Research on the Method of Power Grid Equipment Material Price Forecast Based on Grey Theory

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Abstract: The purchase cost of equipment and materials occupies a large proportion in the cost of power grid technical renovation and overhaul projects, and has a greater impact on project cost control. Therefore, improving the scientificity of equipment and material price forecasting methods is of great significance for controlling the cost of technical renovation and overhaul projects. This article takes the tower Q345 as the research object, and builds a prediction model based on gray theory based on the analysis of the company's current tower price prediction methods and prediction effects. Through empirical verification, the model can effectively improve the accuracy of equipment material price prediction.

1 Introduction

In recent years, with the continuous expansion of the scale of capital investment for power grid technological transformation and overhaul projects, strengthening project cost management and achieving lean management of power grid investment has become an important research topic in the development process of power grid enterprises [1]. At the same time, the purchase cost of equipment and materials occupies a large proportion in the cost of power grid technical renovation and overhaul projects, and has a greater impact on project cost control. Therefore, improving the scientificity and accuracy of equipment and material price forecasting methods is of great significance for improving the company's technical renovation and overhaul project cost control level and improving investment efficiency. It is of great significance to improve the cost management and lean management of the entire project.

In view of the wide variety of equipment and materials required for the technical renovation and overhaul project of State Grid Yili Power Supply Company, this article mainly focuses on the tower Q345 as the main research object, adopts the method of "point-to-face" to carry out key research, and analyzes the company's current tower price Based on the forecasting method and forecasting effect, a price forecasting model based on gray theory was constructed, and through empirical analysis, the forecasting reliability of the model was verified. The research ideas of this article are as follows:

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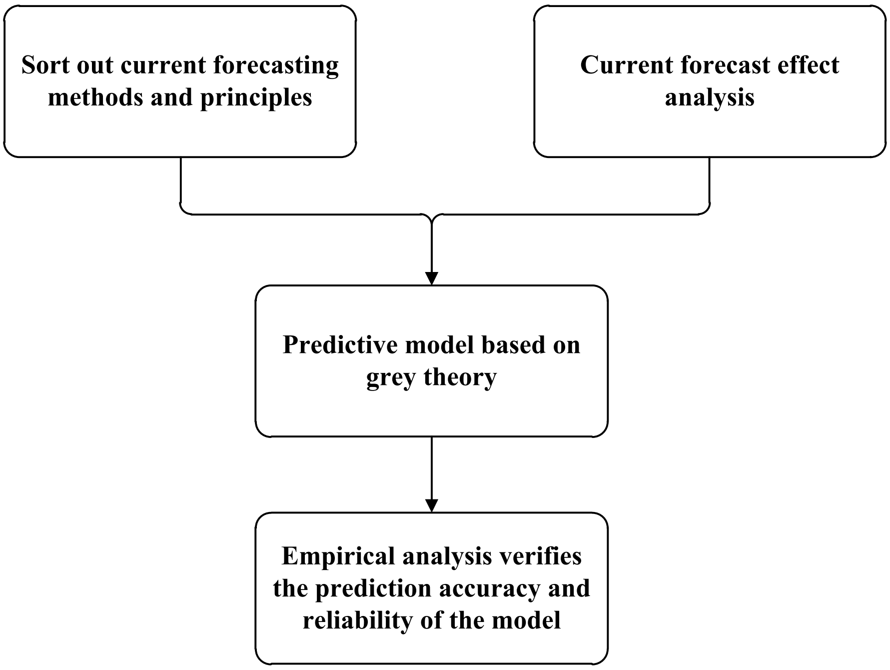

Figure 1. The main research ideas of this article.

2 Analysis of current situation of power grid equipment material price forecast

At present, when the State Grid Yili Power Supply Company prepares feasibility study estimates and preliminary estimates for the technical renovation and overhaul project, the reference data of equipment and materials prices mainly come from two aspects: First, the State Grid Grid Co., Ltd. won the bid for six batches of large-scale materials centralized bidding each year. The second is the price of equipment and materials released by the State Grid Economic Research Institute on a quarterly basis every year. Among them: For some commonly used equipment and materials that have not been tendered this year, refer to the information prices of equipment materials issued by the State Grid Economic Research Institute in the current period; State Grid Corporation’s annual release of six batches of bid-winning price information is collected in four quarters.

The forecasting method adopted by State Grid Yili Power Supply Company on the price of equipment and materials is mainly determined by trend analysis based on historical data of past prices. This method has certain reliability in short-term equipment and material price forecasting. However, in the medium and long term, due to the influence of national economic policies, market supply and demand, and fluctuations in the price of raw materials of the tower itself, this forecasting method has certain limitations and is prone to deviations, which is not conducive to the cost management of technical renovation and major repair projects. Long-term development.

3 Construction of equipment material price prediction model based on grey theory

3.1 Basic principles of gray theory

The research object of gray system theory is the uncertainty system of "part of the information is known, part of the information is unknown, small sample, poor information". Through the analysis and processing of a small amount of raw data, the development and change of the generated data are studied, and the gray prediction model is established. To make predictions. This method has simple calculation and high prediction accuracy, and solves the problems that could not be studied in the past due to the lack of data and uncertain information. As one of the important contents of gray system theory, the gray GM(1,1) model does not look for statistical laws, not probability distributions, but treats random variables as gray quantities, searches for laws between data, and makes up for the lack of data processing methods. , Is currently the most widely used prediction model for predicting a variable and first-order differential equation.

3.2 Method steps

(1) Construction of gray GM(1,1) model

The first step: Given the observation sequence X(0):

$$X(0)=\{X(0)(1), X(0)(2), X(0)(3)\ldots X(0)(N)\} \quad (1)$$

Accumulate and generate a sequence of numbers X(1):

$$X(1)=\{X(1)(1), X(1)(2), X(1)(3)\ldots X(1)(N)\} \quad (2)$$

among them:

$$X(1)(i)=\sum_{j=1}^{n} X(0)(j) \quad (i=1,2,3\ldots N) \qquad (3)$$

The ups and downs of the original number sequence itself are accumulated once to generate a new number sequence, the fluctuations are weakened, and the new number sequence generated takes an incremental form.

Step 2: Assume that X(1) satisfies the first-order differential equation:

$$\frac{dx^1}{dt}+ax^1=u \qquad (4)$$

Among them, a and u are constants.

When the equation satisfies the condition t=t$_0$, the solution of X(1) =X(1)(t$_0$) is:

$$x^{(1)}(t)=[x^{(1)}(t_0)-\frac{u}{a}]\mathrm{e}^{-a(t-t_0)}+\frac{u}{a} \qquad (5)$$

The discrete value (t$_0$=1) sampled at the same interval is:

$$x^{(1)}(k+1)=[x^{(1)}(1)-\frac{u}{a}]\mathrm{e}^{-ak}+\frac{u}{a}, \quad k=1,2,3\cdots N-1 \qquad (6)$$

$$\hat{U}=[a,u]^{\mathrm{T}}=(B^{\mathrm{T}}B)^{-1}B^{T}y \qquad (7)$$

among them:

$$B=\begin{bmatrix} -\frac{1}{2}[x^{(1)}(2)+x^{(1)}(1)] & 1 \\ -\frac{1}{2}[x^{(1)}(3)+x^{(1)}(2)] & 1 \\ \cdots\cdots & 1 \\ -\frac{1}{2}[x^{(1)}(\mathrm{N})+x^{(1)}(\mathrm{N}-1)] & 1 \end{bmatrix} \qquad (8)$$

$$U=[a,u]^{\mathrm{T}} \qquad (9)$$

Step 4: Substituting estimated values $\hat{a}$ and $\hat{u}$ respectively to obtain the response equation:：

$$\hat{x}^{(1)}(k+1)=[x^{(1)}(1)-\frac{\hat{u}}{\hat{a}}]\mathrm{e}^{-\hat{a}k}+\frac{\hat{u}}{\hat{a}} \qquad (10)$$

When K=1, 2, 3,...N-1, $\hat{x}^{(1)}(k+1)$ is the fitted value of $x^{(1)}$, and when K=N, $\hat{x}^{(1)}(k+1)$ is the predicted value of $x^{(1)}$. Then perform post-subtraction reduction operation. When K=1, 2, 3,...N-1, $\hat{x}^{(1)}(k+1)$ is the fitted value of $x^{(0)}$, and when K=N, $\hat{x}^{(1)}(k+1)$ is the predicted value of $x^{(0)}$.

4 Empirical analysis

This paper takes the tower Q345 as the research object, and selects the tower prices (average price) of the 6 purchase batches of State Grid in 2016 and 4 purchase batches of State Grid in 2017 as the original sample data as shown in Table 1, and GM(1,1) Construction of prediction model:

Table 1. Original data table of grey prediction model.

Tower model	purchase time	Purchase batch	X (Average purchase price)
Tower (angle steel Q345)	2016	A batch of State Grid	6177
		State Grid Second Batch	6412
		State Grid three batches	6331
		State Grid four batches	6264
		State Grid five batches	6504
		Six batches of State Grid	6940
	2017	A batch of State Grid	7167
		State Grid Second Batch	7096
		State Grid three batches	7095
		State Grid four batches	7250

Combining the basic principles of the prediction model, the deviation between the predicted value and the actual value is calculated as shown in Table 2 below:

Table 2. Tower Q345 Price Forecast Analysis Table.

Tower model	Purchase batch	Actual value	fitted value	Relative error(%)

	A batch of State Grid	6177	6177	0
	State Grid Second Batch	6412	6246.13	2.59
	State Grid three batches	6331	6377.52	-0.73
	State Grid four batches	6264	6511.67	-3.95
	State Grid five batches	6504	6648.64	-2.22
	Six batches of State Grid	6940	6788.5	2.18
Tower (angle steel Q345)	A batch of State Grid	7167	6931.3	3.29
	State Grid Second Batch	7096	7077.1	0.27
	State Grid three batches	7095	7225.97	-1.85
	State Grid four batches	7250	7377.97	-1.77

Through the comparative analysis of the predicted value of the Q345 price forecast on the Shanghai Tower and the actual winning price, it can be seen that the average relative error rate of the forecast model is 1.89%, and the forecast accuracy is good.

5 Conclusion

In the early stage of the implementation of the power grid technical transformation and overhaul project, in order to carry out reasonable project cost control, the power grid company needs to make a reasonable assessment of the equipment purchase cost based on the historical information of the power grid engineering equipment material price. However, the current information price is often different from the actual price. More and unreasonable information prices make the existing project balance rate generally higher. In order to solve this problem, this article combines the actual cost control of the technical transformation and overhaul project of State Grid Yili Power Supply Company, and constructs a gray theory-based equipment material price prediction model. This model has high prediction accuracy and can effectively improve the company's feasibility study estimates and preliminary evaluations. Involving the quality of budget estimates.

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