Research on Coal Mine Accident Death Prediction Based on Exponential Smoothing Method

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Abstract

In order to find out the occurrence of coal mine accidents, reduce coal mine accidents and the mortality rate. This research is based on exponential smoothing method, and analyze the death of coal mine accidents from 2003 to 2017 in China. Using this method is to model, prediction, China's accident in 2018 death. The study based on the corresponding measures are proposed, and lay the foundation for the decision makers to make prevention and emergency work.

Keywords

Coal mine accidents; exponential smoothing; forecast analysis.

1. Introduction

The coal industry is known as a dangerous industry, and most people believe that the coal industry has the highest number of deaths than other industry. Although the energy structure has changed, but the coal resources in China's energy structure is the main position.The coal resources still account for more than 60%. The coal mine system is a very complex system with many unsafe factors. In the early years, the accident model of Heinrich(1936) was the main theory.Tian Shuicheng and Li Hongxia (2007) proposed three major hazard sources. These experts have rich research experience on the occurrence or prediction of coal mine accidents. Coal mines include many uncertainties. However, these uncertainties are difficult to quantify under the only modern conditions. Therefore, the prediction of accident mortality can help to find out the regularity of accidents and reduce the loss of miners' lives and property.

2. Forecast index and model.

Brown proposed exponential smoothing method. He pointed out that the overall trend of time series is stable and the overall situation comparison rules can be reasonably extended to the future. The exponential smoothing method, which is widely used at present, is a short-term time prediction method, which is mainly used in the production industry. The main prediction method is to calculate the exponential smoothing value by establishing the weighted average model.This paper analyzes the characteristics of coal mine accidents over the years in China.The initial value and exponential smoothing constant α are determined by repeated calculation, and error test is carried out to ensure the truth and accuracy of the data. The original model is as follows:

$$\hat{y}_{t+1} = a * y_t + (1-a) * \hat{y}_t \tag{1}$$

$\hat{y}_{t+1}$ ——The predicted value of the t + 1 period, that is the smoothing value S_t;

y_t ——Actual value of t period;

$\hat{y}_t$ ——The predicted value of the t period, that is the smoothing value of the previous period S_{t-1};

The exponential smoothing method can be explored according to the order of the time axis, and can be developed according to the known time series.

3. Empirical analysis

According to data from the State Administration of Safety Supervision and Supervision, the number of mine fatalities has been falling since 2011. It is the first time that mine accidents have fallen below 2000/a.Specific data are shown in table 1.

Table 1 Death toll in 2006-2017 of coal mine accidents

year	Death toll	year	Death toll	year	Death toll
2006	4746	2010	2433	2014	924
2007	3786	2011	1973	2015	598
2008	3215	2012	1384	2016	526
2009	2631	2013	1067	2017	375

On the basis of repeated calculations, the death toll in the three years from 2000 to 2002 was used as the initial value. The results are as follows

$$S_0 = \frac{x_1 + x_2 + x_3}{3} = 3915 \quad (2)$$

The range of constants α is 0 to 1.After repeated calculations, α is determined to be 0.9 for calculation.The calculation table is shown in

Table 2 Predicted number of deaths

year	Death toll	Predicted value	year	Death toll	Predicted value
2006	4746	4662	2012	1384	1447
2007	3786	3873	2013	1067	1105
2008	3215	3280	2014	924	942
2009	2631	2695	2015	598	632
2010	2433	2459	2016	526	536
2011	1973	2021	2017	375	391
			2018		376

Finally come to the conclusion $\hat{y}_{2018} = 376$.

4. Results Analysis and measures

According to the calculation of the above parameters, the overall trend of coal mine fatalities in China in 2018 is still decreasing.In order to reduce the occurrence of accidents, we should start to improve the following aspects:

(1)Human being is the main body of safe production and the main cause of accidents. It is necessary to improve the skills and cultural quality of coal miners, coal mine managers and so on.

(2)Gas, coal dust, fire and flood are the main causes of coal mine accidents.What organizers can do is to be strict with each link, do a good job of prevention and emergency response and other measures.

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