Analysis of Global Warming Development Research -- Taking Scottish Fisheries as an Example

Jiahe Zhang*

School of Economics, Henan University, Henan, China

*Corresponding author e-mail: 973635601@qq.com

Abstract. As the carbon emissions caused by human activities continue to increase, the greenhouse effect continues to increase, leading to global warming, which changes the global ocean temperature, and marine life migrates to future life and habitats that are easy to reproduce successfully. This is a company that depends on marine life the economy has caused severe impacts. This article focuses on the distribution of two fish populations that have significant economic contributions to the fisheries in Scotland, analyses the data related to global warming and climate factors, and further proposes a stable plan for the fishery economy in Scotland.

Keywords: Global warming, nonlinear integer programming, neural network models.

1. Problem background

As people burn fossil fuels, such as petroleum, coal, etc., or deforestation and burning will generate a large amount of carbon dioxide, these greenhouse gases are highly permeable to visible light from solar radiation, and long wave radiation is highly absorptive, and can strongly absorb infrared rays in the ground radiation, which will cause the temperature of the earth to rise. Global warming will redistribute global precipitation, glaciers and frozen soil ablation, sea-level rise, etc., not only endanger marine ecosystem balance also threatens human survival.

With the increasing amount of carbon dioxide ha, the acidity of seawater increases, affecting the stability of underwater ecology. At the same time, due to the reduction of biodiversity, each species will play a more important role in the ecosystem in different proportions. Therefore, studying the impact of global warming on marine life is of long-term value and significance.

2. Model assumptions

(1) It is assumed that the statistical data information obtained from the network is true and reliable;
(2) It is assumed that the main factors are independent of each other and will not affect each other;
(3) Suppose that in the regression model, the small correlation between variables is ignored;
3. Explanation of symbols

| Symbol | Explanation                  |
|--------|------------------------------|
| f      | Fishing effort              |
| q      | Capture factor              |
| K      | Environmental load capacity |
| r      | Population intrinsic growth rate |
| π      | Profit                       |
| TR     | Total revenue               |
| TC     | Total cost                  |
| P      | Price                       |
| c      | Unit cost                   |
| B      | Resources                   |

4. Establishment and Solution of Problem One Model

The first problem is to process the global ocean surface temperature data obtained on the network over the years to obtain a gis map, and to predict the change of water temperature through a neural network model.

4.1. Data preprocessing

This article uses NOAA OISST (Optimum Interpolation Sea Surface Temperature) The optimized interpolated monthly average sst dataset is used as a background field to study the correlation between the changes in the Pacific sst and the sea ice in the Bohai Sea. The time range of this data is from December 1981 to the present, and the spatial coverage, With a spatial resolution of The following figure shows the global sst distribution field of this data.

![Oisst global sst distribution](image)

**Figure 1. Oisst global sst distribution**

4.2. Establishment of neural network model

Based on the processing and analysis of the data, in the neural network model, according to the distinction of the interconnection modes of the neural network, the neural network can be divided into feed-forward neural network, feedback neural network and self-organizing neural network.
The BP neural network is used in this question, because in the neuron network model, the neural network model with feedback has stronger correction. In order to improve the accuracy of this model, this question uses feedforward neural network as the basis for model construction. as the picture shows:

4.2.1. Model Solving Based on Genetic Algorithm. Step 1: Calculation of neuron input and output
The data of each input layer and output layer are defined separately. After calculating the input and output of neurons in each layer, we can get:

1. The hidden layer input vector is:
   \[ h_i(k) = \sum_{r=0}^{n_i} w_{ir} x_r(k) \quad h=1,2,\ldots,13 \]

2. The hidden layer output vector is:
   \[ h_o(k) = f(h_i(k)) \quad h=1,2,\ldots,13 \]

3. The input vector of the output layer is:
   \[ y_i(k) = \sum_{r=0}^{n_i} w_{or} o_r(k) \quad o=1 \]

4. The output layer output vector is:
   \[ y_o(k) = f(y_i(k)) \quad o=1 \]

Step 2: Calculation of partial derivatives of each neuron in the output layer by the error function
After the input and output functions are obtained, the partial derivatives of the error function to each neuron in the output layer need to be obtained through mathematical operations.

Step 3: Calculation of partial function of error function for each neuron in the hidden layer
When calculating the partial derivative of the error function for each neuron in the hidden layer, the connection weight of the hidden layer to the output layer, the function of the output layer, and the function of the hidden layer need to be used for calculation and calculation.

Step 4: Use the output layer to modify the connection weights
By using the output of each neuron to modify the connection weight, the specific solution is calculated as:

\[ \Delta w_{oh}(k) = -\mu \frac{\partial e}{\partial w_{oh}} = \mu \delta_o(k) h_o(k) \]
\[ w_{oh}^{N+1} = w_{oh}^N + \mu \delta_o(k) h_o(k) \]

Step 5: Use the input layer to modify the connection weights
By using each neuron input to modify the connection weight, the specific solution is calculated as:

\[ \Delta w_{h_i}(k) = -\mu \frac{\partial e}{\partial w_{h_i}} = \delta_h(k) x_i(k) \]
\[ w_{h_i}^{N+1} = w_{h_i}^N + \mu \delta_h(k) x_i(k) \]

Step 6: Calculation of global error
\[ E = \frac{1}{2m} \sum_{x=1}^{m} \sum_{i=1}^{13} (d_x(k) - y_x(k))^2 \]
Step 7: judge
In the judgment, the accuracy needs to be compared with the maximum number of budgets. When the accuracy and the number of budgets do not meet the requirements, the above steps need to be cycled until the requirements are met.

4.2.2. Icon results. After adjusting the neural network model established in this question, the neural network regression graph obtained in this question is shown in the following figure:

Figure 4. The above figure can be obtained through regression analysis, and the most likely distribution positions of herring and mackerel are as above.

5. The establishment and solution of the second problem model
It is required to analyze the rate of change of seawater temperature, use the model to predict the best case and the worst case for fish schools beyond the fishing range of small fisheries companies. Considering the fishing range of small fisheries companies, consider the problem one model and solve two cases The most likely time. This section adds more consideration variables, using the collated data set, 80% of the data is used to solve the model to determine the weights and thresholds of the variable indicators, and the remaining 20% of the data Residual calculation is used for model accuracy test. In order to further improve model accuracy and calculation efficiency, this paper proposes to use Levenberg-Marquardt algorithm to solve.

5.1. Spatial distribution of ocean warming trends
By analyzing the trend graph of Net SLA, you can comprehensively understand the speed of warming or cooling in the waters of Scotland, so as to have a comprehensive understanding of the increase in the heat of the global ocean.

Figure 5. Spatial distribution of Net SLA linear trend
5.2. Model Improvement Based on Levenberg-Marquardt Algorithm

In order to improve the accuracy of the model prediction and the speed of calculation, this section uses another algorithm for BP neural network model solving, which is committed to reducing residuals and reducing the number of iterations. Therefore, this paper introduces the Levenberg-Marquardt algorithm for model solving.

The lm algorithm based on numerical optimization uses not only the first derivative information of the objective function, but also the second derivative information of the objective function. The iterative formula of the lm algorithm is:

\[ X_{k+1} = X_k - (J_k^T J_k + \mu I)^{-1} \cdot J_k \cdot F(X_k) \]

In the formula, \( J \) is a Jacobin matrix containing the first derivative of the network error pair weight and threshold, \( I \) is the identity matrix, and \( \mu \) is the damping factor. The LM algorithm dynamically adjusts the damping factor based on the result of the iteration so that the value of the error function for each iteration There is a decline. It is a combination of gradient descent and Newton's method, and its convergence speed is faster.

![Residual plot of actual value and expected output after precision improvement](image)

**Figure 6.** Residual plot of actual value and expected output after precision improvement

The improved BP neural network model is solved according to the above steps, and the residual map obtained according to the corresponding more accurate weights and thresholds is shown in the figure above.

After analyzing the changes in seawater temperature and the operating hours of the fishery company, the following results were obtained:

![Graph showing seawater temperature and operating hours](image)

**Figure 7.** As can be seen from the above figure, as the temperature changes, the shortest time is 116 days and the longest time is 337 days.

6. The establishment and solution of the fourth model

First, we must consider the impact of the fishery's trans-territorial waters on the company's revenue, and then evaluate whether the strategy in question three is feasible based on the economic situation. Since the company cannot fish across the territorial waters, if the school of fish across the country's territorial waters due to rising temperatures, the company can The number of fish catches is less than the predicted value. In the transboundary marine fisheries management problem, there is a diffusion function of fish...
catches. Similarly, the number and quality of a country's fishery ecosystem is not only affected by its own fishing goods, but also further influenced by the conditions and policies of other countries.

### 6.1. Model Construction
We first represent the number of fisheries ecosystems with the utility function \( x \):

\[ x = \text{number of fisheries ecosystems} \]

### 6.2. Economic impact analysis
According to the business strategy of Question 3, if entering the territorial sea of another country, the cost will increase due to the policies of different countries. At this time, cooperative games will be required to maximize the benefits. We can use income calculation to estimate the entry into the seas of other countries. Economic impact.

Among transboundary fishery countries, if a dialogue mechanism can be established to reach a transboundary fishery agreement, then the fishery countries that have transboundary fisheries can achieve cooperation, which can ensure the stability of the fishery ecosystem and achieve transboundary fisheries harmony in fisheries management. Let us illustrate the model of cooperative game.

In a cooperative game, transboundary fishery countries as a whole take the same action, minimizing their total cost as a whole, and then allocating the added utility.

### 7. Conclusion
The data used in the model in this article are all historical data provided by the network, which are simply processed and analyzed according to the model. Future scientific and technological progress will predict the impact of global warming on marine fisheries from various aspects, so in the model establishment adding multiple data and impact factors will significantly improve the accuracy of the model calculation.

This article selects different models for different problems, not only for the purpose of solving the problem, but also for testing the model, ensuring the accuracy of the model, and providing a research path for predicting the impact of global warming on marine fisheries. The model results are not limited to individual countries, and are generally applicable in various countries around the world. It has a high use value and a wide scope of application, and provides a certain reference for future scholars' research on similar evaluation and analysis problems.

### References

[1] Zhao Lei. Preliminary Study on the Interactive Relationship between Global Climate Change and Marine Fisheries [j]. Ocean Development and Management (8): 89-95.

[2] Zhou Guangzheng. Global warming will affect fisheries [j]. Marine Development and Management, 1992 (3): 74-75.

[3] Jiao Yongfeng. Harm of Climate Warming to Fisheries and Suggestions [j]. Henan Fisheries, 2007, 71 (2): 39-39.

[4] Douglas C. Montgomery, Introduction to Linear Regression Analysis (5th edition of the original book), Mechanical Industry Press, 2016, 4

[5] Si Shoukui, Sun Xijing, Mathematical Modeling Algorithms and Applications, Beijing: National Defense Industry Press, 2014.9

[6] Han Genghan, Mathematical Modeling Methods and Applications (Second Edition), Beijing: Higher Education Press, 2009.6

[7] Xue Yi, Mathematical Modeling: Based on r, Mechanical Industry Press, 2017, 7