

Research on sustainable development of insurance property based on IDP model

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Abstract. Extreme weather events are becoming homeowners and insurers. Insurance companies continue to face more and more serious claims, increasing the cost of payments. and it is difficult for insurance companies to accurately assess and quantify risks. In this paper, this text incorporate the Geography and Environment factors together with Economic factors to build an Insurance-Development-Protection Model (IDP Model) to help homeowners and insurance companies solve crises. IDP Model consists of three interlocking submodels. They are Insurance model, Real estate development model and Protection model. By factoring in some parameters, sustainability and equity are upgraded to priorities at the sacrifice of economic profit. The model help insurance companies maintain profitability among Insurance Development and protection and provide decision support to community leaders to ensure that community buildings are making the right decisions about current or future insurance coverage when they are affected by extreme weather.

Keywords: IDP Model, Assessment Model, Prediction Model.

1. Introduction

China is one of the countries with serious natural disasters in the world, with many kinds, wide distribution, high frequency and heavy loss. In the past 20 years, earthquakes, typhoons, floods, droughts and other disasters have caused an average annual direct economic loss of more than 300 billion yuan, seriously threatening people's lives and property safety. In the context of global climate change and rapid national economic development, the loss of natural disasters in China is likely to continue to increase, and the risk of catastrophe is becoming increasingly severe [1].

The frequency with which catastrophes occur causes damage that is increasingly difficult to measure. For many community leaders in our country, they are faced with the responsibility of preserving buildings of cultural, historical, economic or community significance. The catastrophe risk assessment model is widely used in the United States, Australia and other regions. The model evaluates the potential catastrophe risk through independent modeling and analysis of the three elements of risk source, risk object vulnerability and risk object value, and connects the analysis results of each part together, so as to provide the reference basis for managers to choose and implement risk management strategies [2].

For developing countries, where data on owned wealth changes rapidly and the integrity and reliability of the underlying data cannot be guaranteed, catastrophe risk assessment models may recommend against underwriting current or future property insurance policies, which may lead to difficult decisions for community leaders regarding property of cultural or community significance [3].

Based on the above problems, the IDP model is established in this study. The model uses fuzzy comprehensive evaluation rules to avoid the problem of incomplete data [4]. Conduct detailed cultural and historical assessments to determine which buildings have special cultural or historical value, and take appropriate disaster response measures to protect the buildings, and advise community leaders on decision-making [5]. The IDP model studies the stochastic change of climate, the probability of risk occurrence and the pricing of insurance cost, and helps the insurance company to give the optimal

premium pricing. IDP model has enriched the sustainability and natural disaster risk assessment system of China's property insurance industry, and has certain scientific significance for rational planning of the profitability of insurance companies and the affordability of owners [6].

2. Model

2.1. The structure of IDP model

IDP model is a composite model, which is composed of insurance, development and protection. The model incorporates geographic and economic factors to help homeowners and insurers cope with crises triggered by extreme weather events. The IDP model structure is shown in Figure 1.

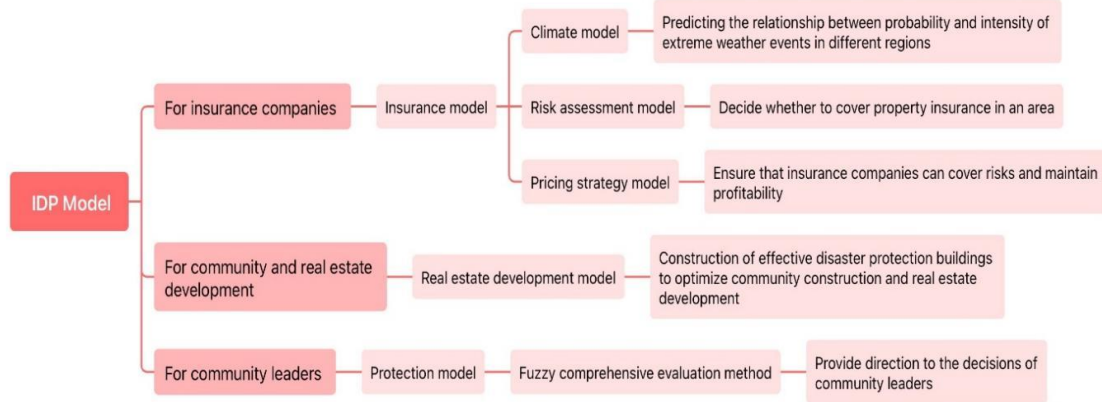


Figure 1. IDP model structure.

2.2. The establishment of Insurance model

The insurance model is composed of climate model, risk assessment model and pricing model. The climate model predicts the probability and intensity of extreme weather events in different regions, and the risk assessment model helps insurance companies decide whether to cover property insurance in a certain region [7]. Finally, a pricing strategy model is established according to the time value theory of funds. Make the insurance company maintain profitability and carry on the profit and loss analysis of the insurance company [8].

Due to the existence of the time of funds, so that different amounts of funds at different points can have the same economic value, therefore, in order to ensure the same value, the amount of compensation required at different times is different.

The amount that the insurance company is required to pay out at some point should be

$$s = a * (1 + n)^n \tag{1}$$

Where s is accumulated value; a is present value.

The relationship between the total cost of a product and its production and sales can be approximated as linear.

$$C = C_f + C_v * Q \tag{2}$$

$$B = (P - T_b - T_v) * Q \tag{3}$$

Where C is cost; C_f is fixed cost; C_v is variable cost.

2.3. The establishment of Development model

We mainly think about where to build and how to build it. According to the current conditions, the preliminary judgment is made, the prediction model and parameter evaluation are established by selecting factors, and the buildings with effective disaster protection are constructed to optimize community construction and real estate development.

In this paper, different prediction models (such as linear regression, random forest, gradient ascending regression) are used to predict key factors such as population and carbon dioxide emissions, and the accuracy of the model is evaluated by MSE, RMSE and other indicators.

2.4. Establishment of protection model

We will establish a protection model for community leaders, using the fuzzy comprehensive evaluation method to provide decision-making support and ensure that when buildings in the community are affected by extreme weather factors, they can make correct judgments on whether to insure current or future insurance policies to protect buildings with cultural, historical, economic, or community significance [9].

In this paper, the index weights of fuzzy comprehensive evaluation are set up, and a linear regression model is established to predict the damage degree under extreme weather conditions.

$$evaluation_result : [2.16 \cdot 2.03 \cdot 2.33] \tag{4}$$

$$prediction_damage : [22.05595454] \tag{5}$$

This paper constructs a relationship matrix, calculates the correlation matrix, sets different labels, and draws a heat map of the relationship among the age, historical value, economic benefit and damage degree of 10 cultural relics.

Through the analysis of the heat map, it is known that different cultural relics exhibit different correlation relationships between their age, historical value, economic benefits, and degree of damage. This depends on the inherent properties of the cultural relics. Some cultural relics may have different economic benefits and historical values due to their different age, and may suffer varying degrees of damage when affected by extreme weather factors.

3. Results

3.1. Results and Analysis of Insurance model

We created simulations of extreme events (precipitation) in two regions over a ten-year period and used linear regression analysis to predict future trends of these extreme events. the probability and intensity of extreme weather events is shown in the Figure 2.

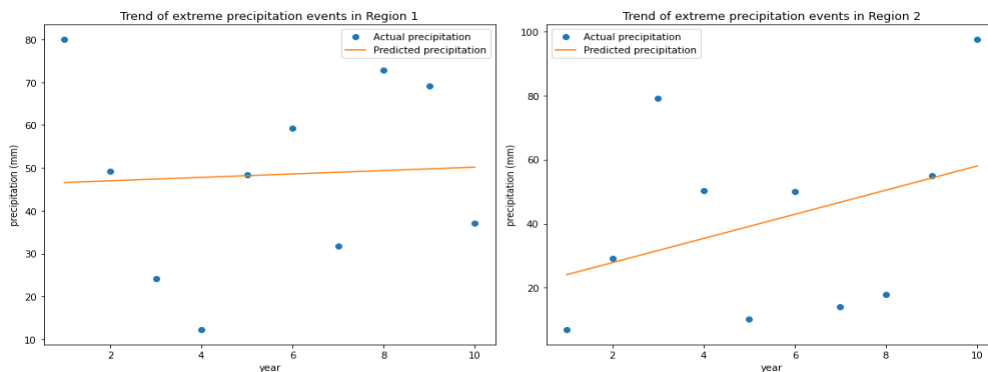


Figure 2. Graph of the probability and intensity of extreme weather events.

For this model, we first generate two sets of data: one is the average claim amount in the region over the past few years, and the other is the premium income over the same period. We then calculate the claim rate (that is, the ratio of the total amount claimed to the premium income) and use this ratio to determine whether the insurance company is taking on the risk in the area. Let's assume that if the claim rate falls below a certain threshold (say 40%), the insurance company accepts the risk. Risk assessment diagram for insurance company is shown in the Figure 3.

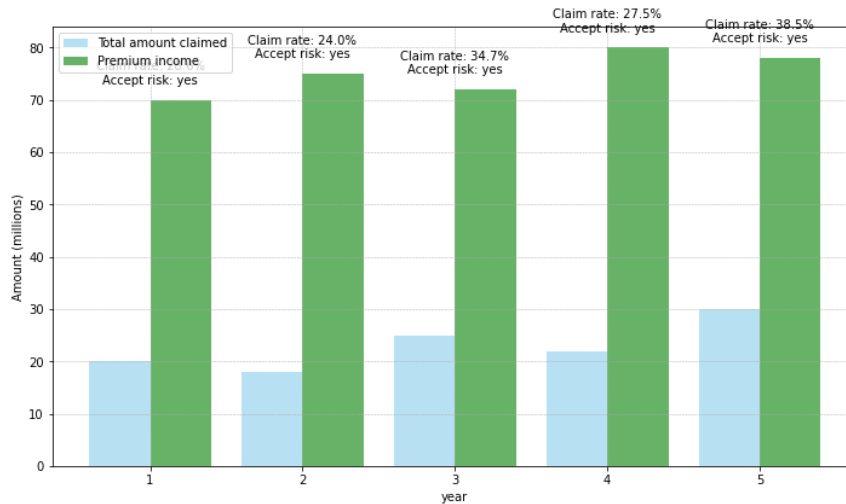


Figure 3. Risk assessment diagram for insurance company.

The profit and loss analysis chart of the insurance company was obtained, as shown in the Figure 4.

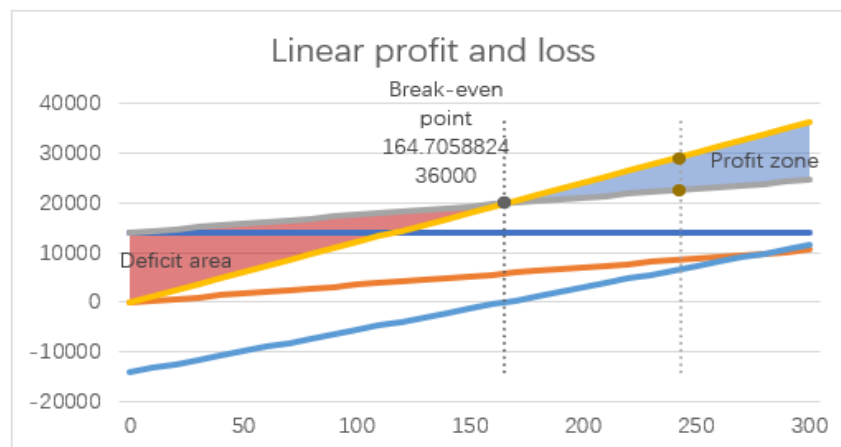


Figure 4. Linear profit and loss.

To sum up, when the insurance company pays a one-time compensation of 36 million yuan, it does not lose money, and at this time, the insurance company has the ability to operate.

3.2. Result and Analysis of Development model

Conduct a comprehensive natural disaster risk assessment of potential construction sites using advanced risk assessment tools and techniques. Prioritize sites that have a low risk of natural hazards or that can be effectively mitigated through sound design and engineering measures. Adopt up-to-date building codes and standards to ensure that new buildings can withstand anticipated natural hazards. Encourage the use of innovative materials and design methods to improve the structural resilience and durability of buildings.

Adapt insurance strategies, including purchasing more comprehensive insurance coverage and increasing the amount of retained risk, based on the risk level of the construction site and the resilience criteria of the building. Explore new insurance products and services, such as parametric insurance and catastrophe bonds.

3.3. Result and Analysis of Protection model

As community leaders, we must consider the historical value of artifacts when making decisions. Therefore, we analyze the proportion of cultural relics' historical value influenced by cultural age, economic benefit and destruction degree [10]. It also predicts the loss of historical value of cultural relics under the influence of extreme weather in the future. The impact of cultural relic age, economic benefits, and degree of damage on historical value is shown in the Figure 5. Predicting the Loss of Historical Value of Cultural Relics Caused by Extreme Weather is shown in the Figure 6.

The extent to which different factors influence the historical value of cultural relics

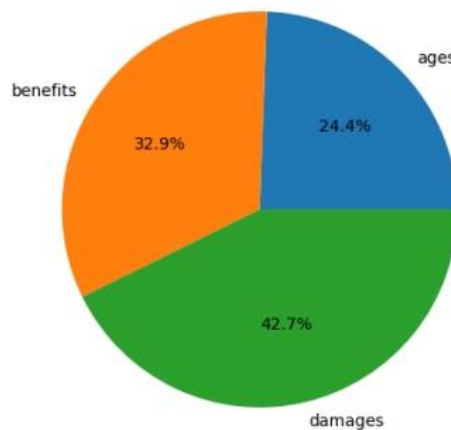


Figure 5. The impact of cultural relic age, economic benefits, and degree of damage on historical value.

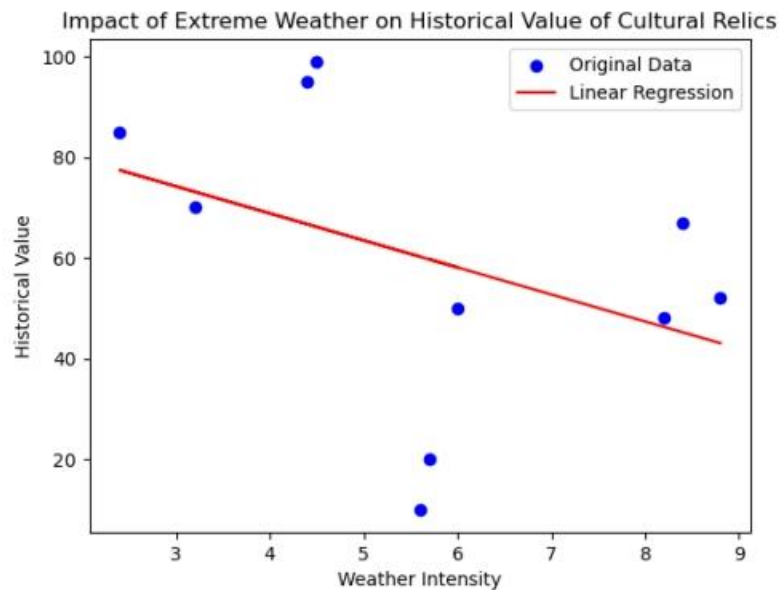


Figure 6. Predicting the Loss of Historical Value of Cultural Relics Caused by Extreme Weather.

By analyzing the figure above, we can find that the age, economic benefit and damage degree of cultural relics have different influences on the historical value. Community leaders can develop targeted solutions through different influencing factors, so that community leaders can take targeted measures to better protect those cultural relics in need of protection.

For the optimization of the protection model, we need to continue collecting new feature data of cultural relics and better incorporate them into the model to improve its adaptability and accuracy. When optimizing the model, it is necessary to consider the sustainable development of cultural relics protection and the needs of community people, while increasing the publicity efforts of the community to raise people's awareness of protecting cultural relics.

4. Conclusions and Outlooks

The IDP model provides an effective solution for homeowners and insurers to help them cope with the insurance crisis triggered by climate change. By combining geographical and environmental factors with economic factors, the IDP model can comprehensively consider various factors and formulate conservation strategies that meet the actual situation. This study presents a case study of Litua Bay. First of all, a comprehensive value assessment of Litua Bay, including its natural value, cultural value and economic value. Through the assessment, the importance and conservation significance of Litua Bay can be determined, and the basis for the formulation of conservation strategies can be provided. Secondly, formulate the future development plan of Litua Bay, including community construction, tourism development and other aspects. In the planning process, the protection needs of cultural relics should be fully considered to ensure that new construction activities will not cause damage to cultural relics. Finally, make a detailed cost financing plan, including the source of funds, use plan and risk management. With a reasonable funding option, this text can ensure that Litua Bay conservation is adequately funded.

IDP model can better help enterprises understand and manage risks, and price products and services reasonably, so as to improve the competitiveness and profitability of enterprises. Through the IDP model, enterprises can better respond to market changes and challenges and achieve long-term sustainable development. In the future, we will continue to improve the IDP model, explore more application scenarios, and contribute to the sustainable development of society.

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