food to fill their stomachs, to get taste satisfaction, not to have food itself. Therefore, the real product is actually the carrier of delivering services to customers. Undoubtedly, this reflects the modern marketing theory of customer-centered management. Therefore, for manufacturers, we should pay attention to both tangible products and services, so as to meet the real needs of customers. Enterprises should pay attention to the improvement of the whole product service (including pre-sale and after-sales service) while improving the product quality, otherwise, it will lead to the fact that the product entity is the shell of the service. The task of marketing is not only to describe the product appearance, but also to show the services contained in the product entities to the market [9-10]. Otherwise, the enterprise will fall into "marketing myopia", that is, in marketing, only focus on product quality and technology, ignore the change of market demand, and the result will lead to the loss of market and competitiveness.

2.2 An analysis of the factors affecting the sales of enterprises' products

(1) Analysis of marketing factors influencing enterprise product sales

Based on the actual situation of the enterprise, this paper mainly selects some product classifications that help to find the factors that affect the sales of the enterprise's goods.

1. According to the use time of products, products can be divided into durable goods and non durable goods. Durable goods are tangible goods that can be used many times under normal circumstances. For example, body armor, riot suit, helmet, etc. Because these consumer goods are generally of great value, consumers tend to be very cautious when buying such products. Besides considering price factors, there are also product performance, quality, after-sales guarantee, etc. Therefore, the factors affecting durable goods sales are price, quality assurance, after-sales service level and personnel promotion level. Non durable goods refer to the tangible goods that are consumed in one or several uses under normal circumstances. For example, disposable plastic handcuffs, disposable cordon and so on, these products are quickly consumed, consumers and users buy a large number of them, and the purchase frequency is high. For goods like this, consumers generally want to buy products with low prices. They don't have high quality requirements, and they are in a hurry to buy. Therefore, the factors affecting the sales of such products are price, delivery time, etc.

2. According to whether the product is tangible or not, the product can be divided into tangible product and service product. Products in the form of physical entities become tangible products. Durable goods and non durable goods mentioned above are tangible products. Tangible products sell use value, while service products sell added value. Service is a kind of paid activity, which is not in the form of material entity but in the form of providing living labor to meet the special needs of others. The product of service is imperceptible, inseparable, non storable and non transferable. From these characteristics, we can see that the factors affecting the sales of service products include

publicity and promotion, service price, service personnel level, service environment and service efficiency. For the enterprise, the services that can be provided to consumers include the services accompanied by tangible goods.

3. According to consumers' purchasing quantity and habits, products can be divided into four categories: urgently needed products, mass purchased products, special products and potential demand products. This classification system has been well applied in our company's marketing transactions, products, services and ideas.

(2) Analysis of external environmental factors affecting product sales
1. Technology environment. Science and technology are the primary productive forces. The development of enterprises must rely on the reform and innovation of technological forces. The rapid development of process technology and management technology of raw materials will have a huge impact on the operation of the enterprise. If it can not adapt to the development of these technologies, the enterprise will be in a weak position in the competition; At the same time, the rapid development of advanced mechanical technology provides help for enterprises to save labor costs; The management technology combined with computer can help enterprises to better complete the production scheduling and sales decision, and further improve the pre-sale and after-sale service.

2. Political environment. The second environment that affects the operation of enterprises is the political environment, which is an important factor affecting the sales performance of foreign trade enterprises' products in foreign markets. The police equipment produced by our company is generally used by government departments, so it is much more affected by the political environment than other products.

3. Social environment. The social environment that affects product sales includes demographic characteristics and changes in income level. The degree of this influence is generally related to the market positioning of the target group of enterprise products.

(3) Analysis of internal and internal factors affecting enterprise product sales Analysis of factors
Internal factors play a vital role in the survival and development of enterprises, and they are the key factors affecting the sales performance of enterprises. Internal factors include enterprise profitability, cash flow ability, operation ability, development level, solvency and financial level. It involves operating profit rate, return on assets, net profit of current assets, current ratio, quick ratio, cash ratio, working capital to total assets ratio, accounts receivable to income ratio, accounts receivable turnover ratio, inventory to income ratio, inventory turnover ratio, total asset turnover ratio, total asset growth rate, net profit growth rate, asset-liability ratio, debt guarantee ratio, interest guarantee multiple, current asset ratio, fixed asset ratio, financial coefficient and other indicators In the study of sales forecast of a specific product, business clarity is also an important index, which is defined as the ratio of sales volume of a specific product to total sales volume of all products in a period of time. Forecasters must study these indexes deeply, find out the meaning of the indexes, and adopt scientific methods to correct the predicted values according to the changes of the indexes.

III. Artificial neural network

3.1 Introduction of artificial neural network
Neural network is an intelligent computer network system simulating biological neural network. It is generally composed of several interconnected network nodes connected in a certain way. Each node in the network is equivalent to a neuron, which can memorize and process certain information and work in parallel with other nodes. The structure and function of each neuron is relatively simple, but the system behavior produced by the combination of a large number of neurons is very complex. In the neural network, the function of the neural network is mainly determined by the neural nodes in the network. By changing the weight of the connecting neural nodes through feedback to train the neural network, specific functions can be realized.

Neural network is similar to the closed-loop feedback model in automatic control system. Generally speaking, it is adjustable, or it can be trained and learned through feedback. Because of this automatic adjustment function, a

specific input can get the expected output. The typical neural network model is shown in Figure 1. In this feedback system, the neural network adjusts the weight of the neural network according to the comparison between the output and the target value. The final goal is to make the output match the expected target. As a typical example, many input / target correspondence methods have been used to train neural networks in supervised mode.

In neural network, as the basic processing unit of neural network, neuron is generally a multi input single output nonlinear device. As shown in Figure 2, it is a typical structure model of neuron.
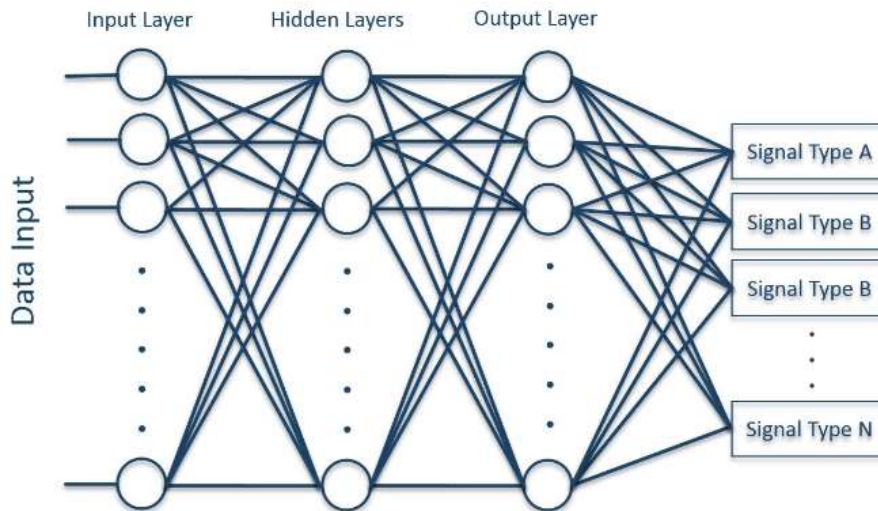

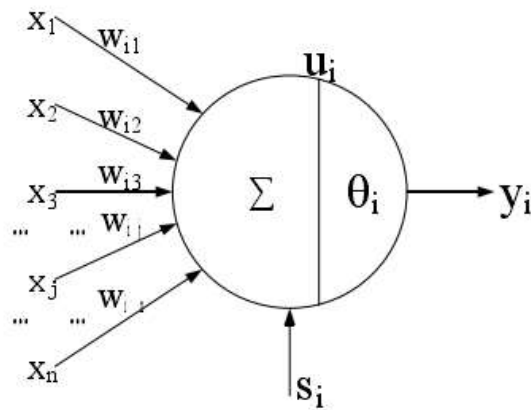*Fig 1: Typical neural networks*

Fig 2: Neuron model

Neuron model is usually described by first-order differential equation (simulating the variation of synaptic membrane potential with time in biological neural network):

$$\begin{cases} \tau \dfrac{du_i}{dt} = -u_i(t) + \sum w_{ij} x_j(t) - \theta_i \\ y_i(t) = f\left[u_i,(t)\right] \end{cases} \quad (1)$$

The output of neuron can be expressed by function f mathematically. In the research of neural network, the following mathematical functions are often used to express its nonlinear characteristics.

(1) Threshold type, similar to step function

$$f(u_i) = \begin{cases} 1, & u_i \geq 0 \\ 0, & u_i \prec 0 \end{cases} \quad (2)$$

(2) Piecewise linear form

$$f(u_i) = \begin{cases} 1, & u_i \geq u_2 \\ au_i + b, & u_1 \leq u_i \prec u_2 \\ 0, & u_i \prec u_1 \end{cases} \quad (3)$$

Where c is a constant.

The S-shape curve reflects the saturation characteristics of neurons mathematically. From the point of view of calculus theory, because its function is continuously differentiable, as long as some parameters of the curve are adjusted, some functions similar to the threshold function can be obtained. Therefore, S-curve is widely used in the output characteristics of neurons.

3.2 EBP neural network

Two or more neurons can be combined into a layer, and a typical network can include one or more layers. A single layer network composed of R input elements and S neurons is shown in the figure below:
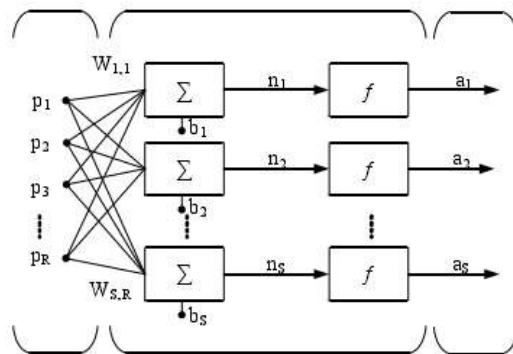

Fig 3: A single layer neural network composed of R input elements and S neurons

In practical application, the most widely used is the multi-layer neural network. Figure 4 is a three-layer neural network diagram.
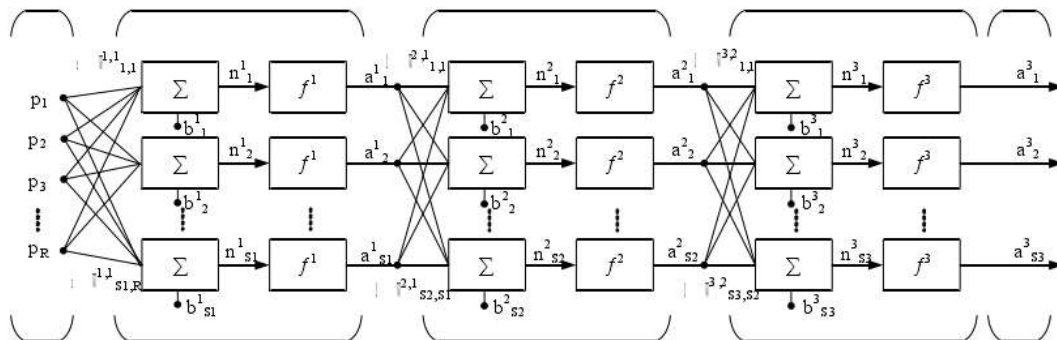

Fig 4: Three layer neural network

The network shown in fig. 4 has r inputs, including S1 neurons in the first layer, S2 neurons in the second layer and S3 neurons in the third layer. Generally, different layers have different numbers of neurons. The bias input of each neuron is constant 1. The output of the middle layer is the input of the next layer. The second layer can be regarded as a single-layer network with S1 inputs, S2 neurons and S2×S1 first-order weight matrix W2. The input of the second layer is a1, and the output is a2. According to all the vectors and matrices of the second layer, it is converted into a single layer network for understanding and operation. Other layers can also be processed according to this step.

IV. Research on Sales Forecast Based on BP Neural Network

4.1 Brief introduction of Jiangsu Anhua Police Equipment Manufacturing Co., Ltd

Jiangsu Anhua Police Equipment Manufacturing Co., Ltd. was established in 1993, the main products are electric batons, police handcuffs, tear gas, riot clothing, bullet proof clothing, police shields and so on. The main customers of an enterprise are divided into domestic customers and foreign customers. Domestic customers refer to the domestic public security bureaus, police stations, troops, security offices and other units responsible for security or guarding functions; Foreign customers are mainly government departments, police, military and so on in other countries. In recent years, enterprises pay attention to personnel training, technological innovation, improve the market share and the quality of service personnel, the production scale is expanding, the level of production technology is gradually improving, and the profits of enterprises have been further increased. The profit of an enterprise is closely related to the sales situation. The quality of sales directly affects the profit of an enterprise. Conversely, the profit of an enterprise used for reproduction can affect the sales performance. Annual profit is one of the factors that affect the sales situation of enterprises. Its irregular broken line trend increases the difficulty of sales forecasting, and poses a severe challenge to the forecasting method.

4.2 Research on the prediction of enterprise product sales volume

There are so many products in the business that it is too complicated to study them all. In order to simplify the analysis model, this paper takes police handcuffs as an example to analyze, and other products are similar to this. BP network has a strong ability of learning and training, has a good adaptability to atypical data, and the learning rules are simple, easy to implement by computer. Therefore, this paper plans to use BP network method to predict the sales volume of enterprise products, and hand over the tedious calculation and elimination of interference factors to BP network. Next, we will use BP network to learn the previous sales data of enterprises, and predict the annual sales volume of enterprise police handcuffs in 2012.

(1) Acquisition of BP network learning data

According to the previous description, there are many factors affecting product sales, mainly including marketing factors, external environmental factors, industry factors and internal factors, each of which contains many specific indicators. BP neural network modeling is based on a large number of typical and high-precision sample data. According to the market research and the balance sheet, income statement and other documents of the enterprise, through sorting and calculation, various index data affecting the sales of police handcuffs from 2001 to 2011 are obtained.

(2) Selection of sample data

Taking the index data affecting sales volume as input data and sales volume as output data, there are 11 groups of data from 2001 to 2011. Eight groups of data in 2001, 2003, 2005, 2006, 2007, 2009, 2010 and 2011 were selected as learning sample data for training and learning; Three groups of data in 2002, 2004 and 2008 were taken as test sample data to test the prediction accuracy.

(3) Establishment of simulation model

The Neural Network Toolbox of MATLAB software provides Neural Network Blockset, which includes the following four modules:

①Control Systems: provide neural network reference model controller;

②Net Input Functions: provide addition (subtraction) method module and multiplication (division) method module;

③Transfer Functions: provide transfer functions commonly used in neural networks such as compet, hardlim, hardlims, logsig, poslin, purelin, radbas, satlin, satlins, softmax, tansig and tribas;

④Weight Functions: provide weight functions commonly used by neural networks such as dist, dotprod, negdist and normprod.

(4) Test of prediction accuracy

After the training of sample data, input the test data to verify the prediction accuracy.

(5) Sales forecast of police handcuffs in 2012

The test results show that the prediction model has high prediction accuracy. According to the actual situation of product marketing factors, external environmental factors, industry factors and internal factors of the enterprise in 2012, input various index data that affect the sales volume of police handcuffs of the enterprise, and finally get the prediction result that the sales volume of police handcuffs of the enterprise in 2012 is predicted to be 44200 sets.

V. Conclusion

Globalization is the general trend. With the further development of globalization, most Chinese enterprises will participate in the international market competition. In order to occupy the market in the fierce competition, we must speed up technological innovation, improve the technical content of products, and win customers with high quality service. However, the occupation of the market is by no means simple subjective, and depends on scientific and effective prediction. There are many researches on sales forecast at home and abroad, but it is quite difficult to make a scientific forecast of sales in the complex economic situation. According to the superiority of BP neural network in dealing with nonlinear problems, this paper takes the sales forecast of Jiangsu Anhua Police Equipment Manufacturing Co., Ltd. as an example to visually simulate the future development trend of enterprise product sales.

References

[1] Hu Wenji, Xu Mingwei. Analysis of Secure Routing Protocols for Wireless Sensor Networks. Journal of Beijing University of Posts and Telecommunications, 2006, 29 (s1): 107-111

[2] Wei Yonglian, Yi Feng, Feng Dengguo, Yong W, Yifeng L. Network Security Situation Assessment Model Based on Information Fusion. Computer Research and Development, 2009, 46 (3): 353-362

[3] Xu Guoguang, Li Tao, Wang Yifeng. A Network Security Real-time Risk Detection Method Based on Artificial Immune. Computer Engineering, 2005,31 (12): 945-949

[4] Jiang Wei, Fang Binxing, Tian Zhihong. Network Security Evaluation and Optimal Active Defense Based on Attack Defense Game Model. Acta Computer Sinica, 2009, 32 (004): 817-827

[5] Miao Yongqing. Stochastic Model Method and Evaluation Technology of Network Security. China Science and Technology Investment, 2017, 4: 314

[6] Yi Hua Zhou, Wei Min Shi, Wei Ma. Research on Computer Network Security Teaching Mode for Postgraduates Under the Background of New Engineering. Innovation and Practice of Teaching Methods, 2020, 3 (14): 169

[7] Li Weiming, Lei Jie, Dong Jing. an Optimized Real-time Network Security Risk Quantification Method. Acta Computa Sinica, 2009 (04): 793-804

[8] Bao Xiuguo, Hu Mingzeng, Zhang Hongli. Two Quantitative Analysis Methods for Survivability of Network Security Management Systems. Acta Communication Sinica, 2004, 25 (9): 34-41

[9] Yang Yi, Bian Yuan, Zhang Tianqiao. Network Security Situation Awareness Based on Machine Learning. Computer Science and Application, 2020, 10 (12): 8

[10] Li Zhiyong. Hierarchical Network Security Threat Situation Quantitative Assessment Method.

Communication World, 2016, 23: 70-70