

# Prediction and Analysis of Enterprise Financial Index Based on Neural Network

## --Taking Aofei Entertainment as an Example

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### Abstract

**Aofei Entertainment Co., Ltd. is an animation and entertainment cultural industry group. As the first listed animation company, it is committed to building a pan-entertainment ecosystem with IP as the core, and takes content as the king, Internet, internationalization and technology as the four strategic goals of the company. It is the leader of today's Chinese animation diffuse entertainment culture. This paper uses BP neural network's financial index prediction model and other methods to predict different indicators of its solvency, profitability, operating ability and growth ability, and makes a comprehensive analysis to obtain its comprehensive income statement for the next three years.**

### Keywords

**Accounting; IP entertainment; Financial index; BP neural network; Strategy analysis.**

## 1. Introduction (Heading 1)

Over the past 70 years and more, the entertainment industry in New China has been developing with remarkable achievements. Especially in the 40 years since the reform and opening up, overseas entertainment products have become the main force, and domestic entertainment has been exported to overseas countries. Internet literature, movies and games have all achieved great results[1].

China's cultural and entertainment industry has undergone rapid development and reform, with various business model innovations constantly emerging and more diversified cultural and entertainment contents. On the whole, the increase of per capita disposable income, the replacement of consumption, the rapid development of mobile Internet and the strong support of industrial policies, four positive factors have become the core driving factors supporting the rapid development of China's culture and entertainment industry[2]. According to the 2018 Research Report on China's Culture and Entertainment Industry, the scale of China's culture and media industry is expected to exceed 2 trillion yuan by 2021.

In the animation industry, domestic animation is generally at an upper level in the world. Through Ne Zha, we can see that China Animation is on the way to rise. In fact, although I only participated in part of the production of this anime film, I still have some understanding of the creation process of the whole film and the development experience of their company.[3] In my opinion, Chinese animation films as a whole are still in the development stage at present, and the whole industrial chain is not mature and sophisticated."Zhang Bing said.

At present, Chinese animation films are generally at the top level in the world, with mature painting style and technology, but there are still relatively obvious shortcomings in story telling and plot creation. But the rising space is relatively large, especially the future market size is

immeasurable[4]. The 2015 release of *Monkey King: Hero is Back* ignited the market's enthusiasm for domestic animated films[5], and the 2016 release of a number of high-quality domestic and foreign animated films such as *Zootopia*, *Kung Fu Panda 3*, *Your Name* and *Big Fish & Begonia* pushed the market sentiment to a high point[6]. In the following two years, the domestic animation film market maintained a relatively stable performance, and the annual total box office volume of animated films (excluding service fees) remained around 4 billion yuan. Animated films are expected to make up a record share of the box office this year, with blockbuster hits such as *Ne Zha* expected to help the market boom again.

my country's animation industry has the following four characteristics:

- (1) China's animation industry has huge potential. The passion of the creators is being stimulated, the voice of the audience continues to rise, and the balance of the capital market is also constantly tilting.
- (2) Chinese animation industry market scale is huge, "two yuan" and "mainstream" gradually integrated. At the very beginning, animation was often labeled as a quadratic, and was not recognized and accepted by the mainstream culture. It was even regarded as "alternative". But in recent years, the audience has penetrated beyond the "quadratic" users to a wider range, breaking through the barriers of age and industry.
- (3) The integration ability of China's animation industry is increasing. The animation industry is divided into many subdivisions, and for many years have mostly fought in silos. Now it has become a sunrise industry integrating creative industry and cultural industry, and is even penetrating and blending into more fields with its unique radiation and transformation capabilities.
- (4) Chinese policy support to animation industry is strengthening, and the consciousness of constructing industrial chain as the leading is also clear.

Of course, the shortcomings of China's animation industry are also obvious. In addition to the obvious shortcomings of narrative and plot creation, we should make further efforts in the mature painting style and technology. In order to enable the rise of Chinese animation industry in the domestic can go abroad, gain more recognition in the world.

Therefore, in this analysis of the cultural market, first of all, the managers of the animation industry, such as Aofei Entertainment and Meisheng Culture, should take a long-term view and expand the development pattern. To achieve profit, we should break our own boundary restrictions, link up with more related industries, and establish a complete ecological chain of animation. Secondly, the process management of animation industry operation is also very important, otherwise it will cause a lot of cost waste. In the face of the change of market environment, we should actively move the strategic transformation of enterprises.

## 2. Financial Index Forecasting Model Based on BP Neural Network

BP neural network has the ability of arbitrarily complex pattern classification and excellent multi-dimensional function mapping. It can solve the Exclusive OR and some other problems that simple perceptron cannot solve. Structurally speaking, BP network has input layer, hidden layer and output layer. In essence, BP algorithm is to take the square of the network error as the objective function, using the gradient descent method to calculate the minimum value of the objective function, as shown in Figure 1.

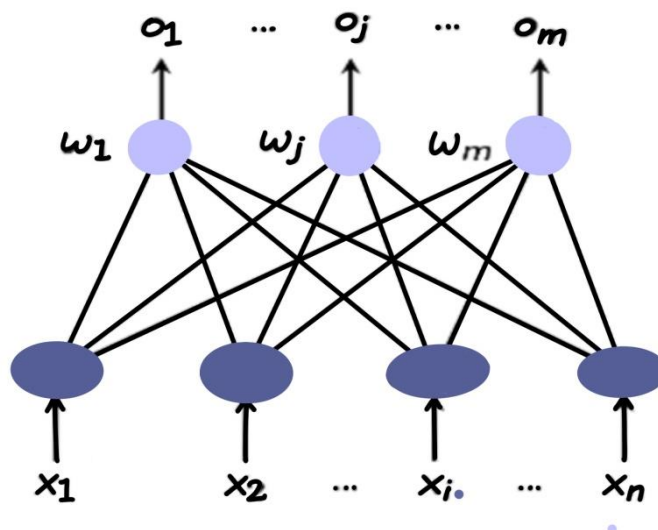


Figure 1. Structure of bp neural network

**2.1. Data preprocessing**

The basic purpose of data processing is to extract and derive valuable and meaningful data for some specific people from a large number of data that may be chaotic and difficult to understand.

Data processing The technical process of analyzing and processing data, both numerical and nonnumerical. Including all kinds of original data analysis, sorting, calculation, editing and other processing and processing. More than data analysis. With the increasing popularity of computer, in the field of computer application, the proportion of numerical calculation is very small, information management through computer data processing has become the main application.

Table 1. Raw data of current ratio

Year/Month/Current Ratio	2016	2017	2018
03-31	1.39	1.21	1.22
06-30	1.38	0.98	1.31
09-30	1.33	0.99	1.31
12-31	1.21	0.92	1.05

Table 2. Raw data of asset-liability ratio

Year/Month/Current Ratio	2016	2017	2018
03-31	40.19	40.24	40.23
06-30	41.09	43.17	33.28
09-30	40.43	40.61	32.45
12-31	41.55	41.29	40.18

**2.2. Model building and solving**

BP neural network is a kind of multi-layer feedforward neural network, its main characteristics are: the signal is forward propagation, and the error is back propagation. Specifically, for a hidden layer of neural network model shown in Figure 2:

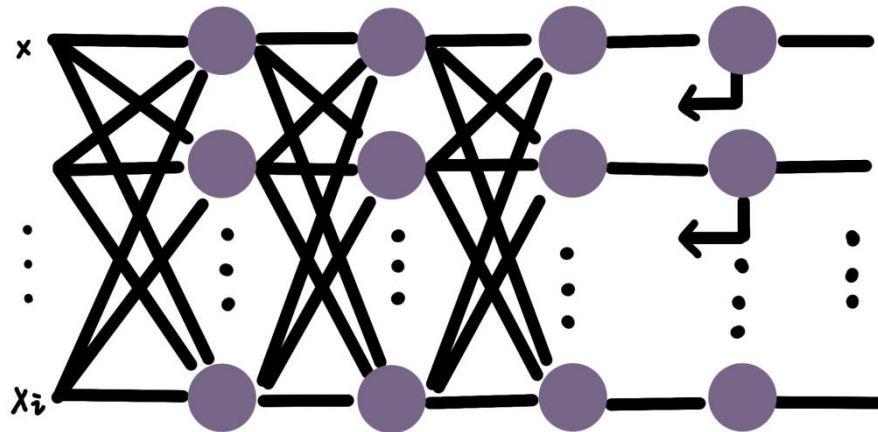


Figure 2. Three-layer BP network

The process of BP neural network is mainly divided into two stages. The first stage is the forward propagation of signals from the input layer through the hidden layer and finally to the output layer. The second stage is the back propagation of errors. From the output layer to the hidden layer and finally to the input layer, the weight and bias from the hidden layer to the output layer are adjusted successively, and the weight and bias from the input layer to the hidden layer are adjusted successively.

After knowing the characteristics of BP neural network, we need to construct the whole network according to the forward propagation of signal and the back propagation of error.

**2.2.1. Network initialization**

Assume that the number of nodes in the input layer is  $n$ , the number of nodes in the hidden layer is  $l$ , and the number of nodes in the output layer is  $m$ . The weight from input layer to hidden layer, the weight from hidden layer to output layer is, the bias from input layer to hidden layer is, and the bias from hidden layer to output layer is. The learning rate is, and the excitation function is. The excitation function is Sigmoid function. The form is:

$$g(x) = \frac{1}{1 + e^{-x}} \tag{1}$$

The visual representation of the activation function is shown in Figure 3:

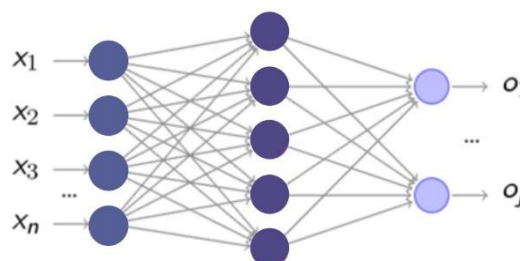


Figure 3. Excitation function implementation

**2.2.2. Hidden layer output**

As shown in the Figure 3 three-layer BP network, the output of the hidden layer is As shown in the above three-layer BP network, the output of the hidden layer is:

$$H_j = g\left(\sum_{i=1}^n \omega_{ij}x_i + a_j\right) \quad (2)$$

### 2.2.3. Output layer output

The output of the output layer results in the following:

$$o_k = \sum_{j=1}^l H_j \omega_{jk} + b_k \quad (3)$$

### 2.2.4. Calculation of error

The error is taken as:

$$E = \frac{1}{2} \sum_{k=1}^m (Y_k - O_k)^2 \quad (4)$$

Where  $Y_k$  is the expected output, let's say

$$Y_k - O_k = e_k \quad (5)$$

Then E can be expressed as:

$$E = \frac{1}{2} \sum_{K=1}^M e_k^2 \quad (6)$$

### 2.2.5. Model training

When such a process is completed, a training cycle is completed. When the error of the output layer meets the accuracy, the training is finished; otherwise, the next training cycle is carried out. Through this process, single-step prediction can be completed. When multi-step rolling prediction is carried out, the output new predicted value can be brought back into the sample, and the predicted value in any future period can be obtained continuously by updating the sample.

Then import the financial ratio data into MATLAB to get the quarterly forecast results of Aofei Entertainment for the next three years, and calculate the average value to get the annual financial ratio forecast value for the next three years.

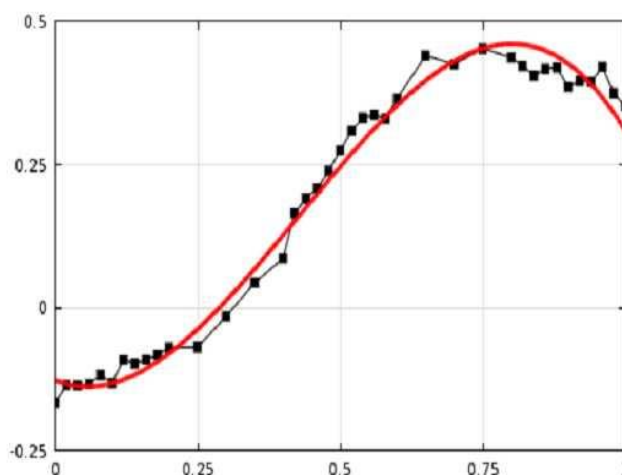
### 2.2.6. Feasibility test of BP neural network

Table 3 shows the comparison between the predicted results of BP neural network and the actual results.

**Table 3.** Actual and predicted values of financial indicators.

Financial analysis	Financial ratio	Actual value	Predicted value
Solvency	Asset-liability ratio	40.18	41.24
Profitability	Gross profit margin	38.53	38.04
	Sales margin	-59.57	-47.33
	Return on equity	-41.59	-38.73
Operational capacity	Return on total assets	-22.48	-21.97
Growth ability	Revenue growth rate	-22.04	-21.33
	Gross profit growth rate	-1908.72	-1898.97
	Net profit growth rate	-205.02	-200.77
	Total assets growth rate	-41.59	-40.81

The above method is used to forecast part of the financial data in 2018 and compare it with the actual value. The results shown in Figure 4 are obtained through data fitting.



**Figure 4.** Fitting curve of financial indicators.

It is found that the difference between the predicted value and the actual value is relatively small, so the financial data should be predicted more accurately. Therefore, this method can be used to predict the next step.

### 3. Financial ratio forecast results

Table 4 and Table 5 show the actual data and forecast data of Aofei Entertainment.

**Table 4.** Raw data on solvency

year	Solvency analysis	
	Current ratio	Asset-liability ratio
2016	1.21	41.55
2017	0.92	41.29
2018	1.05	40.18

**Table 5.** Forecast data of solvency

year	Solvency analysis	
	Current ratio	Asset-liability ratio
2019	1.33	41.01
2020	1.07	43.44
2021	1.14	42.72

Thus, it can be seen that the solvency of Aofei Entertainment Company presents a stable development trend, accompanied by small fluctuations. Similarly, the profitability and operating capacity of a company can be predicted in the same way.

#### 4. Discussion and analysis

In 2013, after Aofei Entertainment announced to acquire the brand and team of Pleasant Goat and Big Big Wolf for 540 million yuan, the company began to build a pan-entertainment ecosystem integrating animation, toys, children, games, licensing, media and movies with IP as the core. Aofei Film and Aofei Game two subsidiaries have been established successively. At the same time, it also acquired the largest domestic original animation platform "YouWuqi" for 900 million yuan, forming its own ACG ecological layout. In their view, IP is an asset for the sustainable operation of an enterprise, whose business value will continue to expand and increase like a snowball. High-quality IP groups, like many magnets, can continue to stick to more users without energy, with very unique advantages[7]. But compared with the IP itself, the core competitiveness of Aofei Entertainment is more proud of their independent IP creation ability, multi-development ability and multi-channel output ability[8]. "There are tens of thousands of IP is like the rock in the mine, after professional vision and team grinding can become IP gems, at the same time for multi-industry extension, linkage development, will further reduce the development cost and risk." Aofei Entertainment vice general manager Wang Jing said[9]. In 2003, Aofei Entertainment entered the animation industry to create IP and active mergers and acquisitions after listing, so that Aofei Entertainment has become the largest number of IP groups, the highest visibility[10]. Since then, the target customer group of the company expanded from children to all ages, and a pan-entertainment empire "with IP as the core" began to gradually form.

During this period, while maintaining the "content + toys + platform" business model, Aofei Entertainment began to expand the company's other main businesses. At this time, Aofei Entertainment has developed animation toys, content creation, mobile games, media operations, In the six major sectors of toy marketing and baby products, the company's operating income has been continuously expanded on a large scale, investment income has increased, and the company's overall competitiveness has been greatly improved. On the way of pursuing the rapid development of the enterprise, Aofei Entertainment also has a strong global strategic vision. It has reached a strategic cooperation with the well-known overseas animation brand "Beacon Bear" and realized the globalization of enterprise development. In 2014, Aofei Entertainment began to enter the big screen, established a subsidiary of Aofei Pictures, and entered the film industry competition. At this time, Aofei Entertainment's ambition to build "Oriental Disney" has gradually revealed. The producer, New Regency Entertainment, reached an in-depth cooperative relationship, participated in the investment of "The Revenant" and shared the film's global box office revenue. In addition to the film field, Aofei Entertainment also actively dabbled in the field of online dramas. The company established Aofei Drama Industry to test the water, "Street of the Soul", which he invested in and filmed, was well received.

The rise and development of AR, VR and other high-tech technologies bring opportunities and challenges for pan-entertainment companies. As an entertainment company and the industry leader in the mode of large IP group, Disney has been transforming itself from a traditional entertainment company into a TV network company by investing in many technology companies since the 1990s, and is now transforming into a pan-entertainment high-tech company. Alfie Entertainment is also aware of the increasing demand for technology in the market, recognizing that technology has become the most important element to change the way of entertainment. Therefore, it actively learns from the experience of Disney Company, focuses on the further development of the strategic layout of science and technology investment to build the science and technology +IP industry, at the same time, according to the long-term strategic goals and its own development, the development of content is king, Internet, internationalization and science and technology four strategies, around the four strategies for continuous innovation and development.

At present, Aofei Entertainment has participated in 5 companies related to VR technology, and has initially formed a complete VR ecosystem to promote its further transformation. In the future, Aofei Entertainment will deepen the exploration and integration of science and technology and pan-entertainment in the way of "IP+VR". Aofei Entertainment will not forget to accelerate the development of AI technology while closely focusing on the development of VR industry. It invested 50 million yuan in Turing Robotics, whose Turing OS is one of China's first commercially available AI-level robotic operating systems and is an absolute leader in Chinese language processing. AI refers to the technology of presenting human intelligence through ordinary computer programs. Computer language is obscure and difficult for ordinary people, and Ofair has a powerful IP mode gene cluster, which has the advantage of linking users and artificial intelligence emotions. The strong cooperation between Alan Turing and Ofair will greatly promote the development of Ofair entertainment technology.

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