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Relationship between Risk Factors of Water Conservancy Project Based on Machine Learning Algorithm

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Abstract: In recent years, with the continuous progress of science and technology, water conservancy projects are playing an increasingly important role in social economy. However, the risk accidents caused by the lack of traditional engineering experience and human factors are also gradually increasing. As one of the national infrastructure construction projects, the importance of water conservancy is self-evident. Therefore, how to improve the quality, reliability and operation efficiency of water conservancy projects through computer technology is very necessary and has practical significance. This paper first introduces the commonly used mathematical statistics methods and the application status of machine learning algorithm, and then uses machine learning method to build probabilistic neural network technology to study the role of artificial neural network in risk prediction of water conservancy projects. Finally, the numerical simulation software is used to convert the risk factor relationship analysis results into actual data. The test results show that the impact between natural disasters and engineering geological conditions is the greatest. Therefore, in the risk prediction of water conservancy projects, special attention should be paid to the concurrent impact results of these two.

1. Introduction

In today's world, the rapid development of science and technology has pushed human society into a new era. With the continuous progress and in-depth integration of computer technology, the Internet and communications and other fields, people's demand for knowledge and information has increased dramatically. The importance of water conservancy projects as one of the important components of national economic construction is also gradually highlighted. The level of project quality is a key indicator to measure a country's modernization level [1-2]. The water conservancy industry is related to the national economy and the people's livelihood, the normal production and life of the people, and affects the stable development of the society. Therefore, in each stage of the

project, attention should be paid to the risk factors and their harmfulness and sensitivity analysis [3-4].

Many scholars have conducted relevant research on the risks of water conservancy projects. Foreign scholars mainly put forward the risk identification method based on Bayesian theory in the research of computer application field. The algorithm can simplify the complex problems through identification and classification, and select appropriate models for analysis according to the actual situation. However, it ignores the influence of a large number of uncertain factors in many random processes, such as noise, data transmission, etc., which will cause large differences between the calculation results and the real values, leading to lower accuracy, etc. [5-6]. Domestic scholars have studied the relationship between risk factors in the field of water conservancy in China, and put forward some views. For example, some scholars found that hydraulic structures can be divided into four categories after classified analysis of water conservancy projects. The construction process of water conservancy system projects is complex, with multiple objectives and complexity. Therefore, in order to solve these problems, it is necessary to establish a complete and perfect risk assessment model. Some scholars use the fuzzy comprehensive evaluation method to study the gap between China's hydropower development technology and foreign countries, and put forward suggestions on how to improve the quality of China's hydropower projects and improve the utilization rate of water resources [7-8]. Therefore, based on machine learning algorithm, this paper conducts an in-depth study on the relationship between risk factors of water conservancy projects.

This paper mainly introduces and studies the relationship types that may exist in water conservancy projects, and illustrates how various risk factors interact with each other to form an overall structural system, and then summarizes the importance ranking of each related factor for the degree of impact of the project and the coherent distribution of each factor through its practical application effect.

2. Discussion on the Relationship between Risk Factors of Water Conservancy Project Based on Machine Learning Algorithm

2.1. Machine Learning Algorithm

Artificial neural network is an adaptive and non-peer learning method, and its basic principle is shown in Figure 1. Artificial neural network contains a large number of nodes and hidden layers. Each node is called mapping relationship by one or more neurons through simulating the information processing process of human brain. The hidden layer is responsible for storing all input mode data (including output) stored in the knowledge base, identifying and matching, while the barrier is a human brain neural network used to prevent hidden in the network from being attacked and damaged, protect them from interference from external factors and other influences, so as to ensure the efficient operation of the whole system [9-10].

In engineering practice, it is found that the knowledge base is built from within the system, and then corresponding algorithms are designed for each task model to obtain the required database. Finally, according to the actual situation, appropriate programs are selected to execute and output results, so as to provide technical support, theoretical basis and guidance for improving the work efficiency of the next step and making the whole process more efficient [11-12]. The accuracy rate can be used to measure the ratio of the number of positive samples with correct classification to all positive samples, while the recall rate is used to measure the ratio of the number of positive samples with correct classification to all positive samples.

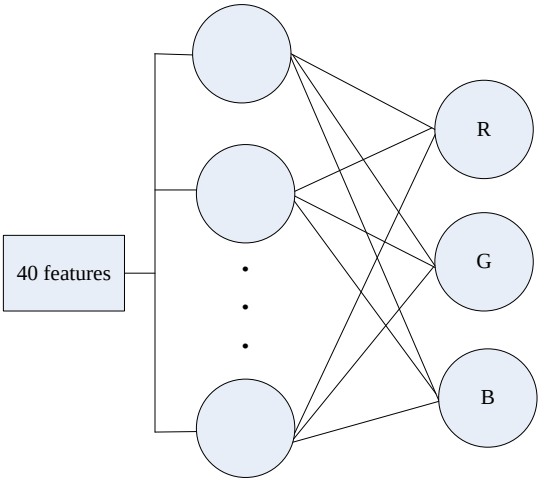

Figure 1. Machine learning algorithm

Set the set with correct classification as A and the set with errors as B:

$$\Pr ecisio(A,B)=\frac{|A\cap B|}{|A|},\operatorname{Re} call(A,B)=\frac{|A\cap B|}{|B|} \tag{1}$$

Coverage refers to the proportion of classified samples in the total samples. Accuracy refers to the ratio between the number of correctly classified samples and the total number of samples. When calculating the accuracy rate of the algorithm, if Y is the prediction category of the ith sample and n is its real category, then the accuracy rate is:

$$accuracy=\frac{1}{n}\sum_{i=1}^{n}1(\hat{y}_t=y_t) \tag{2}$$

These technologies can be used to deal with the problems caused by using manual operations to solve complex problems that cannot be solved with existing knowledge, or the inefficiency and cost increase caused by errors due to imprecision. In addition, by integrating different types of information, better results can be achieved and system performance can be effectively improved.

2.2. Types of Risk Factors of Water Conservancy Projects

Risk factors of water conservancy projects refer to various situations in actual operation due to various uncertainties and randomness in the construction process of water conservancy projects, which will directly affect the construction efficiency and quality [13-14]. It is found in the hydrogeological survey that topography, climate, seasonal changes and other natural disasters will have an impact on water conservancy projects. For example, floods and debris flows may occur due to flood disasters, and serious problems such as floods and debris flows may occur due to rainstorm. These are unavoidable and insurmountable risk factors for water conservancy projects. Therefore, natural analysis of water conservancy and hydropower projects is also essential. Figure 2 shows the risk impact types of water conservancy projects.

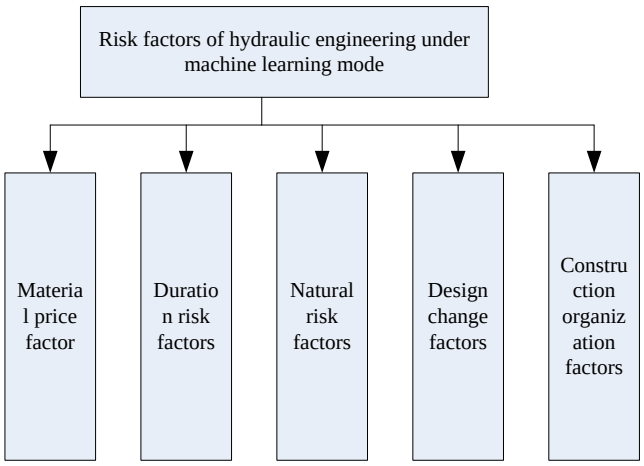

Figure 2. Impact factors of water conservancy projects

Risk factors of water conservancy projects mainly include the following aspects:

First, natural disasters. Due to the public welfare characteristics and social benefits of water conservancy projects, many natural phenomena, such as floods or droughts, often occur in the construction process. These events are very easy to cause casualties, property losses and even security threats, and also bring great economic losses to the project. Therefore, for the water conservancy system, we must pay attention to the prediction and analysis of various possible risk factors of water conservancy projects, and formulate corresponding preventive measures to avoid major accidents caused by such problems [15-16].

The second is engineering geological conditions. The natural environment, such as terrain and climate, has greatly changed the project construction. For example, when the hydrogeological conditions change greatly, it is easy to cause floods. When encountering earthquake or flood disasters, it is easy to cause natural disasters such as mud rock flow, which may lead to dam break and even damage the water conservancy facilities. In addition, some severe weather may lead to drought and salinization in some areas; it will also have a great impact on the water conservancy system.

Third, the allocation of water resources and hydropower resources is unreasonable. For example, there are a lot of hydrological stations and bridge works in some large hydropower stations, while some small reservoirs have no bridge culverts or navigation requirements, or flood overflow is caused due to the low elevation of the top of the flood control embankment, which will have a great impact on the construction of water conservancy projects.

Fourth, the quality and management level of the personnel involved in the project construction are insufficient. In risk identification, the personnel quality and limited ability should be fully considered. In addition, appropriate technical methods should be selected from the actual situation of the project to deal with various emergencies and crisis events such as possible and unforeseeable events, and other factors affecting the water conservancy project should be analyzed and studied to prevent similar accidents or disasters in the water conservancy project [17-18].

2.3. Comprehensive Evaluation Method of Risk Factors

The comprehensive evaluation method of risk factors is an analysis method based on mathematical statistics, which divides a single data set into several populations, and then according to the relationship between the components in each subset. The risk factor relationship analysis method has been applied to various fields of water conservancy projects. However, due to the complexity of its research object, the wide range of coverage, the large amount of data and

information, and the greater technical difficulty, etc. This classification method can better deal with complex and uncertain problems, and will be interfered by various natural, social and man-made external environments in the process of water conservancy projects. This comprehensive evaluation method has the following advantages in application. First, it can accurately reflect a problem. Second, it can quantify each sub factor to obtain the final data information that is relatively small, and it can directly use computer algorithms to simulate the model output and analyze the prediction accuracy. Through the quantitative research on the interaction and influence of various elements, we can obtain the change state weight of various things under certain conditions. This method can better reflect the consequences and risk degree caused by possible deviation of results when there are multiple uncertain events or processes in a field. It has high practical value and advantages in scientific theoretical basis and practical experience. In water conservancy projects, long construction period and great technical difficulty are generally involved. By combining historical data, probability distribution and relevant literature, a qualitative and quantitative combination of data is obtained to quantify the risk classification.

3. Experimental Process of Relationship between Risk Factors of Water Conservancy Project Based on Machine Learning Algorithm

3.1. Schematic Diagram of Risk Factors of Hydraulic Engineering Based on Machine Learning Algorithm

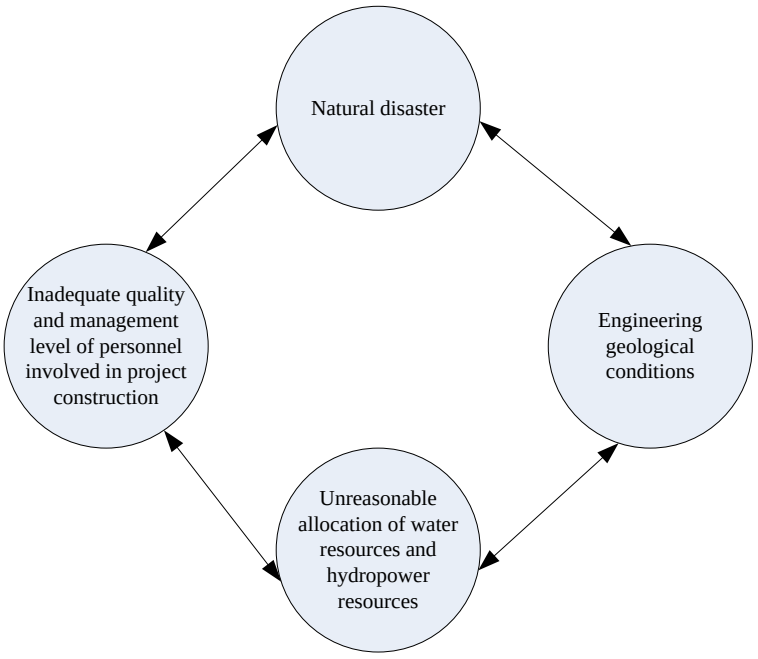

Figure 3. Schematic diagram of the risk factor relationship of the water conservancy project

The relationship diagram of risk factors of water conservancy projects (as shown in Figure 3) mainly refers to natural disasters and man-made disasters. When describing them, these risk events can be considered as a whole. Natural causes refer to water and soil loss caused by force majeure such as typhoon and rainstorm. The construction of dams or dams in the natural environment will produce floods to a certain extent. The river bed will be raised or the river bank will be straightened due to siltation caused by earthquakes or debris flows, which will lead to floods. Man made disasters mainly refer to the inconvenience that water conservancy development projects bring to

people's lives, and even affect life safety. In the simulation analysis of water conservancy projects, we should first take the possible emergencies in each process of water conservancy projects as the basic data, and then establish the correlation matrix between the corresponding risk impact factors. Each variable is subject to various random and uncertain disturbances. Therefore, in order to improve research efficiency and reduce human intervention, the model is introduced.

3.2. Test of Interaction Degree of Risk Factors of Hydraulic Engineering Based on Machine Learning Algorithm

The interaction between risk factors of water conservancy projects is complex and highly related. When evaluating water conservancy projects, different stages, different periods and various emergencies need to be considered. Therefore, in order to better analyze the risk status and contact situation in each period. In this paper, statistical software is used to analyze the existing problems in the water conservancy system and the probability of accidents, losses and consequences. In this process, machine learning technology is applied. This method can transform a large number of complex and uncertain engineering behaviors into simple, understandable and highly targeted ones, and is widely used in the risk assessment system of water conservancy projects.

4. Experimental Analysis of the Relationship between Risk Factors of Water Conservancy Project Based on Machine Learning Algorithm

4.1. Test and analysis of Interaction Degree of Risk Factors of Hydraulic Engineering Based on Machine Learning Algorithm

Table 1 shows the test data of interaction degree of risk factors of water conservancy projects.

Table 1. The mutual degree of influence between risk factors in water conservancy projects

Risk factor	Natural calamities	Engineering geologic requirement	Unreasonable allocation of water resources and hydropower resources	The own quality and management level of the participating project construction personnel are insufficient
Natural calamities	0.2	0.9	0.6	0.7
Engineering geologic requirement	0.9	0.1	0.7	0.4
Unreasonable allocation of water resources and hydropower resources	0.6	0.7	0.2	0.3
The own quality and management level of the participating project construction personnel are insufficient	0.7	0.4	0.3	0.3

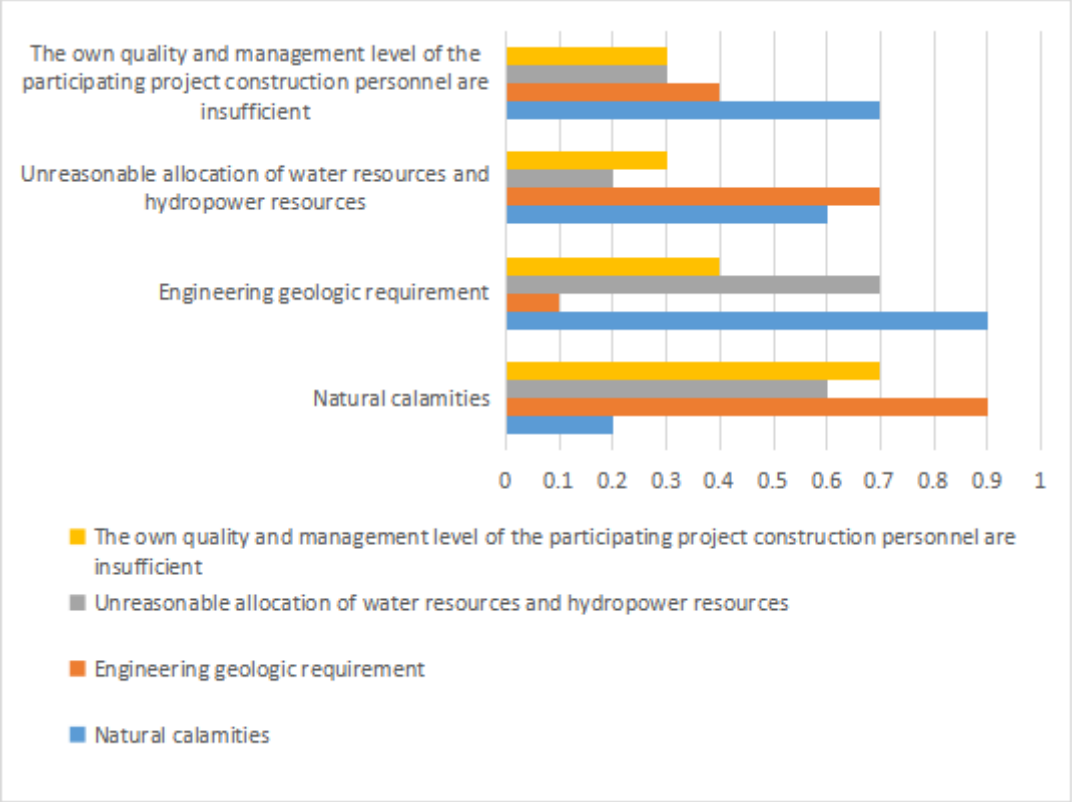

Figure 4. The degree of influence engineering risk factors based on machine learning algorithm

In order to verify the effect of the model on the interaction between the risk factors of water conservancy projects, the following methods are adopted for analysis in this paper. In the process of model establishment, artificial neural networks are used to simulate the structure and operation rules of human brain neurons, and the internal relations among various indicators are transformed into correlation matrices with MATLAB software. Through this technology, we can achieve a quantitative description of the risk assessment results. We use expert experience to calculate the weight of each index (the closer the index is to 1, the greater the impact). As can be seen from Figure 4, the impact between natural disasters and engineering geological conditions is the greatest. Therefore, we need to pay special attention to the concurrent impact results of these two in the risk prediction of water conservancy projects.

5. Conclusion

This paper mainly makes statistics and analysis on the number and types of various risk factors in water conservancy projects, and on this basis, establishes the corresponding Bayesian leaf distribution model, and puts forward risk control measures for its influencing factors. According to the practical experience of water conservancy projects, problems of varying degrees will occur due to external conditions, climate and environment in the actual work process. Therefore, in order to reduce the losses brought to people by these adverse factors and ensure the normal construction order and stable operation, this paper also verifies the feasibility and scientificity of using the analytic hierarchy process (AHP) to carry out quantitative risk assessment and quantitative calculation, and provides certain technical support for the construction of water conservancy projects.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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