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LETTER TO THE EDITOR

Early Warning Model of Carrying Capacity of Ecotourism Environment Based on Parallel Coordinate Visualization

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With the rapid development of eco-tourism, a series of problems such as over-exploitation, environmental pollution and ecological damage have occurred in ecologically fragile tourist destinations. Domestic and foreign research began on the carrying capacity of ecotourism environment, and it has been continuously enriched and improved from theory and practice. However, its research on single-dimensional and static has become an insurmountable obstacle in the direction of its research and development. Based on the spatial and temporal evolution and changes of tourism ecosystem and environmental quality, this paper proposes the use of parallel coordinate visualization to multidimensional analyze the changes of tourism environment caused by tourism activities. At the same time, from the perspectives of system theory, cybernetics and decision theory, the structure, characteristics and operation mechanism of the early warning system for the carrying capacity of ecotourism environment are studied. The warning work on the carrying capacity of ecotourism environment is finally completed.

carrying capacity of ecotourism environment; parallel coordinate visualization; early warning system

1 Introduction

Eco-tourism is a new type of tourism formed in the 1980s to adapt people to “return to nature” and protect the ecological environment of tourism. It is one of the main directions of tourism development in the world in the 21st century. It is increasingly loved by people, and its development has attracted wide attention from all over the world. However, with the rapid development of eco-tourism, a series of problems such as over-exploitation, environmental pollution and ecological damage have occurred in ecologically fragile tourist destinations. The formation and development of ecotourism bearing capacity has become the effective means and scientific management method to coordinate the contradiction between tourism development and ecological environment in scenic spots.

Na Zheng published an article in the Ekoloji (Issue 107, 2019), entitled “Automatic Early Warning Method for Landscape Tourism Ecological Environment Pollution of Mountain Scenic Spot”. This paper uses the expert opinion method to construct a health assessment system for the landscape ecological environment in mountainous scenic spots. Combined with the systematic evaluation index and the analytic hierarchy process, the pollution status of the landscape tourism ecological environment in mountainous scenic spots was evaluated. Then, according to the ecological environment quality indicators, early warning standards were formulated. The concept

of the change of ecological environment carrying capacity with time and its calculation formula are introduced. The mathematical model of automatic warning of landscape tourism ecological environment carrying capacity in mountainous scenic spots was constructed, and the early warning of bad state, deterioration trend and deterioration speed was realized.

Based on the analysis of the ecotourism environment system, the literature (Wen et al. 2016) put forward the concept and connotation of the carrying capacity of ecotourism environment. The correlation between the carrying capacity of ecotourism environment and the capacity of the tourism environment was analyzed. It points out that the carrying capacity of ecotourism environment is an effective way to resolve the contradiction between ecotourism development and environmental protection. This article only provides a basis for the orderly development of tourist attractions, and can not effectively warning. In the literature (Dorini et al. 2016), based on the system analysis method, the concept of carrying capacity of ecotourism environment was proposed, and a set of index system and evaluation model for carrying capacity of ecotourism environment including economic and social carrying capacity were established (Yasin et al. 2017). The Wuyishan Nature Reserve is an example for empirical research. The research results show that its environmental carrying capacity far exceeds the actual number of tourists, and measures such as strengthening ecological monitoring and scientific functional zoning are needed. This paper proves the problems in the current ecotourism environment, but does not propose an effective solution.

This paper reviews the research progress of ecotourism carrying capacity, and starts from the connotation, systematically summarizes the definition, characteristics, classification, system composition and influencing factors of ecotourism carrying capacity (Saidan and Tarawneh 2015). Aiming at the parallel coordinate visualization technology, the early warning model of environmental carrying capacity is proposed. The model can give quantitative evaluation of the application effect of parallel coordinate technology on the data set, and can be applied to data mining to complete the warning work of carrying capacity of ecotourism environment.

2 Idea description

The parallel coordinate method is a geometric projection method for expressing data in a multidimensional space, and is also the visualization technique for representing a multidimensional object in two dimensions. It can be applied to data representation in data mining processes. Each data dimension is represented by the horizontal or vertical axis, and the n axes are organized into evenly spaced parallel lines. A data element of an n-dimensional space is mapped to a polyline that traverses all horizontal or vertical axes.

Early warning is the advanced informational alert to a crisis or dangerous state. Narrow warnings refer only to alarms that may be caused by natural resources or ecological security failures or crises, while broad-based warnings cover the maintenance of ecological security and prevent the development of crises. It includes the current police situation, analyzing the warning signs, finding the source of the police, judging the police, and taking the correct warning method to eliminate the whole process of the police. The scope of the warning concept of the carrying capacity of ecotourism environment referred to in this paper belongs to the latter. That is, the warning for the carrying capacity of ecotourism environment is the multi-dimensional continuous, dynamic prediction, analysis and evaluation of the current status of the ecotourism environment in a certain period. It can determine the trend, speed and time to reach a certain limit of change in the quality of the ecotourism environment. Finally, various warning information and corresponding countermeasures for change and deterioration are given in real time as needed. The early warning for the carrying capacity of ecotourism environment is to timely report the quality of the tourism environment and the reverse succession, degradation and deterioration of the ecosystem. It has the forward-looking, predictive and advanced function that has the alert effect on evolutionary trends, directions, speeds, and consequences. It has the scientific functions and basic functions for the ecological tourism

environment remediation and ecological construction (Fan et al. 2017).

2.1 Early warning standard for carrying capacity of ecotourism environment

In order to meet the requirements of early warning, it is necessary to establish the new system for identifying indicators according to new standards. The establishment of the ideal standard as the evaluation reference system is the core of the identification evaluation. Since the impact of regional ecotourism development on ecology and environment is diverse and the state of the system varies, in order to carry out comprehensive quantitative analysis and evaluation, it is necessary to determine the standard before evaluation and early warning. It is called the quality standard for ecotourism environmental. The determination of this standard is based on the assumption that an ecological factor, environmental factor, or the environment as a whole is an ideal existence. This can be used as the frame of reference or to evaluate the highest score in the warning of the carrying capacity of ecotourism environment. Establish early warning standards based on the quality indicators of the ecotourism environment, and use this as a warning line (threshold) for the tourism environment. According to the changes of the status quo (not affected by humans) and the future (after human influence), they are compared with the ideal state. It can distinguish the quality status of the current situation and the quality of the tourism environment after being disturbed by humans. On the one hand, the standard can accurately determine the impact of tourism activities on ecology and environment; on the other hand, it can grasp the various ecological factors, environmental factors and the state of the system and its changing trend and speed in different periods. It provides comprehensive and comprehensive information for early warning, making the classification of early warning types and the establishment of early warning patterns intuitive and concise.

2.2 Measurement model for early warning system of carrying capacity of ecotourism environment based on parallel coordinate visualization

In the past, research on the carrying capacity of ecotourism environment was limited to a certain point in time, while the carrying capacity of ecotourism environment was dynamic over time. Research from the carrying capacity of ecotourism environment is not well-predicted, and it is studied from the carrying capacity of ecotourism environment and time. At the same time, the parallel coordinate visualization method is introduced to make it more visual and convenient.

2.2.1 Determination of visual parameters and algorithm decomposition

Visualization technology has its own characteristics in data mining for the application of data objects and mining processes, both in common and different (Mullakkezhil et al. 2017). The visualization of data objects is mainly done by static display. It is relatively simple from the perspective of technology and expression. The visualization of the process can be considered from two aspects: First, after the results of the data mining process are generated, the data mining process is reproduced through the visualization method. The other is to apply visualization techniques to data mining to produce effective mining results. The visualization technology used in the data mining process can be based on mining algorithms. Specifically, it can be divided into the following steps: (1) decomposition algorithm or its execution process. Separate the tunable parameters, objects, or factors that affect the algorithm as visual parameters. These visual parameters can be used as visualizations. (2) Select the intermediate results obtained by the algorithm execution. Determine which valid objects that can affect the performance of the algorithm by the visual parameters as a visual intermediate. These visual intermediates can be used as a visualization to describe the characteristics of the data mining process. In the process of applying visualization technology, it is necessary to consider the commonality and characteristics of reflecting data objects and influencing mining processes and results, as well as methods for analyzing and comparing these properties. The commonalities and characteristics between attributes or objects have different roles and meanings for

revealing the associations between objects. Algorithm decomposition can be hierarchical and hierarchical. The grading reflects the laterally separable features of the algorithm decomposition, that is, the width separable features. The layering reflects the degree of detail of the algorithm decomposition. It embodies the longitudinally separable features of the algorithm decomposition, that is, the depth separable features. It can more realistically reflect the carrying capacity of the ecotourism environment.

2.2.2 Application of parallel coordinate method

The parallel coordinate method is a geometric projection method for expressing data in the multidimensional space, and is also the visualization technique for representing the multidimensional object in two dimensions. It can be applied to data representation in data mining processes. Each data dimension is represented by a horizontal or vertical axis, and the n axes are organized into evenly spaced parallel lines. A data element of the n-dimensional space is mapped to a polyline that traverses all horizontal or vertical axes. There are two main types of data objects in the data mining process, namely continuous and real. Continuous data is mainly represented by real numbers or integers with specific meanings. It can be normalized first, and then mapped to the corresponding coordinate axes in a certain corresponding way. For the real data, it can be mapped to the coordinate axis in a certain corresponding way, such as sorting and interval size. The axes in the parallel coordinate system can correspond to different ranges, including continuous data and real data. For the real data, it can usually be adjusted according to the needs of the parallel axis, including the corresponding mode, data interval size and so on. If the graphical polyline of the corresponding value is too dense or sparse, you can improve the visual effect by adjusting the coordinate interval unit. Finally, the ecological environment carrying capacity early warning model is clearer.

2.2.3 Measurement model of parallel coordinates

The metric model can be determined by metrics and metric generation mechanisms and can be used to measure or measure visual effects. The main consideration here is the resolvability and intuitiveness of the visual representation. The metrics will be determined in terms of the visualization method and graphical features of the data objects according to the parallel coordinate method. In the measurement model, the indicator system includes cognitive complexity and visual performance (Pahuluan et al. 2017). The former describes the difficulty of visualization in terms of cognition, and is determined by indicators such as data density, dimension, overlap and intersection. The latter reflects the visualization from the intuitive visual perspective. Eventually, the real-time reflection of the carrying capacity of ecotourism environment is completed.

2.2.4 Determining the weight of the indicator

In the carrying capacity of ecotourism environment comparison matrix, the value of aij can be referenced by Satty's proposal and assigned according to the specified scale. Aij takes values between 1 and 9 and its reciprocal. The importance of four indicators that affect cognitive complexity, namely data density, data dimension, data overlap and data intersection, is compared, and finally the 4×4 pairwise comparison matrix A=(aij)4×4 is obtained. The feature vector corresponding to the largest eigenvalue of the paired comparison matrix A is known by calculation. After normalization, the feature vector becomes a weight vector. The relative importance of each indicator is determined by the individual components of the weight vector. The weight vector reflects the important order of the indicators affecting cognitive complexity is data overlap, intersection, density and dimension. The weight of cognitive complexity and visual performance indicators can also be determined by analytic hierarchy process. The influence coefficient of cognitive complexity on the total score and the influence coefficient of visual performance on the total score can be obtained.

2.3 Application of Visual Measurement Model

2.3.1 Implementation of the metric system

Based on the defined metrics, the corresponding parallel coordinate visualization evaluation system is established. It can support parallel coordinate visualization of cubes and quantitative evaluation of the visualization of the carrying capacity of ecotourism environment. The system has the following three functions: (1) establishing and presenting a metric-based indicator system; (2) providing tools for verifying the correctness of the metric model; (3) adjusting the attribute axis orders to provide optimal visualization. In addition, the system also has functions such as index threshold control.

2.3.2 Indicator calculation

Take the soy bean-small data in the UCI experimental data as an example. The visualization results are shown in Figure 1. The system name and data value can be read from the data file. The attributes are evenly arranged on the horizontal axis, and the data values are equally divided on the vertical axis. According to the parallel coordinate visualization method, in the grid background, the visualized broken line information is displayed, and the data set name, data amount, and dimension are displayed. Based on the parallel coordinate visualization, the visual effects were quantitatively evaluated. The system can calculate the tourism environment indicators. The difference in the order in which the attributes are arranged may result in differences in data overlap, intersection, and overall score. The data set can be optimally visualized for the overlap and intersection, cognitive complexity or total score, in order to obtain the optimal tourism environment warning.

3 Results

From the experimental results, the results reflected by parallel coordinate visualization are basically consistent with the actual situation of carrying capacity of ecotourism environment. This reflects the visual effect to some extent. Its application has a good auxiliary role in the early warning of the tourism environment (Wang et al. 2017). The working description and significance of this paper are as follows: (1) The application of parallel coordinate method for visualization of multi-dimensional data objects can fully display the relationship characteristics between data objects, which is conducive to the application of visualization technology in the mining process; (2) Apply the metrics represented and defined by the parallel coordinates to the data mining, which has a good auxiliary effect on the data mining effect. (3) The established metrics can reflect the degree of resolvability of the data visualization display. These indicators can be used as one of the quantitative indicators for the analysis and evaluation of data visualization in data mining, thus completing the early warning work on the ecotourism environment.

4 Discussion

The research on the carrying capacity of ecotourism environment is getting hotter in the context of people's growing concern about the tourism environment and the growing demand for prevention of the tourism environment. However, the evolution of the carrying capacity of ecotourism environment is the controversial process. Since the carrying capacity of ecotourism environment is not only restricted by the natural environment, but more importantly, it is determined by human society. These include political system, cultural background, technological progress, distribution methods, consumption patterns, value judgments, development goals, etc., which are not only diverse but also constantly changing over time. Therefore, the carrying capacity of ecotourism environment is endowed with multi-level, dynamic, non-objective and even political qualities. The warning study on the carrying capacity of ecotourism environment takes into account the above characteristics. In the management of tourism environment, we hope to study and establish the early warning model of carrying capacity of ecotourism environment by comprehensively considering and coordinating contradictions and conflicts in social values, technical levels, institutional arrangements, and target selection. In this paper, the model based on parallel coordinate technology is proposed. The application method is illustrated by experiments and the experimental results are analyzed. Experiments show that the establishment of parallel coordinate visualization can reflect the

degree of data resolvability, which can be used as one of the quantitative indicators for the analysis and evaluation of data visualization, thus completing the early warning work on the ecotourism environment.

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