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Research on the Prediction of Gas Emission Quantity in Coal Mine Based on Grey System and Linear Regression for One Element

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Abstract

On the basis of introducing two kinds of basic forecasting methods of grey forecast and the forecast of one element linear regression, and in combination with the actual situation of coal mines, this paper predicted the amount of gas emission and compared the accuracy of forecast value of the two methods. The results show that, for the data conforming to the linear relationship, model GM(1,1) of grey forecast is better than one element linear regression in accuracy of forecast value, and this provides the ways and means for the study and numerical prediction for similar problems.

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0 Introduction

The safety of the coal industry has been a top priority in the industrial safety, and in coal mine accidents, 95% of the accidents were gas incidents. As the coal mining, gas pressure of coal seam was from the relatively stable into pressure instability, leading to sudden gas emission increase in the moment^[1]. Therefore, the gas emission as a measure the important parameters of gas accidents, and have a major impact to the mine design, construction and mining. The factors affecting gas emission have coal layer of gas components, mining depth, mining conditions and ground atmospheric pressure. At the same time, gas emission is the primary indicators to determine mine ventilation, so accurate prediction of gas

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emission have important practical significance to guide the mine design and production safety. To this end, the author combined with the actual situation of coal mine, and compared the two kinds of forecasting methods based on one element linear regression model with GM(1, 1) of grey forecast model, through error analysis to identify the most suitable coal mine gas emission prediction models.

1 Establishment Forecast Model

1.1 Establishment One Element Linear Regression model

Studying on the forecast model, the simplest and commonly used are two characteristic parameters change and distribution for near-linear relationship of system, for such models, typically using one element linear regression method, named least-squares method. That is the data of basic line of the linear relationship, using one element linear regression method of least-squares method, regression line with the hash to the point of minimum distance in the Y direction to find the regression line for the conditions of the coefficients a and b.

Given n points, $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$, supposed the regression line equation^[2],

$$y = bx + a \quad (1)$$

It can be used to describe the total distance of hash n points to the straight line in the y direction.

$$y = \sum_{i=1}^n [y_i - (a + bx_i)]^2$$

If regard it as two elements function,

$$Q(a, b) = \sum_{i=1}^n [y_i - (a + bx_i)]^2,$$

Then the problems that find a line closest to n points can be transformed into find a, \tilde{b} ,

Make two elements function Q(a,b) the minimum when

$$a = a \quad b = \tilde{b}$$

Through formula derivation, obtained

$$b = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})} \quad (2)$$

$$a = \bar{y} - b\bar{x} \quad (3)$$

$$\text{Notes: } \bar{x} = \frac{1}{n} \sum_{i=1}^n x_i; \quad \bar{y} = \frac{1}{n} \sum_{i=1}^n y_i$$

1.2 Establishment Grey Forecast Model

According to the theory of grey system^[3]: Any system exists relevance and influence each other between the various factors, showing some known, some unknown state, so we can take the object as a gray system, in the study system, through the information of characterization of the system, using correlation analysis, grey number generation, gray modeling information processing means to explore the internal laws of the system and to predict the future development of the system state. Gray forecast is a

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