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Nature conservation planning model of Masai Mara based on Genetic algorithm optimization neural network

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Abstract: *Balancing wildlife survival and human economic life is of great significance to Kenya's wildlife reserves. In this paper, Adaboost algorithm is used to obtain the correlation between tourism planning, wildlife species, unemployment rate and people's income on people's economic growth and the importance of each factor. Based on the model of multi-weight TOPSIS algorithm, it is known that in the off-season of tourism, the optimal strategy is to establish more nature reserves, while in the peak season of tourism, the optimal strategy is to vigorously develop tourism. Finally, using the BP neural network model to classify the off-season and peak seasons of tourism, the predicted economic impact is $ 429 per passenger and $ 696 per passenger.*

Keywords: *Adaboost Algorithm, Multi-weight TOPSIS Algorithm, Masai Mara Nature Reserve*

1. Introduction

Kenya is a paradise for wildlife, among which the Masai Mara National Reserve in the southwest is the most famous wildlife reserve in the world. [1]In 2013, Kenya revised the wildlife protection management law to strengthen wildlife protection. However, since tourism cannot bring enough benefits in private wildlife reserves, the contradiction between people and animals has intensified.[2] Therefore, it is necessary to make reasonable planning to balance people's interests and minimize the negative effects of animal-human interaction.

The research questions of this paper are as follows: First, the Adaboost algorithm is used to analyze the data collected on the official website of the Masai Mara Nature Reserve to find out the influencing factors of the people's economic growth and the importance of each factor. Subsequently, the model based on the multi-weight TOPSIS algorithm analyzes the strategies that can be implemented in the off-peak season and how to make it optimal. Finally, BP neural network is used to predict it.

2. Establishment and Solution of Model

2.1 Research based on Adaboost algorithm

2.1.1 Selection of indicators

By querying the official website and related factors, this paper believes that the number of residents, animal species, the number of tourists and the area of animal husbandry in the Masai mara Nature Reserve have an impact on the policy and management strategy of the Masai mara Nature Reserve.[3]

2.1.2 Modelling

In order to determine whether the correlation between the samples exists, and to know the importance of each part, the Adaboost algorithm is selected for the reference of the later policy. The flow chart is shown in Figure 1:

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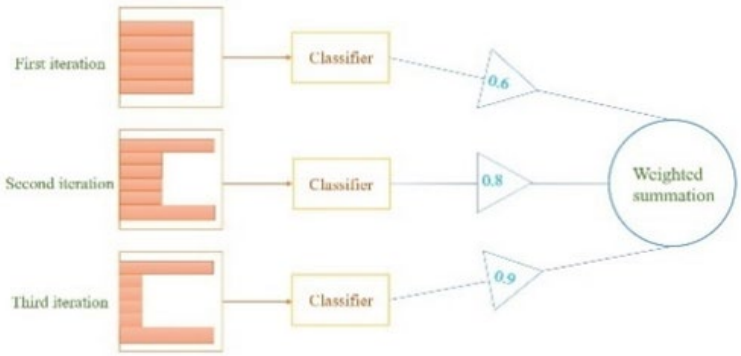

Figure 1. Algorithm flow chart

The steps of establishing Adaboost algorithm are as follows:

1) Initialize a weight E_i for each sample in the training set with the same initial weight.

2) A model P_i is trained according to the sample, and the error rate e_i and weight α_i of the model are calculated.

3) Adjusting the weight of each sample to $E_i + 1$ according to the weight a will reduce the weight of correctly classified samples and increase the weight of wrongly sorted samples.

4) Iterate the second and third steps to know the final model at the training site.

In this process, assuming that x is the sample, $H_i(x)$ is the model trained in the i th round, b_i is the weight of $H_i(x)$, and iterates for n rounds, then the calculation formula of the final model $H(x)$ is:

$$H(x) = \sum_{i=1}^{n} \alpha_i H_i(x) \tag{1}$$

The model weight α_i is calculated as follows, where r_i is the error rate of the i-round model:

$$\alpha_i = \frac{1}{2} log \frac{1-r_i}{r_i} \tag{2}$$

P_{k+1} represents the weight set of k+1 round samples, $t_{k+1,1}$ represents the weight of the first sample in the k+1 round, and $t_{k+1,N}$ represents the weight of the Nth sample in the k+1 round.

$$P_{k+1} = (t_{k+1,1}, t_{k+1,2}, \dots, t_{k+1,N}) \tag{3}$$

The calculation formula of sample weight $t_{k+1,i}$ is:

$$t_{k+1,1} = \frac{t_{k,i}}{Z_k} \exp(-\alpha_i y_i G_k(x_i)) \tag{4}$$

$$Z_k = \sum_{i=1}^{n} W_{k,i} \exp(-\alpha_k y_i G_k(x_i)) \tag{5}$$

Define the maximum value of each column as r_j^+

$$r_j^+ = \max(r_{1j}, r_{2j}, \dots, r_{nj}) \tag{6}$$

Define the maximum value of each column as r_j^-

$$r_j^- = \min(r_{1j}, r_{2j}, \dots, r_{nj}) \tag{7}$$

Define the distance between the i th object and the maximum value as d_j^+

$$d_j^+ = \sqrt{\sum_{j=1}^{n} (r_j^+ - r_{ij})^2} \tag{8}$$

Define the distance between the minimum value and the maximum value as d_j^-

$$d_j^- = \sqrt{\sum_{j=1}^{n} (r_j^- - r_{ij})^2} \tag{9}$$

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The score is

$$Score_i = \frac{d_i^-}{d_i^+ + d_i^-} \tag{10}$$

2.1.3 Analysis of effect

It is obvious that$0 \leq Score_i \leq 1$, when $Score_i$ is larger, d_i^+ is smaller, indicating that the smaller the distance between the index and the maximum value, the closer to the maximum value.

The data collected from the Masai Mara are analyzed in the model and the following results are shown in Figure 2:

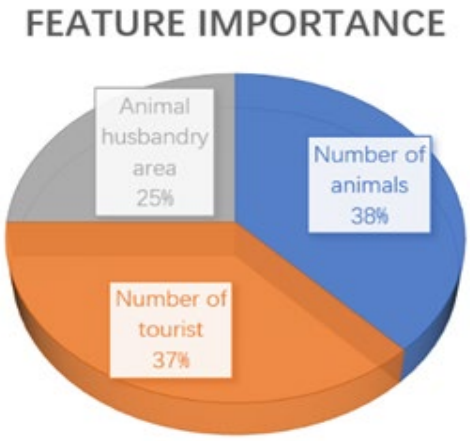

Figure 2. Proportion of feature importance

Through the above calculation, the prediction results are obtained. Due to the randomness of Adaboost algorithm, the results of each operation are different. A total of 30 experiments were carried out in this topic, and it was found that the fitting state of each experimental data was good. This topic selected the best model fitting experiment. And the data as shown in the figure is obtained and analyzed. It can be known from the eigenvalues that the number of tourists plays a vital role in revenue; the number of animals followed, animal husbandry last. In addition, through calculation, the value of R2 is 0.997, which proves that the model fitting effect is excellent.

Based on this importance ratio, this paper recommends measures that can be implemented.

The implementation of anti-poaching measures, such as increased ranger patrols, the use of drones and camera traps, and the encouragement of local communities to report poaching, have helped to mitigate the impact of poaching. Violators will be subject to a certain fine and imprisonment or life imprisonment.

Tourism: Tourism is an important source of income for the Masai Mara reserve, but it also has a negative impact on the natural resources of the reserve. In order to address this situation, sustainable travel times should be implemented, such as limiting the number of visitors allowed to enter the park at any given time, regulating the behavior of having lessons in the park, and educating visitors about the importance of conservation.[6]

Overall, the Masai Mara Wildlife Sanctuary is an important part of Kenya’ s nature permitting and its management is essential to ensure its continued conservation. Community-based conservation, grazing control, wildlife corridors, sustainable tourism time and anti-poaching measures are all policies and management strategies that can be implemented to help protect the natural resources of the reserve while balancing the interests of people living in the area.

2.2 Research on influencing factors based on peak season and off-season

2.2.1 index selection

Since there will be a large-scale animal migration in the Masai Mara area from January to March and from July to September, the income brought by the tourism industry will be different, so it is divided into two cases: the peak season and the off-season.

Consider the optimization policy that can balance the ecological environment and human interests as

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the target layer.

Consider the following variables as the criterion layer-the impact on the people (basic needs such as food, clothing, housing, transportation, safety, employment, etc. affect the population), the protection of raptors, the impact on animals (the number of animals, the number of habitats, water sources, etc.), and the impact on the interaction between man and nature (scientific research, travel, etc.).

Considering the long-term benefits of protecting raptors, establishing a community-based wildlife protection base, prohibiting grazing, prohibiting hunting, and affecting tourism revenue as the influencing factors of the program layer.

2.2.2 Establishment of the model

It can be seen that the weight of the previous method is given according to the law of the data itself or the objective weight method, but no one can determine which method is better. Therefore, from a random point of view, multiple different weights can be given to examine the performance of the object under different weights, such as the multi-weight TOPSIS method,[7] as shown in Figure 3:

Figure 3. Multi-weight TOPSIS flowchart

2.2.3 Model solving

The peak season results are shown in Figure 4:

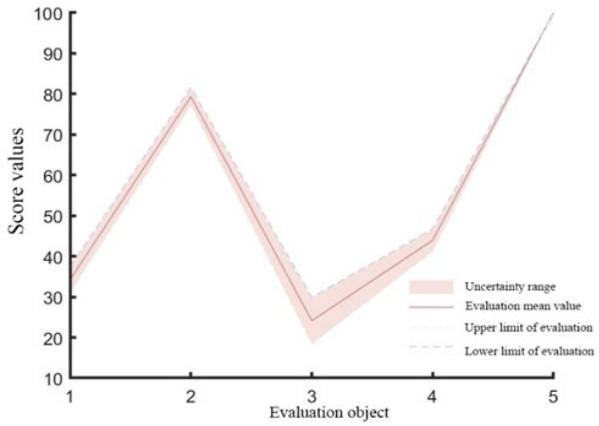

Figure 4. Weight map of measures in peak season

According to the analysis, in the peak season, we should first pay attention to the development of tourism, followed by the establishment of animal protection bases, the third is to prohibit hunting, the fourth is to protect raptors, and finally to prohibit overgrazing.

The off-season results are shown in Figure 5:

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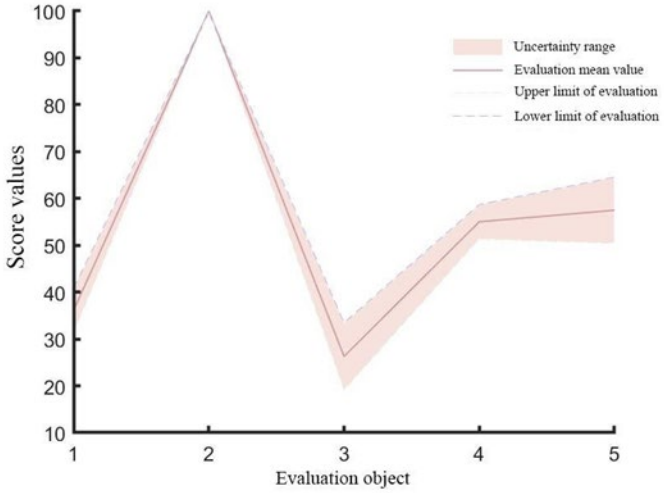

Figure 5. Weight chart of measures in off-season

According to the analysis, in the off-season, we should first pay attention to the establishment of animal protection bases, followed by the development of tourism, the third is to prohibit hunting, the fourth is to protect raptors, and finally to prohibit overgrazing.

2.3 Analysis based on BP neural network model

2.3.1 Data processing and establishment of BP neural network model

Based on the data of previous years, the area of animal husbandry, the number of animals and the number of tourists in the peak season and the off-season were predicted. The economic benefits brought by the hypothesis are used to calculate the fitness function of each population. The input data is X, the real output is y, and the predicted output is y through the model. W (matrix transformation of the first part of the chromosome w1) is the weight matrix connecting the input layer and the hidden layer, b1 is the deviation connecting the input layer and the hidden layer, W2 (matrix transformation of the first part of the chromosome w2) is the weight matrix connecting the output layer and the hidden layer, b2 is the deviation connecting the output layer and the hidden layer, as shown in Figure 6 :

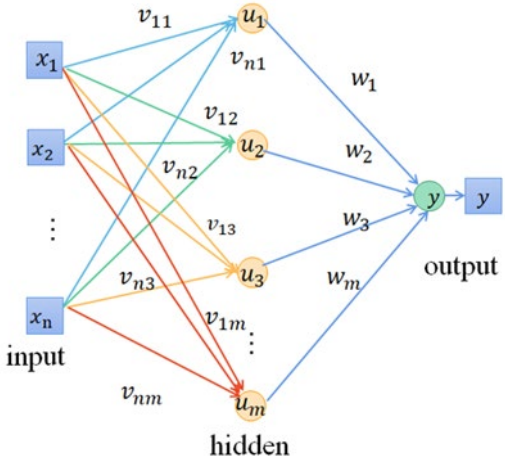

Figure 6. Neural network mind map

2.3.2 Analysis of effect

Combined with the results, the BP neural network [8]was used to conduct 1000 experiments on the data set. According to the predicted value and the real value obtained by the classification of the off-season and peak season of tourism, as shown in Figure 7, the model was used to predict the next economic impact. The predicted values were 429 people / person and 696 people / person, respectively, as shown in Table 1:

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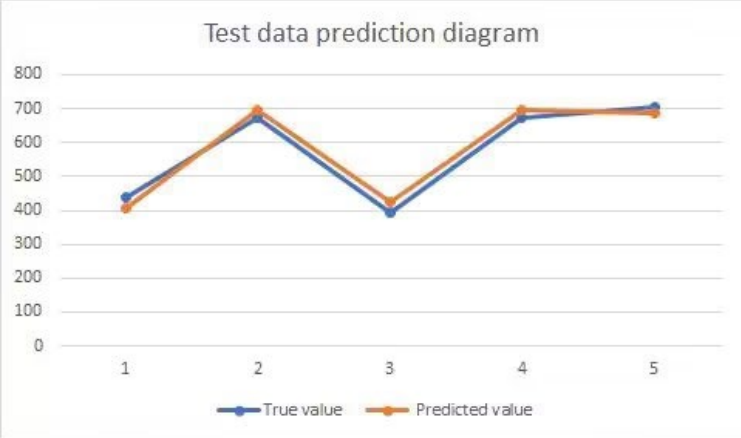

Figure 7. Comparison of predicted and true values

Table 1. Forecasting results

Predicting outcome Y	Area of animal husbandry	Size of animal	Tourist quantity
429.1991690460997	0.3256	3416554	912078
696.0800708568128	0.3965	6245365	976857

3. Model evaluation

The advantages of this model are that the data found are complete and true by consulting relevant literature and databases, including' number of species in Masai Mara', 'unemployment rate in various regions of Kenya', and 'annual precipitation in Masai Mara'. These data provide a solid foundation for the solution of the model, and establish a model to distinguish the off-season and peak season of tourism, considering a variety of situations and conforming to the actual situation. Therefore, the model has good versatility and flexibility.

However, there are still some problems in this model. For example, it is sensitive to outliers, the applicable data types have numerical and nominal data, and the quantitative indicators of each indicator required by the multi-weight TOPSIS method are difficult to select. Therefore, it has certain subjectivity, and ignores the occurrence of natural disasters and the competition between species, which can easily lead to deviations in the results.

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