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Impact of Climate Change on Property Insurance in Northeast China and South China

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Abstract: Extreme weather events are a growing concern for property owners and insurers. Property insurance is not only becoming more expensive, but also increasingly difficult to find as insurers change their underwriting policies and regions. It is important to note that this is a factual statement and not a subjective evaluation. Based on this, the purpose of this model is to study the sustainability of property insurance and other related issues. The aim of this study is to design a weather index insurance scheme for northeast and South China to obtain a reliable momence-based production function estimation. The Unit-Root test and the Feasible Generalized Least Squares method involving the panel data model were explored using provincial cash crop production and weather data from 1989 to 2017. The results of the study show that the main weather variables (temperature and rainfall) have a significant impact on crop production. We propose weather index insurance as an institutional safeguard against the risk of reduced crop yields due to climate change in 2030, 2060 and 2090. According to the weather index insurance design, the insurance schemes for rice, oil palm and rubber tree have risk reduction performance of 8.14%, 13.37%, 2.43%, 6.48%, 8.89% and 14.13%, respectively. Weather index insurance is a guide that farmers can use to mitigate the adverse effects of future climate change on cash crop production. The study proposes an insurance scheme to protect crop production losses from climate change scenarios.

1. Introduction

As the impact of global climate change becomes more pronounced, the frequency and intensity of extreme weather events are increasing. These extreme weather events, such as heavy rains, floods, hurricanes, droughts, and extreme heat, have brought huge losses and impacts to human society and the economy as shown in Figure 1. Property insurance, as one of the important means to deal with these risks, is also seriously challenged in the context of climate change. The sustainability of property insurance is not only related to the survival and development of the insurance industry, but also to the stability and sustainable development of the social economy. However, due to the unpredictability and complexity of extreme weather events, property insurance faces many difficulties and challenges in dealing with these risks [1]. For example, due to the impact of climate change, some traditional insurance products may no longer be able to cover some new risks, and existing insurance terms and policies are facing the need for continuous adjustment and improvement.

Therefore, it is of great practical significance and theoretical value to study the sustainability of extreme weather and property insurance [2]. Through the study of the occurrence pattern, impact degree and coping strategies of extreme weather, we can gain an in-depth understanding of the impact of climate change on property insurance. Then scientific basis and technical support for the insurance industry are provided to promote the innovation and development of insurance products. Hence, the sustainability of property insurance is enhanced [3]. At the same time, the study of extreme weather and the sustainability of property insurance will also help promote the cooperation and exchange between the insurance industry and other related industries. It can also promote the sustainable development of social economy. For example, insurance companies can cooperate with meteorology, environment, construction and other related fields to jointly study and respond to the risks caused by climate change. This can help promote the development and implementation of relevant policies and standards. Based on the above analysis, the main tasks of this paper are as following. A model is first created so that insurance companies can decide whether to insure in areas experiencing an increase in extreme weather events. The model not only includes the viability to offer appropriate services to growing communities and populations, but also explore what can draw from in our model. The main considers question in the model is that how can insurance model be adapted to assess where, how, and whether to build on certain sites. Moreover, small probability events in life (e.g. black swan events, abnormal situations) are eliminated. It's worth stating that only the core factors in the problem are considered, and the influence of secondary factors is not considered. Finally, the assumptions required in the model used. Regarding the assumptions about the form (or distribution) of the parameters in the model, some of the assumptions closely related to the topic are primarily intended to simplify the model. The assumption does not take into account factors other than the conditions given by the question.

Figure 1: Extreme weather map.

2. Construction of the model

The error backpropagation algorithm of BP neural network is based on learning from a set of samples. The input layer neurons receive the sample input. The hidden and output layers perform calculations to generate the predicted output value. If the projected value does not satisfy the expected output criteria, the mistake is backpropagated from the output layer by modifying the weights and thresholds until the requirements are fulfilled [4].

Then the output of the hidden layer neuron is

$$O_j = f\left(\sum_{i=1}^{m} w_{ji}^1 x_i - \theta_j^1\right) = f(net_j), j = 1,2,\ldots,l \tag{1}$$

The output of the output layer neuron is

$$z_k = f\left(\sum_{i=1}^{l} w_{kj}^2 O_j - \theta_k^2\right) = g(net_k), k = 1,2,\ldots,n \tag{2}$$

where $g(\bullet)$ is the transfer function of the output layer.
The formula for adjusting the weights is as follows:

$$\begin{cases} w_{ji}^1(t+1) = w_{ji}^1(t) + \Delta w_{ji}^1 = w_{ji}^1(t) - \eta^1 \dfrac{\vartheta E}{\vartheta w_{kj}^1} = w_{ji}^1(t) + \eta^1 \delta_j^1 x_i \\ w_{ki}^2(t+1) = w_{ki}^2(t) + \Delta w_{ki}^2 = w_{ki}^2(t) - \eta^2 \dfrac{\vartheta E}{\vartheta w_{kj}^1} = w_{ji}^2(t) + \eta^1 \delta_j^1 O_j \end{cases} \tag{3}$$

The formula for adjusting the threshold is as follows:

$$\begin{cases} \theta_j^1(t+1) = \theta_j^1(t) + \Delta\theta_j^1 = \theta_j^1(t) + \eta^1 \dfrac{\vartheta E}{\vartheta \theta_j^1} = \theta_j^1(t) + \eta^1 \delta_j^1 \\ \theta_k^2(t+1) = \theta_k^2(t) + \Delta\theta_k^2 = \theta_k^2(t) + \eta^2 \dfrac{\vartheta E}{\vartheta \theta_k^2} = \theta_k^2(t) + \eta^2 \delta_k^1 \end{cases} \tag{4}$$

Where the η^1 and η^2 are learning steps of the hidden layer and the output layer, respectively:

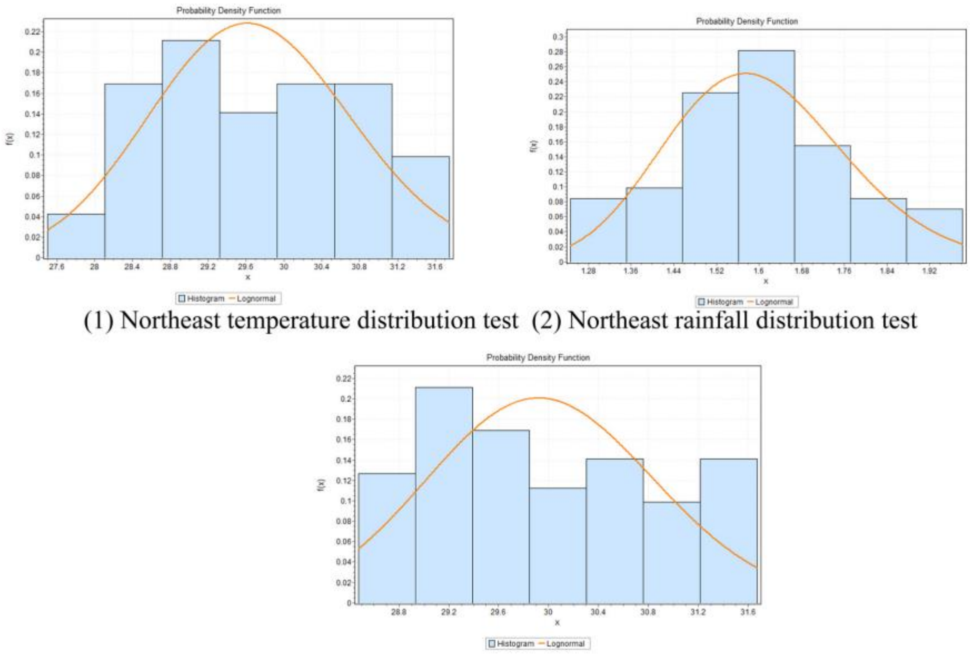
$$\delta_k^1 = \sum\nolimits_{k=1}^{m} w_{kj}^2 \delta_k^2 f'(net_j)$$
$$\delta_k^2 = (y_k - z_k) g'(net_j) \tag{5}$$

3. Result and discussion

3.1 Data analysis

Using climate scenario data for 2030, 2060 and 2090 in the A2 scenario, an insurance policy based on weather indices was designed to reduce the risk of climate change impacts on rice production in the northeast and oil palm and rubber production in the south. Rice production is the primary source of income for local farmers in the north-eastern region. However, climate change has significantly altered temperature and precipitation patterns during the rice growing season. To mitigate the impact of these changes on rice production, the insurance policy focuses on changes in average temperature and total precipitation. If the indicators fall outside the normal range, the insurance company will activate a compensation mechanism to assist farmers in dealing with potential production losses. In the southern region, oil palm and rubber are two significant cash crops that require high temperatures. Therefore, the insurance policy pays particular attention to changes in average temperature. Farmers can receive insurance compensation when the temperature falls outside the appropriate growing range, mitigating economic losses caused by climate change. As shown in Figure 2, the distribution test shows that the lognormal distribution conforms to the empirical distribution for the average temperature and total rainfall in Northeast China and the average temperature in South China. This lognormal distribution is suitable for future WII designs

[5].



(1) Northeast temperature distribution test (2) Northeast rainfall distribution test

(3) South average temperature distribution tests

Figure 2: Weather variable distribution test.

3.2 Historic landmark value based on extreme weather events

Extreme weather events have left a deep mark on the long history of mankind, and these imprints have formed historical landmarks of great value. These landmarks are not only a record of natural phenomena, but also a testimony to the social, cultural and economic development of mankind. The study of these historical landmarks can provide a better understanding of the relationship between humans and the natural environment, and provide useful references for sustainable development in the future.

First and foremost, these historical landmarks serve as a record and warning of natural disasters. Extreme weather events such as floods, hurricanes, droughts and extreme heat have caused enormous damage and impact on human society. The occurrence of these events is a reminder of the power and unpredictability of the forces of nature. Through the in-depth study of these historical landmarks, people can better understand the formation mechanism and impact scope of natural disasters, so as to take effective preventive measures and reduce disaster losses.

Secondly, these historical landmarks are witnesses to the progress of human civilization. In the process of responding to extreme weather events, human beings continue to explore and innovate, promoting progress in science and technology, architecture, engineering and other aspects. For example, ancient water conservancy projects were built to cope with floods, and modern weather forecasting technology was developed to predict and prevent extreme weather events such as hurricanes. These historical landmarks embody the progress of human wisdom and civilization, and provide valuable experience and inspiration for future generations.

In addition, these historical landmarks are also an important basis for the monitoring and protection of the ecological environment. Through the study of historical meteorological records, scientists can understand past climate conditions and trends, and predict future environmental changes. These data provide an important scientific basis for the monitoring and protection of the ecological environment, and help people better protect the natural environment and achieve sustainable development.

Finally, these historic landmarks are also important resources for education and cultural heritage. Through education and awareness-raising, people can better understand the history and impact of extreme weather events and enhance environmental awareness. At the same time, these historical landmarks are also an important part of cultural and tourism resources, helping to promote local economic and cultural development [6].

In summary, historical landmarks based on extreme weather events are of great value. They are not only a record and warning of natural phenomena, but also a witness to the progress of human civilization, an important basis for the monitoring and protection of the ecological environment, and an important resource for education and cultural inheritance. Therefore, we should strengthen the protection and research of these historical landmarks, dig deeper into their value, and provide strong support for sustainable development in the future. At the same time, we should also learn from the experience and lessons of historical landmarks, and continue to explore and innovate to better cope with the challenges of extreme weather events and climate change that may occur in the future.

3.3 Sensitivity analysis

The dynamic model of the company's D&A system was adjusted based on the basic data and historical simulation results. The parameters of the relevant regulatory variables were set according to the scenario simulation scheme. It can be inferred from the Figure 3 below that the dynamic model is well stabilised.

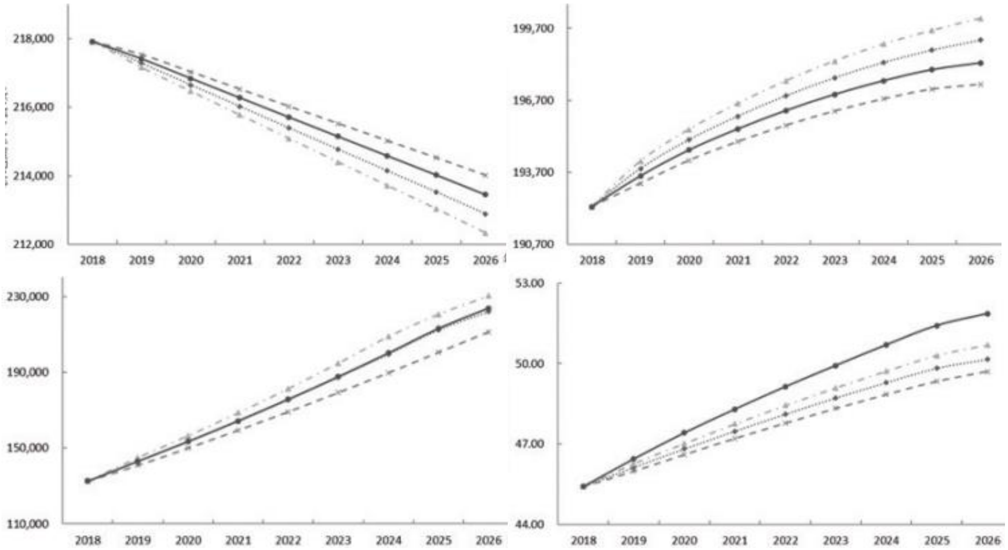


Figure 3: Simulation of the main variables of the subsystem under different scenarios.

4. Evaluation and Promotion of Model

In summary, this model has the following advantages. The distance method of superior-inferior solution makes full use of the attachment data. But it does not need to be tested by data, and has low requirements for the attachment data. It is a commonly used method for comprehensive evaluation within a group. By calculating the optimal scheme and the worst scheme, the closest degree between the evaluated index and the object is obtained, so as to carry out evaluation and analysis. However, there are some drawbacks to this model. The amount of training data in this paper is small, and the accuracy of the algorithm is poor. It can be seen from the classification process that the algorithm has better adaptability to concept drift and class imbalance, which shows a more stable, balanced and accurate classification effect. However, the numerical values in mathematics are selected, and the actual situation of various indicators in real life is not taken into account when selecting indicators.

The artificial neural network has good nonlinear predictive analysis ability, but it is easy to fall into local extreme values and slow convergence. The genetic algorithm has high global optimization ability. Therefore, in view of the instability of the neural network sensitivity analysis method based on connection weight, a sensitivity analysis method of neural network optimized connection right based on genetic algorithm was proposed. After optimization, the error of the artificial neural network increases significantly, the coupling strength is stable, and a stable sensitivity coefficient can be obtained. The sensitivity coefficient can be used to effectively filter out characteristics that contribute greatly to the output. Using this sensitivity analysis method, the main range that contributes the most to the graph classification can be objectively selected.

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