



Prediction of cigarette production in China based on Exponential Smoothing

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Abstract. As a kind of traditional industry in China, tobacco plays an important role in many industries in China. The importance of brand building has been reflected incisively and vividly in today's commercial society. A good brand has immeasurable value. However, most of China's cigarettes lack awareness of brand building. This paper uses the statistical data of China's monthly cigarette output in 2020 in the database of China Commercial Industry Research Institute, and uses Single exponential smoothing to predict. The results show that enterprises can adjust production operation management according to the prediction results, improve the efficiency of the supply chain, reasonably allocate inventory, meet the market demand, actively adapt to the changes of the market, better realize precision marketing, and improve the marketing level and economic benefits of tobacco enterprises, so as to create a better cigarette brand.

Keywords: output prediction; Single exponential smoothing; Brand

1 Introduction

Tobacco has a consumption history of nearly 400 years in China. As a kind of traditional industry in China, tobacco plays an important role in many industries in China^[1]. From the perspective of the whole industry, the tobacco industry is an important source of tax in China^[2]. From tobacco production to consumption, it has created huge economic benefits and played an important role in promoting China's economic development. Developed capital countries such as Europe and the United States have long recognized the importance of brand cultivation. For example, a series of brands such as Coca Cola, apple and IBM have successfully captured a large amount of capital all over the world. Their brand popularity and reputation are self-evident. Some European and American brands can equal the annual fiscal revenue of a small and medium-sized country only by relying on their own value. In recent years, China has also established some excellent brands, such as JD and Huawei, which have a great impact on the domestic consumer market. At present, in China, the Chinese cigarette brand is a relatively high-end successful brand. If many domestic tobacco enterprises want to achieve their own development, they also need to expand their brands and strengthen brand cultivation.

The National Tobacco work conference in 2021 was held in Beijing. The meeting stressed that efforts should be made to strengthen the brand building and market supervision, and attach great importance to the cultivation of cigarette brands; It emphasizes that we should strengthen the cultivation in accordance with the requirements of "532" and "461" brand development, which has effectively promoted the accelerated growth and value promotion of key brands. However, with China's tobacco economy entering the new normal, domestic cigarette brands are increasingly impacted by foreign countries. From the perspective of the international market, it is an objective fact that China's tobacco competitiveness is not enough. The development of the international cigarette market will have a great impact on China's cigarette brands, and the development of cigarette brands is facing new challenges [3]. In short, the cultivation of tobacco brand is not an overnight task, and there is no shortcut to take. It is necessary to condense the joint force of integrated development for a long time, overcome difficulties, work for a long time, cultivate both inside and outside, practice internal skills, focus on market demand, improve quality, strengthen brand and service, and constantly do a good job in brand cultivation, Jointly promote the steady development of China's tobacco brands towards high quality.

In order to strengthen China's cigarette brand construction, meet the market demand and follow the market law. Scientifically predict the production and marketing of cigarettes, accurately grasp the market demand, actively adapt to the changes of the market, produce more marketable cigarettes, improve the order satisfaction rate of retailers, better realize precision marketing, and improve the marketing level and economic benefits of tobacco enterprises, so as to better build cigarette brands [4]. Combined with the current situation of cigarette brand development and brand cultivation, this paper forecasts the cigarette output based on the basic algorithm of time series prediction - exponential Smoothing, and studies the tobacco output from a simple and applicable method, hoping to play a certain role in the research of cigarette production and Marketing Prediction and improving the competitiveness of Chinese cigarette brands.

2 Brand competitiveness

The fierce competition in the market has gradually revealed the one sidedness of the traditional enterprise theory. As a unique and unrepeatable scarce resource, a brand has entered the vision of enterprise management, and the impact of brand on the core competitiveness of enterprises has attracted extensive attention in the industry [5]. Just as Philip Kotler, a marketing master, believes that brand is an "invisible contract" between enterprises and consumers [6]. Brand connects enterprises and consumers, which is very important to the construction of enterprise core competitiveness. In the brand competition theory, Aaker puts forward the brand competitiveness model. He believes that the main elements of brand competitiveness are brand awareness, loyalty, consumer perception, brand association, brand relationship, etc. [7]. Young et al. Put forward the brand equity evaluator model and believed that the competitiveness of a brand is mainly formed by its diversity factors, correlation factors, brand status fac-

tors, brand awareness factors and so on^[8]. Bing Hongyan believes that brand competition is that enterprises make their own brands better meet consumer needs than competitive brands through effective allocation of resources^[9]. Detailed to the theoretical research on cigarette brand competitiveness, Zheng Wei and others selected technological innovation ability, product innovation ability and learning innovation ability to construct the evaluation index system of cigarette brand core competitiveness, and established the fuzzy mathematical evaluation model of cigarette brand competitiveness to evaluate the core competitiveness of cigarette brand^[10]. Gu Shudong and others used the analytic hierarchy process and fuzzy mathematics theory to comprehensively evaluate the competitiveness of cigarette brands from three levels: core product power, formal product power and additional product power^[11]. Xue Yang et al. Used the analytic hierarchy process (AHP) to construct the influencing factor system of cigarette brand competitiveness from four aspects: innovation ability, marketing ability, technology, organization and personnel^[12]. These studies focus on the evaluation of cigarette brand competitiveness. This paper focuses on the following issues: (a) what method can be used to better predict the output of cigarettes in China; (b) Whether this technology can effectively promote the cultivation of Chinese cigarette brand competitiveness. Therefore, this paper will use the exponential smoothing method to make quantitative prediction and analysis based on the data of China's cigarette production in 2020.

Nowadays, the brand has become the soul of the market. The competitiveness of products and enterprises will eventually be reflected in the competitiveness of the brand. Building a brand is the common choice of enterprises seeking development. The life cycle of local brands is very short and their vitality is very fragile. How long is it to go from a nobody to a well-known brand? Brand is only a powerful tool for well-known enterprises? Small and medium-sized enterprises have been troubled by such doubts. How to improve brand value is of great practical significance to China's small and medium-sized enterprises.

Chinese local brands need to go out and improve their international competitiveness. In the context of globalization, most brands must have international competitiveness in order to effectively expand domestic and international markets and make full use of domestic and international resources. Tobacco enterprises must recognize the power of brand, realize the urgency of brand construction, and build an excellent tobacco brand in the hearts of consumers, and its final profit will be unpredictable. In order to achieve their own development, many domestic tobacco enterprises also need to expand their brands, adjust production operation management, improve the efficiency of supply chain, reasonably allocate inventory, actively adapt to market changes, and improve the marketing level and economic benefits of tobacco enterprises, so as to improve the competitiveness of Chinese cigarette brands.

3 Exponential smoothing

Single exponential smoothing is a very important prediction method in mathematical statistics. This method is widely used in the prediction research in the fields of daily

life, production and statistics. It is easy to master and operate ^[13]. The so-called prediction is scientific speculation on the possible trend and possible level of things in the future by using modern management and statistical methods according to the objective process and some laws of things' development and change in the past and referring to various possibilities that have emerged and are emerging at present ^[14]. Single exponential smoothing is one of the prediction methods. This method is developed from the moving average model. The model for determining the prediction value is $SF_{t+1} = \alpha A_t + (1-\alpha) SF_t$ ^[15]. Where SF_{t+1} is the predicted value of phase $t+1$, SF_t is the predicted value of phase t , and A_t is the original true value of phase t , α is the smoothing factor.

3.1 Value of α

In the one-time exponential smoothing method, the value range of α is $0 < \alpha < 1$. The selection of values is mainly determined according to the characteristics of different time series: (a) when the time series has no obvious growth or decline trend, It is better to take a smaller value, which can aggravate the "weight" of the old prediction value, which is generally selected between 0.05 and 0.2; (b) When the time series fluctuates greatly, It is better to take a larger value. In this way, the "weight" of the re-predicted value can be added, which is generally selected between 0.3 and 0.5.

3.2 Determination of initial value SA_0

If there is an obvious initial value in the problem, the given initial value shall be used. If the original sequence has no clear initial value, in principle, the following three methods can be adopted: (a) take the arithmetic average of the original data of previous periods as the initial value, which is suitable for the case of few historical data; (b) The actual data of the first period is directly taken, which is applicable to the situation with many historical data; (c) Subjective estimation, applicable to the situation without historical data.

4 Application of Single exponential smoothing; Brand in cigarette yield prediction

As an application of the exponential smoothing model, collect data from the "database of China Academy of commerce industry" on the monthly cigarette production of China from January to December 2020. Some of the data are not directly reflected in the website data, so the complete data are finally obtained through the processing method of missing value ^[16]. The data list is as follows, and the initial data are pre-processed, Unify all data to one decimal place to maintain the unity of data and retain the authenticity and accuracy of data.

Table 1. Output record (unit: 100 million pieces)

month	1	2	3	4	5	6
production	3198.8	1988.6	2242.1	1806.2	1732.8	1726
month	7	8	9	10	11	12
production	2022.9	2003.6	2241.2	1721.7	1936.6	1242.4

The premise assumption of this prediction: the relationship and interaction mechanism between variables that existed in the past will still exist and continue to play a role in the future. Since there are few original data used in this forecast, the arithmetic mean of the original data of the first three periods is taken as the initial value SA0 of the forecast, and the parameters are set as α Set it to 0.2 and 0.4 for two predictions respectively, and the results are shown in table 2 and table 3.

Table 2. Prediction table of cigarette output by Single exponential smoothing ($\alpha=0.2$)

month	actual production	α *Actual production of last month	Forecast production of last month	(1- α)*Forecast production of last month	Smooth forecast production of this month
1	3198.8				2476.5
2	1988.6	639.8	2476.5	1981.2	2621.0
3	2242.1	397.7	2621.0	2096.8	2494.5
4	1806.2	448.4	2494.5	1995.6	2444.0
5	1732.8	361.2	2444.0	1955.2	2316.4
6	1726.0	346.6	2316.4	1853.2	2199.7
7	2022.9	345.2	2199.7	1759.8	2105.0
8	2003.6	404.6	2105.0	1684.0	2088.6
9	2241.2	400.7	2088.6	1670.8	2071.6
10	1721.7	448.2	2071.6	1657.3	2105.5
11	1936.6	344.3	2105.5	1684.4	2028.7
12	1242.4	387.3	2028.7	1623.0	2010.3

Table 3. Prediction table of cigarette output by Single exponential smoothing ($\alpha=0.4$)

month	actual production	α *Actual production of last month	Forecast production of last month	(1- α)*Forecast production of last month	Smooth forecast production of this month
1	3198.8				2476.5
2	1988.6	1279.5	2476.5	1485.9	2765.4
3	2242.1	795.4	2765.4	1659.3	2454.7
4	1806.2	896.8	2454.7	1472.8	2369.7
5	1732.8	722.5	2369.7	1421.8	2144.3
6	1726.0	693.1	2144.3	1286.6	1979.7

7	2022.9	690.4	1979.7	1187.8	1878.2
8	2003.6	809.2	1878.2	1126.9	1936.1
9	2241.2	801.4	1936.1	1161.7	1963.1
10	1721.7	896.5	1963.1	1177.9	2074.3
11	1936.6	688.7	2074.3	1244.6	1933.3
12	1242.4	774.6	1933.3	1160.0	1934.6

Result analysis: visually display the above results with a broken line diagram, as shown in Figure 1 below.

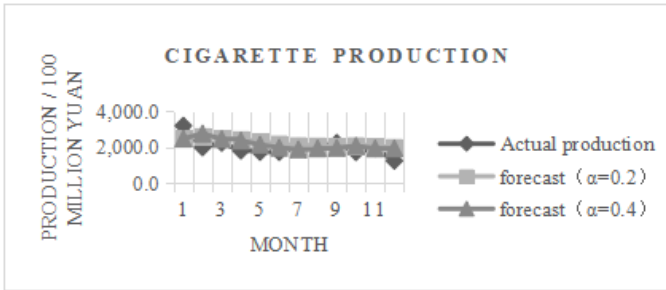


Fig. 1. Comparison between predicted value and actual value

As can be seen from Figure 1, the change trend of the actual value can be described by using the primary exponential smoothing method, but the predicted value also has shortcomings. That is, when the actual value shows a downward trend, the predicted value is generally higher than the actual value. Compare the effects of different smoothing coefficients on prediction, $\alpha=0.4$ (vs. $\alpha=0.2$) the predicted value is close to the actual value.

Error analysis: MAD, MSE, MFE, RSFE and MAPE are used to test and evaluate the prediction results. The calculation process is shown in the table below.

Table 4. MAD, MSE, MFE, RSFE AND MAPE RESULT TABLE ($\alpha=0.2$)

Actual output production A_t	Estimate F_t	Deviation A_t-F_t	Absolute deviation	Square error $(A_t-F_t)^2$	Percent error 100 $(A_t-F_t)/A_t$	Absolute percent-age error 100 $ (A_t-F_t)/A_t $
3198.8	2476.5	722.3	722.3	521717.3	22.6	22.6
1988.6	2621.0	-632.4	632.4	399929.8	-31.8	31.8
2242.1	2494.5	-252.4	252.4	63705.8	-11.3	11.3
1806.2	2444.0	-637.8	637.8	406788.8	-35.3	35.3
1732.8	2316.4	-583.6	583.6	340589.0	-33.7	33.7
1726.0	2199.7	-473.7	473.7	224391.7	-27.4	27.4
2022.9	2105.0	-82.1	82.1	6740.4	-4.1	4.1

2003.6	2088.6	-85.0	85.0	7225.0	-4.2	4.2
2241.2	2071.6	169.6	169.6	28764.2	7.6	7.6
1721.7	2105.5	-383.8	383.8	147302.4	-22.3	22.3
1936.6	2028.7	-92.1	92.1	8482.4	-4.8	4.8
1242.4	2010.3	-767.9	767.9	589670.4	-61.8	61.8
		-3098.9	4882.7	2745307.1		266.8

MAD=4882.7/12=406.9 MSE=2745307.1/12=228775.6
MFE=-3098.9/12=-258.2 RSFE=-3098.9=-3098.9
MAPE=266.8/12=22.2

Table 5. MAD, MSE, MFE, RSFE AND MAPE RESULT TABLE ($\alpha=0.4$)

Actual output production At	Estimate Ft	Deviation At-Ft	Absolute deviation	Square error (At-Ft) ²	Per-cent error 100 (At-Ft)/At	Absolute percentage error 100 (At-Ft)/At
3198.8	2476.5	722.3	722.3	521717.3	22.6	22.6
1988.6	2765.4	-776.8	776.8	603418.2	-39.1	39.1
2242.1	2454.7	-212.6	212.6	45198.8	-9.5	9.5
1806.2	2369.7	-563.5	563.5	317532.3	-31.2	31.2
1732.8	2144.3	-411.5	411.5	169332.3	-23.7	23.7
1726.0	1979.7	-253.7	253.7	64363.7	-14.7	14.7
2022.9	1878.2	144.7	144.7	20938.1	7.2	7.2
2003.6	1936.1	67.5	67.5	4556.3	3.4	3.4
2241.2	1963.1	278.1	278.1	77339.6	12.4	12.4
1721.7	2074.3	-352.6	352.6	124326.8	-20.5	20.5
1936.6	1933.3	3.3	3.3	10.9	0.2	0.2
1242.4	1934.6	-692.2	692.2	479140.8	-55.7	55.7
		-2047.0	4478.8	2427874.9		240.1

MAD=4478.8/12=373.2 MSE=2427874.9/12=202322.9
MFE=-2047.0/12=-170.6 RSFE=-2047.0=-2047.0
MAPE=240.1/12=20.0

The error test of the prediction results shows that the two parameter setting methods have better effects, and the prediction error set to 0.4 is smaller, that is, better unbiased and higher accuracy.

5 Conclusions

In this paper, the statistical data of China's monthly cigarette output in 2020 in the database of China Academy of commerce industry are used to predict by using the single exponential smoothing. The results show that the single exponential smoothing

can have a good prediction effect. It has certain reference significance for predicting China's cigarette output, formulating allocation plan and scientifically arranging production plan, this method can be extended to the production and Marketing Prediction of similar products. Enterprises can adjust production operation management according to the prediction results of this paper, improve the efficiency of the supply chain, reasonably allocate inventory, meet the market demand, actively adapt to the changes of the market, better realize precision marketing, and improve the marketing level and economic benefits of tobacco enterprises, so as to better build cigarette brands and improve the competitiveness of Chinese cigarette brands.

The epidemic has had a certain impact on cigarette brand construction, but through the joint efforts of the industry, the impact of the epidemic on tobacco brand construction will always be controlled within a small range. With the phased achievements in epidemic prevention and control and the gradual restoration of social order, the market will expose another opportunity for high-quality development in parallel with challenges and opportunities to the tobacco industry. Through the joint efforts of the industry, take more targeted measures, adhere to the pursuit of product quality as the core value, brand connotation as the spiritual link, promotion and cultivation as the communication hub, and consumer circles as the dialogue link, so as to gradually form a brand effect, which will eventually realize the high-quality development of cigarette brands under the post epidemic situation. No winter will pass, no spring will come. It is believed that with the joint efforts of the industry, China will have more high-end cigarette brands, and its brand influence will shine in the world.

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