Research on Investment Aid Decision of Transmission Line Project Based on Artificial Intelligent Technology

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Abstract. According to analyze the historical transmission line projects from 2016 to 2018, we screen out a series of key influencing factors by principal component analysis. Aimed at the accuracy of grid investment, this report constructs an artificial intelligent investment aid decision model based on neutral network algorithm to predict the construction cost of the transmission line project.

1. Introduction
Accompany with the downward trend of the international economy and the deepening of the new round of the reformation of electric power system in China, the power grid enterprises are facing significant economic pressure at home and abroad. For this reason, the power grid enterprises have put forward relevant accurate investment controlling requirements and formulated relevant management measures. However, a large number of traditional engineering cost management methods are relied on to compile investment estimates, resulting in poor effect of final accurate investment, which cannot meet the requirements of accurate control, and high project investment balance ratio at present.

We need to use scientific and technological means to break the way of making investment decisions by relying too much on traditional expert experience. Through the research of artificial intelligent technological investment assistance decision model, supported by the final account data of historical power transmission line projects, the model is trained for reinforcement learning; and by inputting the key influencing factors of transmission line projects, the reference value of the investment of a single project is output.

2. Artificial intelligent model theory
Artificial intelligence is a new technical science to study and develop theories, methods, techniques and application systems for simulating, extending and extending human intelligence. With the help of neural network algorithm, the characteristics of artificial intelligence machine self-learning can be played, and the logic rules of data can be deeply mined to build the model [1-5].
In this neural network, there are input layers, hidden layers, and output layers. The input layer is responsible for receiving the signal, the hidden layer is responsible for the decomposition and processing of the data, and the final result is integrated into the output layer. A circle in each layer represents a processing unit, which can be regarded as simulating a neuron. Several processing units constitute a layer, and several layers constitute a network, namely "neural network" which is shown in Figure 1.

2.1. The forward propagation
A neuron has multiple inputs and one output, and the input of each neuron can be the output of other neurons or the input of the entire neural network. The structure of a neural network is the structure of connections between different neurons. The output of the simplest neuron structure is the weighted sum of all the inputs, and the weights of the different inputs are the parameters of the neuron. The optimization process of neural network is the process of optimizing the parameters of neurons.

2.2. The back propagation
When the network prediction results from any sets of random parameters and calculated by forward propagation are obtained, we can use the gradient of the loss function relative to each parameter to correct them. In fact, the training of neural network is such a continuous forward-back propagation process, which until the predictive power of the network reaches our expectations.

2.3. Loss function
The weights of the neural network model are constantly updated by the iterative training process of data and the gradient descent algorithm, so as to reduce the deviation rate and achieve the minimum value of the loss function. Through repeated training for tens of thousands of times, the trend of the loss function curve no longer shows an obvious downward trend with the increase of the number of iterations, which means that the model parameters reach the lowest point of the loss function.

3. Model construction

3.1. Data samples
The typical model samples are from the representative 110kV transmission line projects which have been put into production in a certain region from 2016 to 2018. According to statistics, there are a total of 56 samples of 110kV transmission line projects. According to the analysis of the main influencing factors, there are nearly 40 basic indexes concerning on the construction of the transmission line project, which have a great impact on investment.
3.2. Data pretreatment
Before artificial intelligent machine learning, we firstly need to preprocess the data of the sample projects to avoid problems such as data format, order of magnitude and unclear hierarchy. There are four steps, which are data cleaning, data integration, data transformation and data specification, to ensure the standardization and accuracy of the training sample data entered into the model.

3.3. Identification of key influencing factors
In the data pretreatment, we find that not all the factors have a significant impact on the investment results, so we screen out the key factors with training value through principal component analysis for the further research.

Through comparing the correlation coefficients of the variables in each principal component, we screen out the principal variables with large correlation coefficients, and find out a total of 12 key factors which affecting the transmission line projects. The key influencing factors are shown in the table below:

| Code of Key Factor | Key Factor                           |
|-------------------|-------------------------------------|
| X1                | Voltage grade                       |
| X2                | The length of the line              |
| X3                | The terrain condition               |
| X4                | The total number of tower bases     |
| X5                | Construction site requisition and cleaning fees |
| X6                | Concrete quantity                   |
| X7                | The amount of steel in the tower bases |
| X8                | Earthwork quantity of the tower bases |
| X9                | Tower material quantity             |
| X10               | Material price of tower             |
| X11               | Wire quantity                       |
| X12               | Price of Wires                      |

3.4. Model training and verification
We select 56 110kV data of transmission line projects as data samples, including 46 samples as training samples and 10 samples for model validation. The model builds a neural network with three hidden layers, and the number of neurons in each layer is 32, 64 and 32 respectively. The number of training rounds is 10,000, and the learning rate is 0.01.

The 10 pieces of data are verified, and the verification result table is as follows:

| Project Number | The length of the line (km) | Actual Static Investment (million Yuan) | Forecast Static Investment (million Yuan) | Deviation Rate (%) |
|----------------|----------------------------|----------------------------------------|------------------------------------------|--------------------|
| 1              | 27                         | 13.807                                 | 13.704                                   | 0.74               |
| 2              | 8.7                        | 8.515                                  | 9.457                                    | 11.07              |
| 3              | 10.58                      | 9.914                                  | 9.556                                    | 3.62               |
| 4              | 6                          | 4.437                                  | 3.868                                    | 12.82              |
| 5              | 24.37                      | 25.186                                 | 24.919                                   | 1.06               |
| 6              | 5.6                        | 3.594                                  | 3.543                                    | 1.43               |
| 7              | 10.326                     | 12.556                                 | 12.218                                   | 2.70               |
| 8              | 20.3                       | 11.925                                 | 11.292                                   | 5.27               |
| 9              | 16                         | 9.529                                  | 9.026                                    | 5.28               |
| 10             | 16.7                       | 11.242                                 | 10.983                                   | 2.31               |
According to the above table, 8 of the predicted static investment and real static investment have deviations within 10%, and there are 2 above 10%. The average deviation rate is 4.63%, and the model performs well on the entire sample of the validation set data.

The accuracy of the artificial intelligent model is acceptable, but there are still a small amount of samples with large deviations. The main reason for the large deviation is the limited sample data of transmission line projects and the length of the line. If a large amount and abundant reliable samples are used for training and prediction, it is expected to get a better fitting effect.

4. Conclusion
Based on the historical power transmission line project data, this paper constructs artificial intelligent investment aid decision model depending on neural network algorithm and identifying key influencing factors by Principal component analysis. The results show that by inputting the key influencing factors of the project in the artificial intelligent investment aid decision model, the project cost of the project can be predicted quickly and the investment balance ratio can be calculated reasonably.

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