Research on Analysis and Performance Optimization of Green Building Design Fundamentals Based on Big Data Technology

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Abstract. This paper presents a comprehensive study and analysis of building energy efficiency design in the context of advocating the development of green buildings. The following research is not just the development of green building design, but through the comprehensive application of big data to carry out a combination of research. The development of green building is the key to achieving sustainable development of buildings. Green building design in different regions should follow the concepts of adapting to local conditions, drawing on the essence of traditional architectural culture, and embodying a healthy and natural attitude towards life. Planning, design, environmental configuration and other architectural practices should be used to improve and create a comfortable living environment, so that architecture can effectively become a filter and regulator of the environment and create a healthy and comfortable living environment. Under the support and guidance of the United Nations' sustainable development goals, the development of green building has become the key target and development of today's development. Under the support of the comprehensive development goals and development concepts, the research in this paper is particularly important, and also has great research significance in promoting the sustainable development of green buildings.

Keywords: Green Building; Design Basics; Performance Optimisation Research; Big Data Technology

1 Introduction

The green economy development concept is mainly to promote the organic integration of human society and the natural world, this integration is not only purely in the use of natural pigments, but also in order to achieve the coordinated development of the natural world and people [1]. Although the economy of the construction industry does provide an outstanding contribution to the improvement of the country's overall economic capacity over the long term, the problem of the resulting damage to the natural environment is becoming increasingly serious [2]. What we need is a new type of building that is environmentally friendly, green and healthy, which will in turn better achieve harmony between man and nature and sustainable development. At the same time to

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achieve the low-carbon development of green building has also become an inevitable requirement of China's economic development. It is particularly important to promote the development of green buildings. Green building design from the conservation of resources, improve resource utilisation, is the inevitable requirement for the establishment of a conservation-oriented society in China. At the same time, through the development of green building, can stimulate the promotion of the use of new technologies and the application of new materials, which promotes the development of related industries innovation plays a certain role in promoting [3]. As shown in figure 1.

Fig. 1. Green saving and environmentally friendly building

2 Establishment of Gray Clustering Evaluation Model for Green Buildings

2.1 Weighting by Combined Assignment Method

2.1.1 Hierarchical Analysis Method to Calculate Weights

Hierarchical analysis is based on judgment matrices constructed by experts scoring problems that are multilevel and have many complexities in order to obtain the maximum eigenvalues and eigenvectors of the matrices and to perform consistency tests [4]. The specific steps are as follows:

(1) Hierarchical modeling

Hierarchical analysis is characterized by its hierarchical nature, when using hierarchical analysis to solve problems, you need to divide the research objectives into different levels, this paper is divided into the objective level, guideline level and program level, and compare the importance of the influencing factors between them. Indicators at the same level must be independent of each other, and the next level of indicators are included in the previous level [5]. The evaluation system in this paper is studied using hierarchical analysis, which is divided into a total of three levels, with the target level being green building evaluation, in which the first-level indicators contain eight aspects, while there are a total of 31 specific indicators in the second-level indicators.

(2) Constructing a judgment matrix

In order to avoid subjective differences between decision makers at the indicator level for the degree of importance of the target level, this paper uses the expert scoring method to construct a rating matrix ,and then compares the significance of the bottom index relative to the top index with the degree of affiliation, which is usually used to determine the degree of significance using a ratio scale, with values shown in Table 1. The maximum A eigenroot and eigenvector W were found using Spssau software.

$$A^* = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

Table 1. Judgment Matrix Scale Meaning

scale	hidden meaning
1	Comparison of the two factors, the former and the latter being of equal importance
3	Comparing the two factors, the former is slightly more important than the latter
5	Comparing the two factors, the former is significantly more important than the latter
7	Comparing the two factors, the former is more strongly important than the latter
9	When comparing the two factors, the former is definitely more important than the latter
2,4,6,8	denotes the intermediate value of the above neighboring judgments
from the bottom	If the ratio of the importance of factor i to factor j is , then the ratio of the importance of factor j to factor i is

(3) Hierarchical single ordering and consistency test

The calculation of weights in hierarchical analysis needs to take into account the experience and level of the experts, thus subjectivity and inaccuracies exist. Consistency testing is necessary to improve the accuracy of weight calculation [6]. Specific steps include normalizing the experts' opinions, calculating the consistency ratio and its stochastic consistency index, and determining the reliability of the weight calculation as follows:

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{2}$$

$$CI = \frac{CI}{RI} \tag{3}$$

Style: --Maximum characteristic root;

n--Determining the order of a matrix;

CR--Random Consistency Ratio;

RI--Mean stochastic consistency metrics, whose values are referenced in Table 2.

Table 2. Average random consistency indicator RI

Matrix order n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

When, certain corrections must be made in the matrix and reconstructed to obtain reasonable results. If the calculated CR is less than 0.1, it can be inferred that it complies with the consistency principle and does not need to be reconstructed.

2.1.2 Entropy Weighting Method to Calculate Weights

According to the degree of change of the evaluation indicators, the entropy weighting method is used to calculate the weights of the evaluation indicators, and the specific steps are as follows:

If n samples are evaluated by m evaluation indicators and the corresponding values of each indicator are. Here is taken to ensure that the range of values after data normalization is within. In the calculation, the green building valuation has different types of indicator scales and dimensions, and the raw data needs to be normalized as shown in the formula below [7].

The forward normalization equation is:

$$y_{ij} = \frac{y_{ij} - \min(y_{ij})}{\max(y_{ij}) - \min(y_{ij})} \tag{4}$$

The inverse normalization formula is:

$$y_{ij} = \frac{\max(y_{ij}) - y_{ij}}{\max(y_{ij}) - \min(y_{ij})} \tag{5}$$

Since the entropy value ranges from, the raw data must be normalized to satisfy the requirements to obtain the judgment matrix m denoting the number of indicators and n denoting the number of objects) with the following formula:

$$p_{ij} = \frac{y_{ij}}{\sum_{j=1}^{m} y_{ij}} \tag{6}$$

3 Green Building Gray Clustering Evaluation Model

Due to the many factors affecting the evaluation index of green building, and some data can not be quantified, the use of fuzzy gray clustering method to assess the green building has many advantages[8], it can effectively dilute the unknown information as well as objectively reflecting the nature of the system, will be a variety of influencing factors to integrate the data that can not be quantitatively determined by fuzzy processing, as a way to solve the uncertainty and ambiguity between the various factors of the evaluation system, the principle of the maximum degree of subordination to make the evaluation of the object of the various factors can be comprehensively considered, so that a more reasonable and accurate assessment of the reality of the effect of green building [9].

3.1 Gray Whitening Weight Function

A total of the following gray whitening weight functions are included:

(1) Typical whitening weight function labeled is the turning point of, This is shown in Figure 2(a) below.

The formula for a typical whitening weight function is as follows:

$$f_j^k(x)\begin{cases} 0, x \notin [a_1, a_4] \\ \frac{x-a_1}{a_2-a_1}, x \in [a_1, a_2] \\ 1, x \in [a_2, a_3] \\ \frac{a_4-x}{a_4-a_3}, x \in [a_3, a_4] \end{cases} \tag{7}$$

(2) The lower measurement limit whitening weight function is denoted as, which is the turning point of the whitening weight function, This is shown in Figure 2(b) below.

The formula for the lower measurement limit whitening weight function is as follows:

$$f_j^k(x)\begin{cases} 0, x \notin [0, a_4] \\ 1, x \in [0, a_3] \\ \frac{a_4-x}{a_4-a_3}, x \in [a_3, a_4] \end{cases} \tag{8}$$

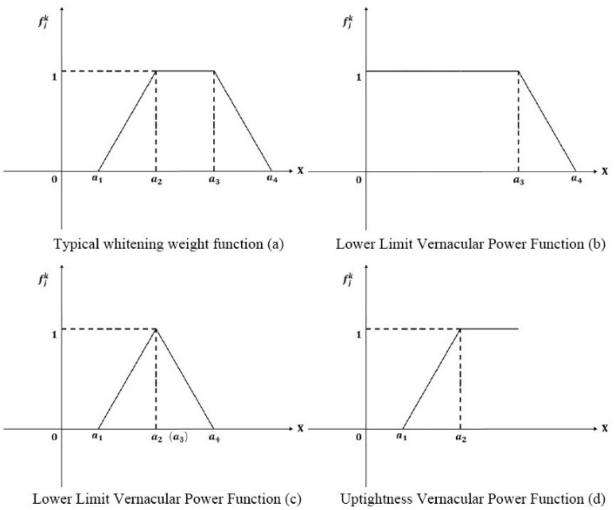

Fig. 2. Images of the four whitening power functions

3.2 Mixed Centroid Whitening Weight Function

The function can more accurately reflect the complex system evaluation [10], but also able to solve the traditional upper and lower limits of the measurement of the whitening weight function of the "cliff" effect, the image is shown in Figure 3 below, set there are n gray class center point, respectively, for the end of the two endpoints are taken for the evaluation of each evaluation index range of values for the factors scored in the interval, respectively, for the.

It follows from the definition of the whitening weight function:

(1) The endpoint first gray class gray number whitening weight function is:

$$f^1(x)\begin{cases} 1, x \in [k_0, k_1] \\ (k_2 - x)/(k_2 - k_1), x \in [k_1, k_2] \\ 0, x \notin [k_0, k_2] \end{cases} \tag{9}$$

(2) The intermediate point gray class gray number whitening weight function is:

$$f^1(x)\begin{cases} (x - k_{m-1})/(k_m - k_{m-1}), x \in [k_{m-1}, k_m] \\ (k_{m+1} - x)/(k_{m+1} - k_m), x \in [k_m, k_{m+1}] \\ 0, x \notin [k_{m-1}, k_{m+1}] \end{cases} \tag{10}$$

(3) The endpoint gray class gray number whitening weight function is:

$$f^1(x)\begin{cases} (x - k_{n-1})/(k_n - k_{n-1}), x \in [k_{n-1}, k_n] \\ 1, x \in [k_n, k_{n+1}] \\ 0, x \notin [k_{n-1}, k_{n+1}] \end{cases} \tag{11}$$

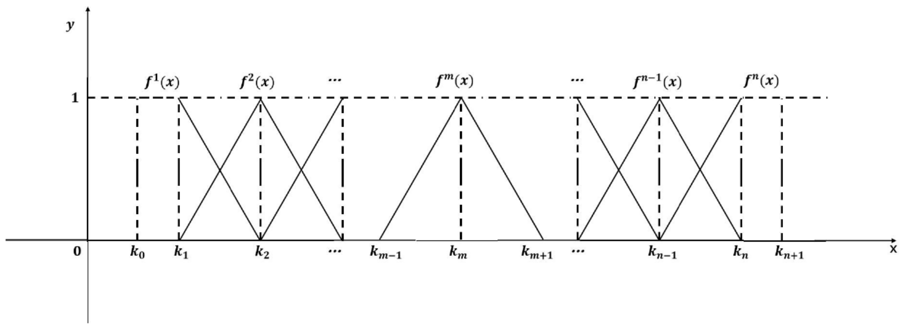

Fig. 3. Mixed centroid whitening weight function image

(4) Composite clustering coefficients of gray class, where the object of calculation.

$$\sigma_i^k = \sum_{j=1}^{n} f_j^k\left(x_{ij}\right) * \eta_j \tag{12}$$

denotes the whitening weight function of the evaluation metric j under the clustering object i with respect to the gray class k, and denotes the combined weight of metric j with respect to the gray class k.

4 Conclusion

This paper focuses on the steps of hierarchical analysis and entropy weight method to determine subjective weights by hierarchical analysis and objective weights by entropy weight method. The two are combined to obtain the comprehensive weights, and the gray clustering evaluation method is applied to construct the green building evaluation model. The model can provide a comprehensive evaluation of green buildings and provide reference for subsequent case analysis. Green development is an all-round, revolutionary change in the modes of production, lifestyles, ways of thinking and values. China has integrated the system concept into the whole process of economic and social development and ecological environmental protection, correctly dealt with a series of relationships between development and protection, overall situation and local situation, and current and long-term situation, constructed a scientific, moderate and orderly spatial layout system of the national territory, a green, low-carbon and recycling economic system, and a system of constraints and incentives, and coordinated the adjustment of the industrial structure, pollution control, ecological protection, and the response to climate change, and synergistically promoted Carbon reduction, pollution reduction, green expansion and growth, promoting ecological priority, conservation and intensification, green and low-carbon development, forming spatial patterns, industrial structures, modes of production and lifestyles that conserve resources and protect the environment, and promoting a comprehensive green transformation of economic and social development.

5 Look forward

Green buildings are ecological and sustainable buildings. Green building can provide a more comfortable living environment is determined by its own nature. Its content includes not only the building itself, but also the ecological function system of the building's internal as well as external environment and the stable ecological service and maintenance function system that constructs a safe and healthy community. Green building has gained momentum over the past few years. The benefits are undeniable, from financial to environmental, especially in the long term. There is a growing demand for green sustainable living and a growing interest in green building. This is definitely the way forward.

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