Forecasting model of electricity market prosperity index based on multidimensional big data

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Abstract. The establishment of electricity market prosperity index prediction model is of great significance to the planning, construction, production and decision-making of electricity market. On this basis, from the perspective of industry and industry, this paper proposes the design of a multi-dimensional big data forecasting model of power industry electricity market prosperity index. This paper analyzes the compilation process of the prosperity index of the power industry, studies the pre-processing method of the power data based on the multi-dimensional big data. Based on the index division algorithm of multi-dimensional big data time difference analysis and the method of compiling the prosperity index of the power industry, the prosperity index of the power market of the power industry is predicted. Through the calculation of the diffusion index method and composite index of power consumption in power industry. Combined with the multi-dimensional big data nonlinear analysis method, it is applied to the prosperity index analysis of the power industry. Finally, the accurate prediction of the electricity market prosperity index of the power industry is realized. Finally, through the simulation test, according to the power data provided by the electric power bureau of a city, the power prosperity index is compiled, and the forecasting effect of the power industry electricity market prosperity index is tested. Experimental results show that the model has high effectiveness in practical application, and can fully meet the research requirements.

1. Introduction
Power prosperity analysis is the basis of industry development decision-making, and its application in power market is very important. This paper provides a theoretical basis for the rational decision-making of the power industry and the government, and puts forward the design of the power industry electricity market prosperity index forecasting model based on multidimensional big data. Based on the theory and method of prediction, regression prediction method and neural network prediction method based on time series are proposed. Based on the analysis and prediction of nonlinear regression relationship between power and various influencing factors, this paper uses data mining analysis method to effectively process multi great data, comprehensively collects internal and external data information, and analyzes the main factors affecting power consumption. To determine the function of electricity market prosperity prediction can achieve the research requirements of accurate prediction of electricity market prosperity. According to the change law of power supply in the past,
the possibility and trend of future power supply can be predicted\cite{3}. The results show that this method has the advantages of high prediction accuracy, simple operation and easy to master.

2. Forecasting model of prosperity index of electricity market in power industry

2.1. Structure framework of business climate index prediction model for power industry

The multi-dimensional big data index prediction model is used to preprocess the electricity boom data. It includes large multi-dimensional data and enhanced processing power. By collecting and preprocessing the data in and out of the electricity market of the power industry, and using the enhanced data to collect and process the season, trend cycle and irregular factors of the electricity market in the power industry\cite{4}. The processing steps are divided into four layers from bottom to top: data source, data platform layer, data service layer and external application layer. Each layer provides upper level data and basic services, and application layer provides end-user services\cite{5}. In the process of prediction, users can get the unified authentication and authorization service of state power and e-commerce company after logging into the system. All data use is included in the existing data standard system. In order to ensure accurate prediction of data market prosperity indicators, a data processing framework for electricity market is further constructed\cite{6}. The specific structure is shown in figure 1.

![Fig. 1 Structure framework of data processing platform for electricity market](image)

As shown in figure 1, in the application process of multi-dimensional data evaluation in the power industry, the market data flow process is divided into the following stages: firstly, the internal and external data of the power industry market index are integrated, and the data collection and preprocessing are carried out in the data center to generate the data intermediate table\cite{7,8}. At the same time, the intermediate table data is extracted from the electronic big data platform regularly for index prediction\cite{9}. Based on this, further external data and intermediate table data are modeled to generate result data, and the result data is regularly pushed to the power market data processing platform for index evaluation and processing.
2.2. Evaluation index of electricity market prosperity index in power industry

Build the auxiliary mode of power market prosperity evaluation in power industry. Six kinds of indicators, including basic electricity consumption information, electricity level, electricity fluctuation, electricity trend and electricity fee information, are integrated, and the scores and credit scores of each index are output to get the formula (1).

\[
Y_i^{(a)} = \lambda^2 + \left[ \left( Y_i / d_i \right)^\lambda - 1 \right] / \lambda, \quad \lambda \neq 0,1
\]

\[
\log(Y_i / d_i) K, \quad \lambda = 0
\]

In formula (1), \( \lambda = 0.12 \) corresponds to the linear transformation. The corresponding number transformation of \( \gamma = 1.27 \). \( d_i \) is the denominator containing information such as month length and calendar influencing factors[10]. Then, the time series of electricity market is further calculated:

\[
\phi_p(B)\phi_p(B')\left( (1-B)^d \right) \left( -B' \right)^D z_t = \theta_\gamma(B)\theta_\gamma(B')a_t
\]

In the above algorithm, \( B \) represents the lag operator of electricity market and satisfies the following conditions: \( Bz_t = z_{t-1} \). \( s \) is the seasonal cycle of electricity market, \( \phi_p(B) \) is the nonseasonal autoregressive characteristic operator of electricity market prosperity index. \( \theta_\gamma(B) \) is a nonseasonal autoregressive characteristic operator of electricity market prosperity index. \( \theta_\gamma(B') \) is the average operator. \( \theta_\gamma(B') \) is market disruption. Where at is the independent characteristic distribution value of the power market index, its mean value is 1, and \( \sigma_2 \) is the variance. \( (1-B)^d \left( -B' \right)^D \).

Taking \( y_t \) as the benchmark, \( x_t \) as the selected index and \( R \) as the correlation coefficient, the specific evaluation algorithm is as follows:

\[
Y_t = \frac{R \sum_{i=1}^{a} \left( x_{i+t} - x_t \right)}{\sqrt{MA_t \sum_{i=1}^{a} \left( x_{i+t} - x_t \right)^2 \left( y_t - x_t \right)^2}}
\]

In formula (3), \( x_{i+t} \) is the maximum number of delays, \( x_{i+t} \) is the number of times after data extraction. When selecting the prosperity indicators of the power industry, the accountant calculates the time difference correlation coefficients of several different time lags, and then calculates and compares them to obtain the maximum time difference correlation coefficient.

2.3. Realization of the prosperity index forecast of electricity market in electric power industry

In order to guarantee the forecasting effect of the prosperity index of the electricity market in the power industry, the electric capacity state, electricity consumption level, electricity consumption payment level, default power consumption, output warning value, risk level and risk code are further established as the prediction indexes. Based on this, this paper further optimizes the information of electricity market prosperity judgment, which is shown in Table 1.

| Serial number | Output field | Field explanation |
|---------------|--------------|-------------------|
| 1             | User code    | -                 |
| 2             | Unified social credit code | - |
| 3             | User name    | -                 |

Tab. 1 Power industry electricity market prosperity judgment information
If there is a certain linear relationship between the total industrial power consumption $X$ and the total industrial power consumption $Y$, the relationship between the total industrial power consumption and the market prosperity index is as shown in Table 2.

### Tab. 2 Power consumption relationship

| Category               | January | X       | Month J | Y       | Month M |
|------------------------|---------|---------|---------|---------|---------|
| Primary industry       | E$_{i1}$ | ...     | E$_{ij}$ | ...     | E$_{im}$ |
|                        | ...     | X$_{i1}$ | ...     | Y$_{11}$ | ...     |
| I industry (industry)  | E$_{ij}$ | ...     | E$_{ij}$ | ...     | E$_{im}$ |
|                        | ...     | X$_{ij}$ | ...     | Y$_{ij}$ | ...     |
| Total power consumption| E$_{0i}$ | ...     | E$_{0j}$ | ...     | E$_{0in}$ |

In Table 2, $E_{ij}$ is the monthly electricity consumption of the power industry, and $m$ is the total consumption parameter of the electricity market. Then the sum of squares of the surplus index of the electricity market of the power industry is further calculated:

$$Q = \sum_{j=1}^{m} (E_{0j} - E_{ij})^2$$  \hspace{1cm} (4)

If the correlation index of industrial power consumption and social electricity consumption is $RI$, the value range is $[0,1]$. It is assumed that the correlation between power industry $\alpha$ and electricity consumption market $\beta$ satisfies: $\alpha + \beta = 1$. Then, the algorithm of leading coefficient $\delta_i$ of electricity market prosperity index is as follows:

$$\delta_i = \alpha R_i + \beta_i = \alpha \frac{\sum_{j=1}^{m} (E_{0j} - E_{ij})^2}{\sum_{j=1}^{m} (E_{0j} - \overline{E}_0)^2} + \beta \frac{\sum_{j=1}^{m} E_{0j}}{\sum_{j=1}^{m} E_{0j}}$$  \hspace{1cm} (5)

Based on the above method, the accurate prediction of the prosperity index of the power consumption market of power enterprises can better guarantee the prediction effect, put forward the prediction accuracy, and fully meet the research requirements.

### 3. Analysis of experimental results

In order to verify the forecasting effect of electricity market prosperity index of electric power enterprises, the experimental detection is carried out. Through an example, the method of establishing the prosperity index of power market and the method of establishing power market prosperity analysis are simulated. The power index based on the city's power situation from 2019 to 2012 is compiled. Data in Table 3 is the power consumption of a power supply company from January 2012 to the fourth quarter of 2019.
Tab. 3 Electricity consumption in 2012-2019 (k/WH)

| Quarter | 1     | 2     | 3     | 4     |
|---------|-------|-------|-------|-------|
| 2012    | 407 365 | 591 572 | 628 315 | 554 068 |
| 2013    | 498 992 | 665 836 | 742 569 | 682 634 |
| 2014    | 572 365 | 785 263 | 856 236 | 756 682 |
| 2015    | 596 865 | 852 635 | 923 568 | 836 545 |
| 2016    | 695 236 | 923 583 | 112 653 | 956 325 |
| 2017    | 775 263 | 110 236 | 110 252 | 115 236 |
| 2018    | 855 623 | 120 023 | 132 562 | 962 563 |
| 2019    | 792 565 | 120 325 | 125 236 | 123 256 |

From the data in table 3, we can see the seasonal variation of the quarterly electricity consumption. Electricity consumption increased gradually in the first quarter and decreased in the third and fourth quarters. Urban electricity consumption has increased year by year. The prosperity index of a city's electricity market is established by using the method of power market prosperity index. The leading index, consistency index and lag index are analyzed by diffusion index and composite index. The forecast results of electricity consumption market consistency index are shown in figure 2 and figure 3.

![Fig. 2 Fluctuation prediction of leading indicators in electricity consumption market of power enterprises](image1)

![Fig. 3 Prediction results of consistency index of power consumption market of power enterprises](image2)

The consistency and delay can be analyzed by using the table index. According to the above experimental prices, it is confirmed that the forecasting model of power enterprise electricity market prosperity index based on multidimensional big data has high accuracy and practicability in the practical application process, which fully meets the research requirements.

4. Conclusion
It has important reference value for the development of the power market to formulate the electricity prosperity index reasonably and analyze it from the perspective of industry and power industry. Therefore, this paper proposes the construction of power enterprise electricity market prosperity index prediction model based on multi-dimensional big data. The index prediction model is preprocessed by
using multidimensional big data, and divided by time difference analysis. After processing, the index is compiled by diffusion index method and comprehensive index method, and the industrial electricity prosperity index and industrial electricity prosperity index are analyzed by nonlinear analysis method. Finally, the experimental results show the effectiveness of the method.

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