

## A Win-win Method Against Disasters

### Summary

Extreme weather events have been occurring frequently in recent years, causing economic, social and ecological damage on a global scale. Among other things, property owners and insurers have suffered many negative impacts. Therefore, it is particularly important to assess whether the property insurance industry is sustainable under the influence of extreme weather events.

First, we innovatively built an insurance model based on **DoPont Analysis** in economics and combined with hierarchical analysis and entropy power method, and analyzed three variables: underwriting profitability, underwriting capacity and underwriting risk. Among them, underwriting capacity is calculated from 11 secondary indicators and 11 tertiary indicators, and the weights of its indicators at all levels are combined by hierarchical analysis and entropy weight method.

Secondly, we chose two regions, the United States and China, and collected the data of related indicators to be substituted into the insurance model, and obtained the trend of **ROE** in the next 15 years in the two countries. By analyzing the graph of **ROE** over time, we found that the number of underwritten policies should be reduced in the event of a surge in risk and that risk-taking should not be an option; at the same time, homeowners can influence the decision of insurance companies by strengthening their own awareness of insurance and taking precautions.

Next, we adapt the **insurance model** for real estate based on existing data and models. Real estate developers should examine the human geographic elements of the corresponding area, choose sites with good environment and high security for development, and improve the infrastructure around the site accordingly to improve the resilience of real estate.

Then, we constructed a conservation model based on **Analytic Hierarchy Process(AHP)**, **Principal Component Analysis(PCA)**, and the **Delphi Method** to assess the conservation value of the building from five value levels: history, science, art, spatial layout, and use, by means of expert survey scoring, and proposed relevant measures to help community leaders better conserve the building from three perspectives: economic, social, and ecological.

Finally, we chose to assess the insurance and conservation value of **Mesa Wai's national park**, obtained its future ROE trend and a conservation score based on subjective decision-making and objective information: **85.1**, and based on the insights therein wrote a letter to the community with future plans, timelines, and cost recommendations for the park.

**Keywords:**ROE,AHP,EWM,Delphi

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# 1. Introduction

## 1.1 Problem Background

From the beginning, human society has been faced with natural disasters and accidents, and in the process of fighting against nature, the idea of insurance against disasters and accidents and the primitive form of insurance methods have been developed since ancient times. Insurance is essentially an economic compensation system. It is a system whereby the insurer uses the risk reserve under the contract to compensate the insured with a certain amount of money for the loss caused by the relevant risk under the contract. It is a "delicate social stabilizer".



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Since the birth of the insurance industry, it has never stopped fighting against the loss of insurance due to natural disasters. Especially in recent years, extreme weather events (floods, hurricanes, droughts, wildfires, earthquakes, etc.) have occurred frequently due to the deterioration of the earth's environment, which has disturbed the living environment of mankind, and forced the insurance industry to make corresponding adjustments to the regulations of insurance contracts, which include the increase of insurance premiums year after year. Real estate is the main industry related to the purchase and sale of insurance, and because of the nature of the industry, the real estate industry is greatly affected by extreme weather. As a result, extreme weather events are becoming a common crisis for both real estate owners and insurance companies.

In order to effectively deal with the critical situation where the insurance industry and the real estate industry share losses due to extreme weather events, which in turn affects the welfare of the society, the catastrophe insurance system has been developed. It consists of a series of insurance products, related policies and systems, and a coordination system between the government and the insurance industry for catastrophe risk management. The catastrophe insurance system can effectively disperse risks through market-oriented operation mechanisms, raise disaster prevention and relief funds through multiple channels in a timely manner, and integrate social resources and forces to actively participate in disaster prevention and mitigation, so as to maximize the protection of people's lives and properties.<sup>[1]</sup>

## 1.2 Restatement of the Problem

In order to effectively analyze the relationship between multiple parties such as

the insurance industry, real estate industry, and social welfare, we need to address the following questions to help us understand the dissection layer by layer, as required by COMAP's Catastrophe Insurance Modeler (ICM).

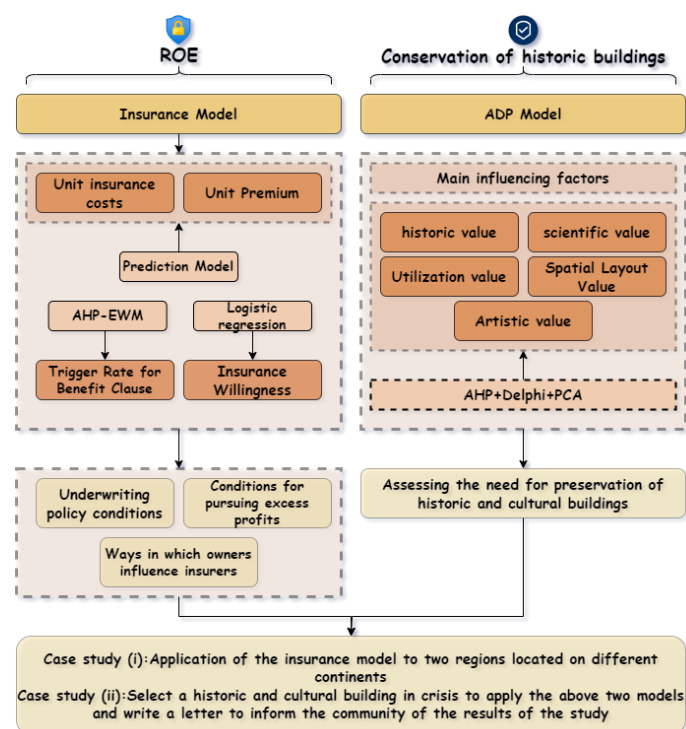
- Develop a model to help insurance practitioners determine whether they should write policies in an area of increasing extreme weather events and analyze the timing of insurers' underwriting of policies and pursuit of excess profits, as well as the impact of homeowners on insurers' decision-making.
- How real estate developers can increase the resilience of future real estate development decisions in response to a growing population and demand for services.
- Developing a protection model to analyze how culturally significant properties can be effectively underwritten.
- Select an extreme weather-prone area to apply the model to evaluate its effectiveness and write a one-page letter to the community suggesting plans, timelines, and costs for the future of their treasured landmark.

### 1.3 Our Work

In order to address the common challenges faced by the insurance and real estate industries as a result of frequent extreme weather events, we developed two models: an insurance model to help the industries make decisions and an ADP protection model to protect cultural landmarks.

We first develop an insurance model to assess the impact of several key metrics on insurance company revenues and apply the model to two specific regions. Second, we developed an ADP

preservation model to assess whether a community's historic buildings are worthy of preservation based on a number of metrics to help community leaders make decisions. Finally, we apply both models to a historic landmark in crisis to provide preservation recommendations to the community. Thus, we achieved the goal of balancing environmental protection, industry economic gain, and social and humanistic concerns.



**Figure 1: Flowchart of the paper**

The specific work we did to address these issues is shown in the figure above.

## 2. Assumptions and Justifications

To simplify the problem, we make the following basic assumptions, each of which is properly justified.

- **Assumption 1:** It is assumed that both the insurer and the insured have a contractual spirit, that there is no breach of contract in the process of the policy coming into force, and that the policy produces the established benefits in accordance with the law.
- **Justification:** In the process of the insurance policy in force, once any party has defaulted, the defaulting party needs to compensate the other party for the liquidated damages, the size of the liquidated damages according to the specific content of the policy and the regulations, so there are uncertainty about the payer and the amount of the payout, which makes the model solution extremely complex, so do not take into account the situation of the default.
- **Assumption 2:** It is assumed that when discussing the sustainability of an insurance company, the company has no liabilities, etc.
- **Justification:** In the actual discussion of a company's total assets, owner's equity is the difference between total assets minus the amount of liabilities. Since only the risk profile of the policy is included in the sustainability discussion in this paper and not the amount of liabilities of the company, total assets are equal to owner's equity.
- **Assumption 3:** It is assumed that there is a proportional relationship between the initial operating costs of an insurance company and its premium income.
- **Justification:** Due to the different operating scale, start-up capital and other conditions of different insurance companies in each region, we are unable to calculate the total amount of initial working capital of all insurance companies within a certain region, so we estimate the initial working capital of the corresponding region as a whole based on the overall premium income of a certain region.
- **Assumption 4:** It is assumed that the conservation modeling scores in the paper and the expert scores have equal validity.
- **Justification:** The scores in this paper are obtained based on objective information from the network of AI and our subjective decisions, avoiding score errors caused by scores that are too subjective and too objective and thus too different from the general perception.

## 3. Notations

In this paper, we first define the important notations used as **Table 1**.

**Table 1: Notations used in this paper**

| Notation  | Definition   |
|-----------|--|
| $U_p$     | Underwriting profits                                   |
| $U_m$     | Underwriting margin                                    |
| $U_l$     | Underwriting leverage                                  |
| $ROI$     | Return on investment                                   |
| $ROE$     | Return on Equity                                       |
| $U_r$     | Underwriting risk                                      |
| $U_{IC}$  | Unit insurance costs                                   |
| $U_{CA}$  | Unit claim amount                                      |
| $R_{CCT}$ | Compensation clause triggering rate                    |
| $PW$      | Insurance willingness                                  |
| $R_{ITP}$ | The ratio of initial working capital to premium income |
| $S$       | Protection score                                       |

**Note:** Some variables not listed here will be discussed in detail in each section of the article.

## 4. Problem analysis

### 4.1 Exploration of economics in response to question 1 and 2

The frequency of extreme weather events has led to a significant increase in the chances of the insurance industry paying out to the insured, thus forcing insurance companies to constantly adjust the terms of their insurance contracts, and insurance premiums and benefits to rise, which has left insurance companies in a worsening situation. The real estate industry, as a major insurance related industry, is also affected by the high number of accidents and rising premiums caused by extreme weather, and is looking for the ideal way to help scientific decision making.

In order to help the industry to solve this problem, we started from the perspective of economics, transforming the problem of determining whether the insurance industry can underwrite a certain business into a quantifiable problem of analyzing the profitability of the insurance industry after underwriting this business, combining with the capital situation of the company, and analyzing the profitability from the influencing factors (e.g., triggering rate of the compensation clause, unit cost and unit premium, willingness to insure, etc.). In the end, we set the criteria for analyzing the profitability

and determine whether the company should underwrite the business based on the profitability. This will help the company to make scientific decisions and minimize economic losses in the event of extreme weather conditions.

At the same time, we can choose two regions in different continents to practice the model, taking into account the scientific and practicality of the model.

## 4.2 Social analysis in response to question 3 and 4

Most of the social organizations such as the insurance industry and the real estate industry carry out a series of social activities for the purpose of obtaining excessive profits economically. In reality, many areas in the world have values that cannot be measured in monetary terms, such as historical value and cultural value, even though the insured cannot bring economic value to the insured subject. Therefore, in the protection of historical and cultural buildings, it is not in line with the reality and the will of the public to rely solely on the profitability to judge whether a building is worth protecting. Therefore, we decided to introduce the historical value, scientific value, artistic value, spatial layout value, use value and other indicators to comprehensively evaluate whether a historical and cultural building is of conservation significance, in order to achieve the purpose of balancing humanistic care and spiritual abundance in a society where economic interests are paramount.

## 4.3 Holistic thinking about the triadic relationship

Overall, the four questions given in the question reflect the status quo of the three themes of environment, economy, and social humanities, which interact and play with each other. Due to environmental degradation and the increase of extreme weather, the profitability of the economy and society is damaged and the improvement of living standard is affected, meanwhile, the policy improvement of economic subjects can largely help the social welfare to rebound. At the same time, in order to alleviate the root cause. Even to solve the problem, the social subjects can improve the environment and reduce the occurrence of extreme weather by enhancing the awareness of environmental protection and increasing the public investment in environmental construction category. The specific thinking path of this paper is shown in the following figure.

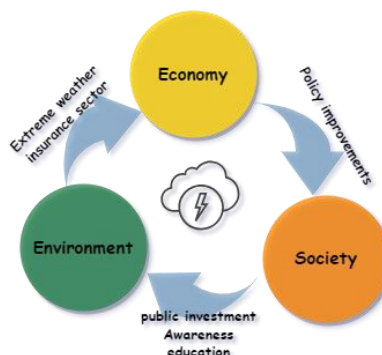


Figure 2: Ideas for solving the problem

## 5. Insurance Model Based on DoPont Analysis

The increasing number of extreme weather events is causing property and casualty insurance companies' operating costs to rise, with the poor contracting status of policies becoming a major obstacle to company growth. In order to study the current insurance company's underwriting situation for insurance policies and help insurance companies to reduce the loss of revenue, we established an insurance model with **ROE** as the core judgment indicator based on **DoPont Analysis**, a well-known financial analysis system within economics.<sup>[2]</sup> Under this model, we can visualize and analyze whether an insurance company should underwrite a certain policy on the premise of being able to make a profit in order to achieve sustainable development.

### 5.1 Analysis of influencing factors

#### 5.1.1 Trigger Rate for Benefit Clause

Benefit Clause Trigger Rate, the probability of the Insured triggering a Benefit Condition.

Generally speaking, there are several factors that influence whether the insurance company is required to pay the insured the insurance amount (i.e., whether the insured triggers the indemnity clause):

- ***Frequency of natural disasters***: The triggering of the indemnity clause during the term of the insurance contract is related to the probability of the occurrence of natural disasters in the area where the property is located. The more frequent and probable the occurrence of natural disasters in the region, the higher the probability that the insured will be compensated by triggering the insurance benefit clause if the insured property is affected.
- ***The owner's choice of location***: The frequency of natural disasters is often calculated relative to a particular administrative division or topographical area, whereas the factors considered by property owners when choosing a site are more refined. Therefore, even though different property owners are located in the same natural disaster-prone area, the probability of triggering the payment provision will be different in the event of a disaster due to the difference in the location of their sites and the level of natural disaster shelter or relief they receive.

$$z = \sum_{i=1}^n \alpha_i x_i \quad (1)$$

where  $x_i$  refers to the  $n$  factors to be considered and  $\alpha_i$  is the parameter they will consider.

- ***Resilience of Buildings to Disasters***: At present, under the same level of impact of natural disasters, it is often the case that buildings with good resilience are weaker and less likely to meet the triggering conditions of the payout provisions. Therefore, we include building resilience in the consideration of impact factors. In order to



better quantitatively assess the disaster resilience of a given building, here we introduce a vulnerability index to measure it.<sup>[3]</sup> The specific scoring criteria are shown in the table below.

**Table 2: specific scoring criteria**

| hierarchy   | Vulnerability index                                   | Type of disaster involved |
|---|---|---------------------------|
| low, medium, high   | [0-0.33];<br>[0.34-0.66];[0.67-1.00]                  | floods                    |
| Slight, moderate, massive,<br>total destruction                                     | [0.1-0.3];[0.4-0.6];[0.7-<br>0.8];[0.9-1.0]           | mudslides                 |
| Substantially intact,<br>slightly, moderately,<br>severely, completely<br>destroyed | [0.1-0.2];[0.2-0.4];[0.4-<br>0.6];[0.6-0.8];[0.8-1.0] | landslides                |
| Very low, low, medium,<br>high, very high   | [0-0.2];[0.2-0.4];[0.4-<br>0.6];[0.6-0.8];[0.8-1.0]   | multi-hazardous           |

The judgment matrix of hierarchical analysis method is completely scored by subjective experts, and it is difficult to eliminate the influence of experts' rich experience on the weight of indicators; entropy weight method calculates the weight according to the objective data, but it reflects the relative competitive intensity among indicators rather than the actual importance.<sup>[4]</sup> Therefore, we choose to combine the hierarchical analysis method with the entropy weight method to form an improved evaluation model, which is applied to the problem of evaluating the impact of the three factors on the trigger rate of the payout clause.

The specific steps are as follows:

Let there be  $x$  number of tier 1 indicators,  $m$  number of tier 2 indicators and  $n$  guidelines for tier 3 indicators. Each secondary indicator contains several subcriteria:

$$n_1, n_2, n_3, \dots, n_m, \text{ and } n_1 + n_2 + n_3 + \dots + n_m = n.$$

**Step 1:** Through the AHP method, a judgment matrix is constructed to find the weights of the first-level indicators:  $A = \{\alpha_1, \alpha_2, \dots, \alpha_x\}$ . Weighting of secondary indicators:  $B = \{\beta_1, \beta_2, \dots, \beta_m\}$ , and a vector of weights for the three levels of indicators:  $C = \{c_1, c_2, \dots, c_n\}$

**Step 2:** Entropy weighting method to find the weight of each criterion:  
 $U = \{\mu_1, \mu_2, \dots, \mu_n\}$ .

The weights of the three levels of indicators obtained from AHP and EWM are simply synthesized to obtain the composite weights:  $T = \{t_1, t_2, \dots, t_n\}$ .

$$t_j = \frac{u_j c_j}{\sum_{j=1}^n \mu_j c_j}, j = 1, 2, \dots, n \quad (2)$$

**Step 4:** Re-expression of the combined weights of the tertiary indicators according to their correspondence with the tertiary indicators:

$$T = \{t_{11}, t_{12}, t_{13}, \dots, t_{1n_1}, t_{21}, t_{22}, t_{23}, \dots, t_{2n_2}, \dots, t_{m1}, t_{m2}, t_{m3}, \dots, t_{mn_m}\}$$

and normalizing the weights of the tertiary indicators within each secondary indicator:

$$D = \{d_{11}, d_{12}, d_{13}, \dots, d_{1n_1}, d_{21}, d_{22}, d_{23}, \dots, d_{2n_2}, \dots, d_{m1}, d_{m2}, d_{m3}, \dots, d_{mn_m}\}$$

$$d_{ij} = \frac{t_{ij}}{\sum_{j=1}^k t_{ij}}, i = 1, 2, \dots, m; k = n_1, n_2, \dots, n_m$$

**Step 5:** Multiply the weights B of the secondary indicators with the corresponding weights D obtained in step 4 to obtain the weights:

$$E = \{e_{11}, e_{12}, e_{13}, \dots, e_{1n_1}, e_{21}, e_{22}, e_{23}, \dots, e_{2n_2}, \dots, e_{m1}, e_{m2}, e_{m3}, \dots, e_{mn_m}\}$$

Among which,  $e_{ij} = \beta_i * d_{ij}$

**Step 6:** Re-express the weights E as:

$$F = \{f_1, f_2, f_3, \dots, f_n\}$$

and normalize the weights F to obtain the final weights:

$$W = \{w_1, w_2, w_3, \dots, w_n\}$$

$$w_j = \frac{f_j}{\sum_{j=1}^n f_j}, j = 1, 2, \dots, n$$

### 5.1.2 Relationship between the ratio of unit premiums to unit insurance costs over time

In order to predict how the ratio of unit premiums to unit insurance costs changes over time, we model the following:

$$y = \frac{A_1}{1 + A_2 \cdot e^{-A_3 \cdot (x-n)}} \quad (3)$$

Where  $y$  is the ratio of unit premium to unit insurance cost,  $A_1, A_2, A_3$  are parameters determined according to the actual situation of the region,  $x$  represents time and  $n$  represents the starting year.

### 5.1.3 Insurance willingness(PW)

According to the science of consumer behavior, the purchase decision process of

consumers can be divided into five stages: problem recognition, information search, option evaluation, purchase choice and post-purchase evaluation. Consumers' awareness of risk and sense of family responsibility will drive them to transfer risk and generate the motivation to buy insurance, for which they widely collect relevant insurance product information and sieve to choose insurance products that meet their needs.<sup>[4]</sup> And we can see from the relevant information, insurance willingness is related to the degree of risk awareness, awareness of insurance products, insurance company service attitude, gender, age, cultural level, average annual income, workplace class and other factors.<sup>[5][6][7][8]</sup>

There are two situations in which consumers purchase insurance products: willingness to purchase insurance and unwillingness to purchase insurance. In this paper, we take insurance willingness as the dependent variable  $PW$ , and define  $PW=1$  as willing to buy insurance and  $PW=0$  as unwilling to buy insurance, and its probability distribution is:

$$y = \begin{cases} 1-p, Y=0 \\ p, Y=1 \end{cases}$$

where  $p$  denotes the probability of willingness to purchase insurance and  $p$  takes the value of  $[0, 1]$ . Consider the discrete nature of insurance willingness. Therefore, we adopt a **non-linear probabilistic Logistic Model** in this question to analyze how the above factors affect the insurance willingness of homeowners. Our specific model is as follows:

$$f(x, \beta) = S(x_i' \beta) = \frac{\exp(x_i' \beta)}{1 + \exp(x_i' \beta)} \quad (4)$$

Where  $x_i$  denotes the corresponding factor mentioned above and  $\beta_i$  denotes the coefficient of the corresponding factor. The specific meanings of the independent variables are shown in the two tables below.

**Table 3: significance of variables-1**

| Influencing factor        | range of values | assign a value                                    |
|---------------------------|-----------------|---|
| willingness to buy( $y$ ) | 0-1             | 1=yes,0=no  |
| Risk Awareness( $X_1$ )   | 1-5             | From very low to very high                        |
| Awareness( $X_2$ )        | 1-5             | From not knowing anything at all to knowing a lot |
| Service Attitude( $X_3$ ) | 1-5             | From very low to very high                        |
| Gender( $X_4$ )           | 0-1             | 1=female,0=male                                   |
| Age( $X_5$ )              | 1-3             | 1=<25,2=[25-60],3=>60                             |

**Table 4: Significance of variables-2**

| Influencing factor             | range of values | assign a value   |
|--------------------------------|-----------------|--|
| Education Level( $X_6$ )       | 1-4             | 1=Junior high school and below;2= Post-secondary;3= High School;4= College and above |
| Average annual income( $X_7$ ) | 1-5             | 1= $\leq 1w$ ,2=[1-3w],3=[3-5w];4=[5-7w],5= $>7w$                                    |
| Working class( $X_8$ )         | 1-5             | 1= common laborer;2= gray collar;3= pink collar;4= White collar;5= Gold Collar       |

## 5.2 Establishment of the Model

Based on the above analysis of the influencing factors and the DoPont Analysis, we get the following model:

$$\begin{aligned}
 ROE &= \frac{U_p + I_p}{O_e} = \frac{U_p}{P_e} \cdot \frac{P_e}{O_e} + \frac{I_p}{T_a} \cdot \frac{T_a}{O_e} \\
 &= U_m \cdot U_l + ROI \cdot F_l = \frac{U_p}{P_e} \cdot \frac{P_e}{O_e} + \frac{I_p}{T_a} \cdot \frac{T_a}{P_e} \cdot \frac{P_e}{O_e} \\
 &= (U_m + ROI \cdot IRC) \cdot U_l
 \end{aligned} \tag{5}$$

Where,  $U_p$  refers to underwriting profits;  $I_p$  refers to investment profits;  $P_e$  refers to premiums earned;  $O_e$  refers to owner's equity;  $T_a$  refers to total assets;  $U_m$  refers to underwriting margin;  $U_l$  refers to underwriting leverage;  $ROI$  refers to return on investment;  $F_l$  refers to financial leverage;  $IRC$  refers to investment return coefficient.

As the insurance company's investment income in the actual situation for bank deposits, investment in real estate, trading bonds, stocks, securities investment fund shares and other securities and other cases, its subsequent profit and loss has nothing to do with the purpose of the study of this model, and does not have an impact on the calculation of this model, therefore, in our study of the insurance model is not involved in a discussion of investment income, thus ignoring the calculation of ROE in the investment income related to the calculation of the ROE, then the ROE model can be simplified as:

$$ROE' = \frac{U_p}{O_e} = \frac{U_p}{P_e} \cdot \frac{P_e}{O_e} = U_m \cdot U_l \tag{6}$$

where owner's equity can simply be classified as total assets, and, for a better understanding of the variables in the simplified model, we give the following expression:

$$\begin{aligned}
U_p &= P_i - C_e, \quad P_i = U_{AC} \cdot N_c, \quad U_l = U_c \cdot U_r \\
U_c &= A_c \cdot D_c, \quad A_c = IWC + P_i, \quad P_i = U_{CA} + P_i \\
D_c &= C_e = U_{IC} \cdot N_c \cdot R_{CCT}
\end{aligned}$$

Among which,  $P_i$ : premium income;  $C_e$ : claims expenditure;  $U_{CA}$ : amount claimed per unit;  $N_c$ : number of unit claims;  $U_c$ : underwriting capacity;  $A_c$ : available capital;  $D_c$ : demand capital;  $IWC$ : initial working capital.

Substituting the above relational equation into ROE, we get the final ROE expression.

$$ROE = U_r \cdot \frac{PW \cdot U_{IC}}{U_{CA} \cdot R_{CCT}} - R_{ITP} \cdot U_r \quad (7)$$

Model solving: based on actual data from China and the US

### 5.3 Model solving: based on actual data from China and the US

#### 5.3.1 Owner site area

The scoring of this indicator is affected by geographic location, meteorological conditions, soil and geological characteristics, water management, protective structures and infrastructure, emergency response and planning, etc. We combine accurate data from the Internet and subjective judgement to score the actual situation in China and the United States.

##### Part 1: China

We calculated the weights of the above indicators by reviewing relevant information and obtained the corresponding weights as follows:

$$\alpha_i = [0.17170.15160.16160.18180.17170.1616]^T$$

##### Part 2: America

We calculated the weights of the above indicators by reviewing relevant information and obtained the corresponding weights as follows:

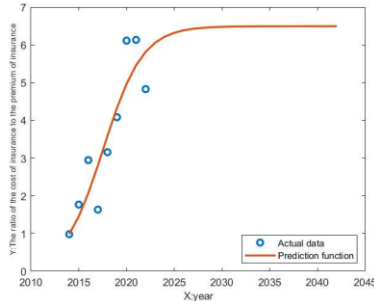
$$\alpha_i = [0.16160.17790.17580.18180.15370.1492]^T$$

#### 5.3.2 The Ratio of Unit Premium to Unit Cost of Insurance versus Time

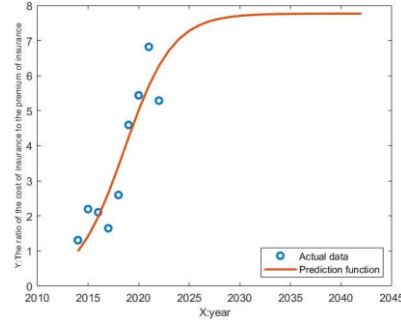
Through calculations, we obtain the forecast curve graphs and the values of  $A_1, A_2, A_3$  in Eq.  $A_1, A_2, A_3$  for both China and the U.S. shown below, with the left graph for the U.S. and the right graph for China. As can be seen from the graphs, the ratio of unit premiums to unit insurance costs in both China and the United States increases with the increase of extreme weather events each year, and the rate of increase tends to flatten out when the environment improves at a later stage. Further analysis shows that the increase in unit insurance cost is significantly larger than the increase in unit insurance cost during the period of extreme weather events, which is not conducive to the sustainability of insurance companies, and is consistent with the model predictions.

$$\text{America: } A_i = \{6.4915, 9.1501, 0.4846\}, i = 1, 2, 3$$

$$\text{China: } A_i = \{7.7694, 104115, 0.4203\}, i = 1, 2, 3$$



Figure(a):Trends in the United States



Figure(b):Trends in the China

**Figure 3: Trend charts for China and the United States**

### 5.3.3 Insurance Willingness

After calculation, we get the two tables shown below. The up graph depicts the willingness to insure in the United States and the below graph depicts the willingness to insure in China.

**Table 5: Willingness to insure in the United States**

| Influencing factor | Coefficient | Std.Error | Prob(t-statistic) |
|--------------------|-------------|-----------|-------------------|
| $X_1$              | 0.261532    | 0.189345  | 0.0159            |
| $X_2$              | 0.204134    | 0.202811  | 0.0337            |
| $X_3$              | 0.235766    | 0.247334  | 0.0469            |
| $X_4$              | -0.082263   | 0.111437  | 0.6721            |
| $X_5$              | 0.198715    | 0.135822  | 0.0405            |
| $X_6$              | 0.233168    | 0.050133  | 0.1805            |
| $X_7$              | 0.245891    | 0.174446  | 0.2674            |
| $X_8$              | 0.119507    | 0.241241  | 0.4189            |

**Table 6: Willingness to insure in the China**

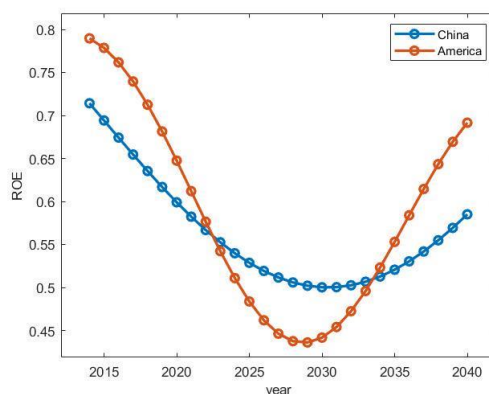
| Influencing factor | Coefficient | Std.Error | Prob(t-statistic) |
|--------------------|-------------|-----------|-------------------|
| $X_1$              | 0.227552    | 0.105532  | 0.0373            |
| $X_2$              | 0.296364    | 0.116507  | 0.0271            |
| $X_3$              | 0.22596     | 0.098764  | 0.0662            |
| $X_4$              | -0.131993   | 0.265321  | 0.3953            |
| $X_5$              | 0.218755    | 0.200543  | 0.0121            |
| $X_6$              | 0.294568    | 0.185614  | 0.2011            |
| $X_7$              | 0.275031    | 0.1755312 | 0.0275            |
| $X_8$              | 0.060407    | 0.076532  | 0.7422            |

From the above two tables, it can be seen that the influencing indicators of insurance willingness in China and the United States have the same situation:

$X_1, X_2, X_3, X_5, X_7$  are statistically significant and positively correlated with the willingness to purchase.

### 5.3.4 ROE

Combining the above metrics, we obtain a predictive curve of ROE over time for the U.S. and China, as shown below.



**Figure 4: Trends in ROE**

Based on the comparison between the existing ROE evaluation system and our calculations, we believe that the property industry in the region is sustainable when the model calculations take the value of 0-15%. As can be seen from the figure, with the increase of extreme weather in successive years, the ROE values of the United States and China have declined to varying degrees, indicating that if the insurance industry does not take specific actions to mitigate the crisis, its economic returns will be greatly affected or even bankruptcy and delisting. At the same time, we projected ROEs after effective interventions, and it is clear that insurance industry returns are picking up in both countries, and are expected to return to pristine levels as protection measures deepen.

Meanwhile, due to the Chinese government's protective policies for the insurance industry, the decline and rise of the ROE index for China's insurance industry is more moderate compared to that of the United States.

### 5.4 Model discussion

Insurance companies whose underwriting situation is affected by extreme weather leading to a surge in risk need to reduce the number of policies underwritten, as evidenced by: appropriately lowering claims premiums, increasing premium costs, reducing the number of policies, etc.; and should not choose to take risks to minimise losses during a time when the rate of reduction in ROE is large, i.e., the absolute value of the slope in the graph in 5.3.4 is large. Owners can influence the insurer's decision by strengthening their own insurance awareness and taking precautions.

Based on the expression of ROE, we can see that in order to regulate ROE under the influence of extreme weather, we can analyse it from the perspective of the three factors mentioned in 5.1.

#### **5.4.1 Optimising the pricing strategy**

This is manifested in the form of appropriately reducing premiums while appropriately increasing insurance costs. This measure can be mitigated by increasing premium income to reduce the expenditure on insurance premiums, thus easing the pressure on enterprises from the supply side of the policy, and at the same time facilitating the effective mitigation of the overheating of the insurance market caused by extreme weather.

#### **5.4.2 Adjustment of promotion mode**

In the state of risk surge, insurance companies can reduce the willingness to insure by means of propaganda in order to reduce the expenditure of certain insurance premiums. From the perspective of propaganda, propaganda can also change the rate of triggering of payout clauses to a certain extent. Through the means of publicity to strengthen people's awareness of the protection of property, thus reducing the trigger rate, and properly compensating ROE to mitigate the rate of decline when affected by extreme weather.

#### **5.4.3 Understanding the market situation**

Insurance companies should always pay attention to the market situation and employ sufficient talents so as to grasp the current wind direction of the world's insurance industry in real time, in order to ensure that they can adjust their strategies in time and respond positively to the occurrence of extreme weather or other sudden changes in social, economic and natural conditions.

#### **5.4.4 Owners Strengthen Insurance Awareness and Take Preventive Measures**

Actively responding to the policy of preventing natural disasters, the acquisition of property should take into account the risks and make corresponding measures to improve the safety of the property, thus regulating the ROE in the range of 0-15%, and ultimately through the market transmission, affecting the decision-making of insurance companies.

### **6. Real Estate Adjustment Strategies**

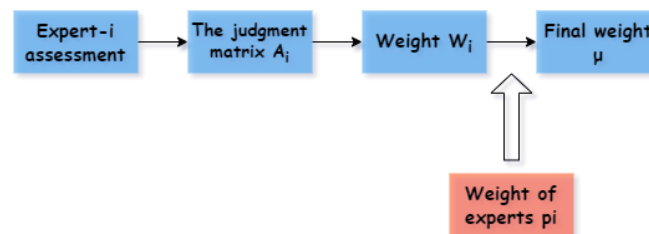
Firstly, the real estate developer should examine whether the social security and insurance measures in the corresponding development area are complete, and by studying the market and analysing the demand, select the development area that meets the market demand and satisfies the conditions such as good accessibility, schools, medical facilities, commercial facilities, and so on. Next, in the case of extreme weather, the size of the security of the housing property is very important for the selection of the site: the area where the real estate is developed and constructed, in addition to the conditions such as the beautiful environment, the security of the environment should be evaluated using our model. According to the results of the model, a higher safety factor should be chosen for the development and construction of properties in the plains than in mountainous and seaside areas. At the same time, the houses themselves should be



optimised for the environment, for example, houses in earthquake-prone areas should have a higher seismic rating. Overall, while ensuring profitability, the safety level of the housing should be increased as much as possible to cater for the changing market winds due to the increasing number of disasters, and the resilience of the property should be improved by proactively improving the infrastructure around the site to increase its resilience to disasters.

## 7. ADP Protection Model Based on AHP-Delphi-PCA

In order to help community leaders weigh the economic benefits with the historical and cultural benefits, so as to effectively protect the local historical and cultural landmarks, we developed an ADP preservation model based on Hierarchical Analysis (AHP), Delphi Method (Delphi) and Principal Component Analysis (PCA) to give them relevant theoretical support. Our specific operation process is shown below:



**Figure 5: scoring process**

### 7.1 Analysis of influencing factors

The conservation of historical buildings has always been concerned by the academic community. Relevant scholars have proposed a variety of evaluation systems for the value of historical buildings.<sup>[11]</sup> As there are many evaluation indexes, here we use the idea of Principal Component Analysis (PCA) to get five basic indexes: historical value, scientific value, artistic value, spatial layout value, and use value.

#### 7.1.1 Historic value

Historical value is the revelation of the historical facts of a historical building, which is realised through the imprints of the era preserved in the historical building, i.e. factors such as the construction date, reflection of the social development at that time, and the relevance to historical figures and important historical events can reflect its historical value.

#### 7.1.2 Scientific value

Scientific value refers to what people have produced and accumulated in long-term historical and social practice, mainly focusing on reflecting the level of science and technology involved in the process of historical architectural design and construction, and thus the integrity of the building, the scientific nature of the overall layout, and the scientific rationality of the architectural components and decorations, etc. can reflect its scientific value.

### 7.1.3 Artistic value

Artistic value mainly reflects the aesthetics of historical buildings, which is mainly influenced by factors such as the artistic aesthetics of the building's regional or national characteristics. Historical buildings show the course of human civilisation development with their unique architectural styles and techniques. Whether it is ancient cultural sites, palaces or churches, castles and other buildings, they all contain rich artistic value. Its unique architectural structure, exquisite carvings, delicate murals and other artistic elements can reflect its artistic value.

### 7.1.4 Spatial layout value

The value of spatial layout mainly reflects the unique wisdom of the ancients in architecture and excellent design methods, which not only played its functional role at that time, but also serves as a reference for the development process and protection of the city at present. Its role in the so-called "environmental design" of each era over the years and its ability to constantly change to meet new needs can reflect its spatial layout value.

### 7.1.5 Usability value

The use value reflects the role that historic buildings have played in political, economic, cultural, social, and other areas from ancient times to the present. For example, the Cape Hatteras Lighthouse serves as an illuminating beacon for maritime traffic, and the Golden Gate Bridge serves as a cross-sea link between the City of San Francisco and Marin County. The important roles they have played in various scenarios over time reflect their value in use.

## 7.2 Establishment of the Model

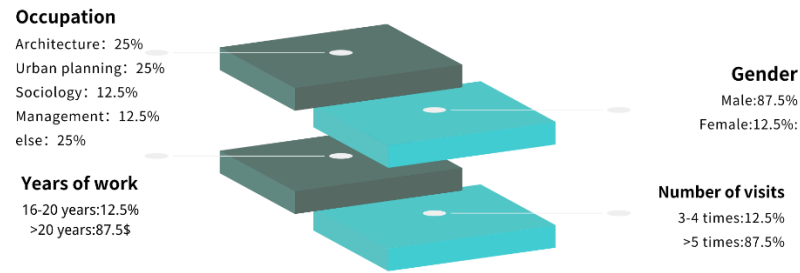
In the selection of existing evaluation indicators, it is inevitable that there are some indicators that are too subjective for experts, and through the combined use of the **Delphi Method (Delphi)** and **Analytic Hierarchy Process(AHP)**<sup>[11]</sup>, the subjectivity and arbitrariness of experts can be avoided and reduced. Based on the analysis of the above indicators and the principles of hierarchical analysis, Delphi method and principal component analysis, we get the following model:

$$S = \sum_{i=1}^5 w_i p_i v_i \quad (8)$$

where  $w_i$  denotes the corresponding weights obtained by hierarchical analysis;  $p_i$  denotes the expert weights obtained by the Delphi Method; and  $v_i$  denotes the corresponding indicators.

## 7.3 Model Solution

We selected eight experts to rate the indicators, and the specifics of the eight experts are shown below.



**Figure 6: Distribution of experts**

We score the historical value, scientific value, artistic value, spatial layout value, and use value based on the following indicators. Considering the length and practical factors, we only show the three most frequently used scoring criteria for each index.

**Table 7: Description of the factors of each variable evaluating each social characteristic of the subject**

| Evaluation Subject Variable Factor | Description of variable factors                                      |
|------------------------------------|--|
| <i>Occupation</i>                  | Architecture=1; Urban planning=2; Sociology=3; Management=4; else=5; |
| <i>Years of work</i>               | 16-20 years=1; 21-25 years=2; >25 years=3;                           |
| <i>Gender</i>                      | Male=1; Female=2;  |
| <i>Number of visits</i>            | 3-4 times=1; $\geq 5$ times=2;                                       |

After determining the specific scoring criteria, we calculated and obtained the following weighting table. Among them,  $w_i$  is derived from AHP, and  $p_i$  is derived from the corresponding value by Delphi method analysis.  $\mu_i$  represents the result after normalising the product of  $w_i$  and  $p_i$ , which we normalised to obtain the final indicator weights on the far right.

**Table 8: Value Guidelines Scoring**

| influencing factor          | marking scheme  |
|-----------------------------|---|
| <i>historic value</i>       | Era of construction(A1); Relevant individuals(A2); Historical events(A4),etc.         |
| <i>scientific value</i>     | Scarcity(B1); Biotic(B2); Authenticity(B3),etc.                                       |
| <i>artistic value</i>       | Ethnic characteristics(C1); Artwork(C2); Garden beauty(C4),etc.                       |
| <i>Spatial layout value</i> | Geographical location(D1); Feng shui arrangement(D2); Rational configuration(D3);etc. |
| <i>usability value</i>      | Touristic value(E1); Residential living(E2); Scientific research(E3),etc.             |

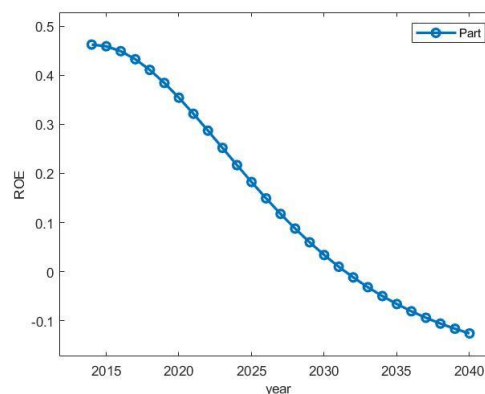
**Table 9: Weights of indicators**

| $v_i$ | $(w_i, p_i)$   | $\mu_i = w_i \cdot p_i$ | normalized weight |
|-------|----------------|-------------------------|-------------------|
| $v_1$ | (0.235, 0.216) | 0.05                    | 0.24              |
| $v_2$ | (0.246, 0.196) | 0.05                    | 0.24              |
| $v_3$ | (0.137, 0.2)   | 0.03                    | 0.14              |
| $v_4$ | (0.228, 0.198) | 0.05                    | 0.24              |
| $v_5$ | (0.154, 0.19)  | 0.03                    | 0.14              |

## 7.4 Mesa Verde National Park Value Assessment

- **Historical value:** Mesa Verde's National Park is famous for its oldest North American Indian historical sites, it was one of the first national parks in the United States to be opened based on archaeological values, and its famous attractions, such as the Jedi Palace and the Spruce Tree House, are listed as one of the world's top 12 places of interest by the United Nations Educational, Cultural and Scientific Organisation (UNESCO).
- **Scientific value:** The park provides a wealth of data for archaeological and natural science research, contributing to the understanding of the past and natural ecosystems.
- **Artistic value:** Although many old murals, handicrafts and other artefacts remain in the park, they are mostly damaged due to poor protection, limiting the artistic research value we can get from them.
- **Spatial layout value:** The remaining Indian architectural relics in the park are mainly wall palaces and spruce tree houses, whose unique geographical location reflects their rich layout value, such as resisting foreign invasion and facilitating religious rituals.
- **Use value:** After investigation and development, people can understand the history through the national park and promote the development of scientific research. Many tourists come here to explore the ancient Indian culture, which drives the development of tourism.

We applied the insurance model and came up with the results shown below:

**Figure 7: ROE trend chart for the park**

From the figure, we can see that due to the increase of extreme weather year after year, the yield of insurance companies to underwrite Mesa de for the national park is decreasing year after year, and without intervention, the park will not be eligible for underwriting.

We applied the ADP conservation model to Mesa Verde National Park to obtain the following scale:

**Table 10: Mesa Verde National Park Rating Scale**

|                | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | Total score |
|----------------|-------|-------|-------|-------|-------|-------------|
| raw score      | 88    | 85    | 75    | 90    | 82    |             |
| Weighted score | 21.12 | 20.4  | 10.5  | 21.6  | 11.48 | 85.1        |

From the table above, we multiplied and summed the specific scores for Mesa Verde National Park's values in terms of history, science, art, spatial layout, and use with the weights of the expert scoring metrics obtained from the conservation model to obtain Mesa Verde National Park's final conservativeness score: 85.1. It can be seen that Mesa Verde National Park embodies great conservativeness values under our conservation model, and therefore effective actions need to be taken to protect it.

In summary, we can see that although the cost input and benefit of protecting Mesa Verde National Park is not balanced at present, and there is a profit loss in the short term, in the long term, it will bring considerable benefits in the fields of economy, culture, science and art.

## 8. Protection Measures

### 8.1 Economy

- Call for government investment to improve the surrounding infrastructure and strengthen the protection of historical landmark buildings: this initiative helps to increase the funds for the construction of historical landmarks, and the infrastructure (e.g., power system, transport system, etc.) helps to meet the basic construction needs in the process of preserving historical landmarks.
- Increase the environmental protection tax: Taxing producers who cause environmental pollution during the production process and thus induce the occurrence of extreme weather, by artificially increasing their production costs, will encourage them to cut costs and reduce polluting production, thus indirectly protecting historic landmarks.
- Government subsidies for social actors involved in the construction and protection of historical landmarks: Provide appropriate subsidies to social actors involved in the protection and construction of historical landmarks (such as project contractors, insurance underwriters, etc.) to make up for the economic losses they incur due to their participation in the protection action, and to strengthen the motivation of the

social groups to protect historical landmarks.

## 8.2 Society

- Establishment of a conservation fund: by raising a conservation fund, when extreme weather occurs, we can use this measure to provide a timely and sufficient source of funds for the remediation of historic landmarks.
- Raise social awareness: Strengthen the publicity of historic landmarks to make the society aware of the value of historic landmarks to all mankind, so as to increase the public's acceptance of the conservation measures.

## 8.3 Ecology

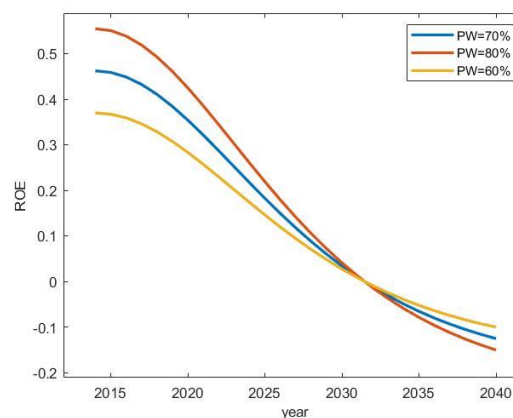
- Strengthening urban greening: helps to improve air quality within the city, reduce urban flooding, alleviate the heat island effect, and protect historical landmarks located within the city.
- Planting trees: helps to conserve water, protect soil and water, and reduce greenhouse gases. As we all know that global warming is the main cause of most extreme weather, and that extreme heat and drought usually cause natural disasters such as forest fires, we must alleviate this situation at the source in order to truly and effectively protect historic landmark buildings from standing in the nature.

## 9. Sensitivity Analysis

Our formula for calculating sensitivity is as follows:

$$\frac{\Delta t/t}{\Delta r/r} \rightarrow \frac{dt}{dr} \cdot \frac{r}{t} \quad (9)$$

We conducted a sensitivity analysis based on the above formula for the two indicators of willingness to insure and the change in the ratio of unit premiums to unit premiums over time, and obtained the following graph:



**Figure 8: Sensitivity analysis process**

We selected the point of ROE in 2024 and varying PW (taking values of

70%,80%,90% respectively), we found that the sensitivity is about 1.0 , i.e., a 1% increase in PW increases ROE by 1%. When the willingness to insure (PW) for Mesa Verde National Park is fixed at 70%, we vary the ratio of unit premium to unit premium at the point 2024 and find that the sensitivity is about 1.6 , i.e., a 1% increase in PW and a 1.6% increase in ROE. The standard evaluation table of sensitivity is shown in the following table:

**Table 11: Level of sensitivity**

| Sensitivity | Forecasting ability |
|-------------|---------------------|
| <10         | High ability        |
| 10-20       | Good ability        |
| 20-50       | Reasonable ability  |
| >50         | Weak ability        |

It can be seen that ROE does not change significantly with changes in willingness to underwrite and the ratio of unit premium to unit premium. In other words, the change of subjective choice coefficients in the model will not cause drastic changes in the model, and the unconsidered factors will not cause the changes of the existing factors, which indicates that our model has some robustness.

## 10. Strength and Weakness

### 10.1 Strength

- In the process of researching the sustainability of property insurance, all data is obtained from official national websites, ensuring the authenticity of the data. The sampling size for all quantities is also quite large, ensuring the comprehensiveness of the data.
- Our model results are consistent with common sense experience.
- We often utilize improved versions of classical models, such as AHP-Delphi-PCA, AHP-EWM, DuPont Analysis, etc., to overcome the inherent limitations of the initial models.

### 10.2 Weakness

- In the process of researching the sustainability of property insurance companies, for data such as initial operating capital that cannot be obtained through queries, we employ methods like approximation and estimation to handle them, resulting in a certain degree of deviation between the model results and the actual situation.
- In the study of the conservation value of historical surfaces, the provided score results are derived from both objective ratings from AI networks and subjective ratings from our own decision-making. Actual expert ratings may vary due to the background, knowledge, and personal perspectives of the experts, resulting in a certain degree of deviation between the model results and the real situation.

# A letter to the Community

From: ICM/Team number # 2406242

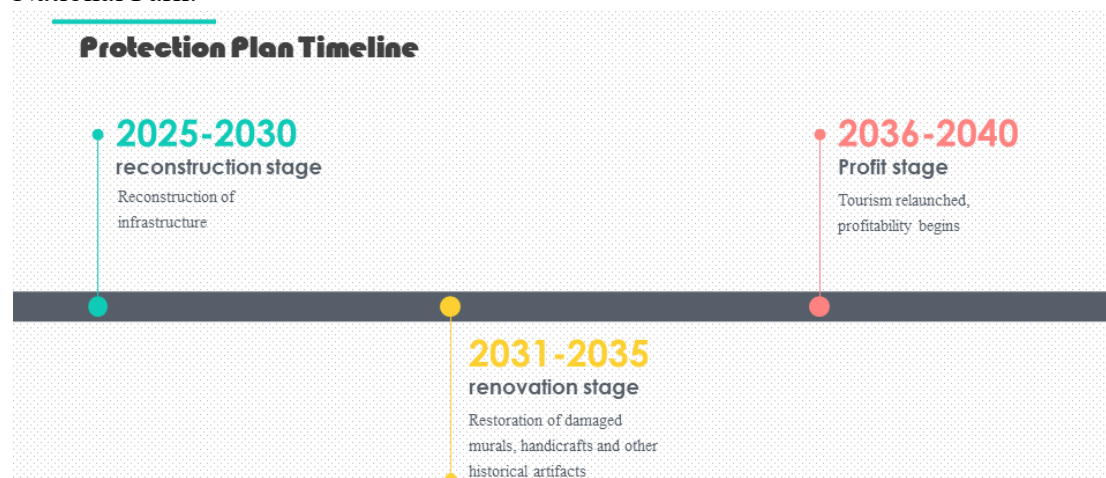
Date: Feb. 5th, 2024

To: the Community



## Dear Community Manager:

After analysing our data, we found that Mesa Verde National Park, although its underwriting yields are declining with the increasing incidence of extreme weather, still has considerable potential to be preserved due to its historical, artistic, and scientific values. Below is a timeline we created for the restoration process of Mesa Verde National Park.



As shown above, we have roughly divided the 15 years from today to 2040 into three phases:

- In the first phase, we plan to rebuild the infrastructural development in and around Mesa Verde National Park in order to be fully prepared for subsequent heritage restoration work and the relaunch of tourism. This is our main construction cost.
- In the second phase, after the infrastructure is rebuilt, we will have a sufficient material base to support the restoration of valuable murals, fine artefacts and other historical artefacts that have been damaged by extreme weather. This is our second cost item.
- In the third phase, after completing the first two phases of reconstruction and restoration, we will resume tourism and increase our promotional efforts so that tourism revenues will cover the up-front cost of the investment.

In summary, Mesa Verde National Park has the potential to be valuable, but requires an upfront cost investment. After our sound analysis, Mesa Verde National Park is well positioned to turn a profit after the successful completion of the three phases, and its historical, artistic, and scientific research values will peak after the second phase of restoration work is completed.

We hope you will consider our comments and look forward to hearing from you.



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# Report on Use of AI

OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query1:** How should insurance companies take risks?

**Output:** The understanding of the phrase "how should insurance companies take risks" in the sustainable development of the insurance industry can be analyzed from several dimensions:

## 1. Innovation & Risk Management

- **Innovation for sustainability:**

Insurers need to respond to changing market demands and environmental challenges with new products, services and technologies, such as emerging risks such as climate change and cybersecurity. These innovations come with their own risks, but in order to be sustainable in the long term, insurers must be willing to experiment and take risks.

- **Balance risk with opportunity:**

Insurers need to assess and manage risk when taking risks to ensure that they pursue innovation and growth without jeopardizing the company's stability and continuity. With accurate risk assessment models and risk management strategies, insurers can take risks and find new growth opportunities.

## 2. Invest in sustainable projects

- **Support green and social responsibility projects:**

By investing in sustainable projects, such as clean energy, environmental protection, and social enterprises, insurers can not only achieve financial returns, but also have a positive impact on society and the environment. This strategy is both risk-taking and socially responsible.

- **Drive sustainability transformation for your industry and your customers:**

By providing insurance solutions for sustainability projects, insurers can contribute to the green transformation of the entire industry and increase the resilience of society.

## 3. Courage in the face of uncertainty

- **Dealing with future uncertainties:**

The insurance industry is naturally an industry that deals with uncertainty. From climate change to new risks brought about by technological innovation, insurance companies need to maintain their own sustainability while also providing solutions for customers to face these uncertainties.

- **Continuous learning and adaptation:**

Insurance companies need to establish a learning organization that continuously learns and adapts, updates its risk assessment models and business strategies, to cope with rapidly changing environments.

# Conclusion

For the insurance industry, taking risks is not blindly pursuing risks, but rather daring to innovate and invest in sustainable development based on a deep understanding and management of risks. This strategy helps insurance companies not only achieve long-term sustainable development economically, but also have positive impacts on society and the environment.

## OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query2:** We want to simulate the profit model of an insurance company. We want to simulate a single insurance project and calculate underwriting profit based on five data: insurance price, number of people paying insurance, number of insurance claims, price of insurance claims, and total company assets. Can you provide relevant professional knowledge and formulas for the calculation process

**Output:** The profit model of insurance companies is usually based on three main components: premium income, compensation expenses, and investment income. For simulating the underwriting profit of a single insurance project, we can simplify it as premium income minus compensation expenses. The following are the relevant professional knowledge and formulas used in the calculation process:

1. **Premium Income:** Premium income is the fee collected by insurance companies from policyholders to bear potential risks in the future. The pricing of premiums usually takes into account factors such as potential payout probabilities, management expenses, and profit expectations.

The formula for calculating premium income is:

$$\text{premium income} = \text{insurance price} \times \text{number of people paying insurance}$$

2. **Compensation Expenses:** Compensation expenses refer to the total amount of compensation provided by an insurance company for insurance accidents that occur under the conditions specified in the insurance contract.

The formula for calculating payout expenses is:

$$\text{payout expenses} = \text{number of insurance payouts} \times \text{price of insurance payouts}$$

3. **Underwriting profit:** Underwriting profit refers to the balance of premium income minus compensation expenses and management expenses. Here, for simplicity, we will ignore the impact of management expenses and investment returns.

The formula for calculating underwriting profit is:

$$\text{underwriting profit} = \text{premium income} - \text{compensation expenses}$$

Assuming that the total assets of a company are used to describe its financial condition, rather than directly participating in the calculation of underwriting profits for a single insurance project, it has a greater impact on the company's capital adequacy ratio and investment ability.

To calculate the underwriting profit of a single insurance item, you need the following data:

- Insurance price (price of each insurance item)
- Number of people paying insurance (number of people purchasing insurance)
- Number of insurance payouts (number of insurance cases that need to be paid)
- Price of insurance payouts (amount of each payout)

Through these data, you can calculate premium income and compensation expenses, and then derive underwriting profits. If you have specific numerical values, I can help you with the calculation.

### OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query3:** What I mean is, can we express "the number of people paying insurance", "the number of insurance payouts", and "the price of insurance payouts" with the same professional meaning? These are just descriptive words for me as an amateur researcher

**Output:** I understand your needs now, let's use more standard insurance industry terminology to rephrase your parameters:

1. **Number of people paying insurance** can be used **Number of Insureds** or **Number of Covered Lives** to express. This reflects the total number of individuals or entities providing insurance coverage for them.
2. **The number of insurance claims** can be described by the **number of claims**. This refers to the number of compensation requests received by insurance companies within a certain period of time.
3. **The price of insurance compensation** can be expressed as **claim amount** or simply referred to as **claim amount**. This represents the average amount paid per claim or the payment amount for a specific claim.

Through this expression, we can transform your descriptive language into more standardized and professional terminology within the insurance industry:

- **Number of Insureds** represents the number of people purchasing insurance.
- **Number of Claims** reflects the number of insurance cases that require compensation.
- **Claim Amount** refers to the amount paid by the insurance company for each claim case.

Such professional terminology helps to facilitate accurate and standardized communication within the insurance industry and with other professionals.

### OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query4:** Please summarize it into a paragraph

**Output:** To ensure that real estate projects are more resilient and consciously serve growing communities and populations, developers need to conduct comprehensive market research and

demand analysis, carefully select project locations, and conduct environmental assessments. They also need to adopt sustainable and resilient architectural design principles, comply with relevant laws and regulations, and actively communicate with community members to integrate feedback. In addition, economic feasibility analysis and risk management are also key components to ensure project success. Through these strategies, real estate projects can meet market demand while having long-term positive impacts on the environment and community.

### OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query5:** How is the underwriting profit calculated

**Output:** Underwriting profit is the profit that an insurance company obtains from its insurance business, usually calculated by subtracting the compensation paid to the policyholder and the operating costs of the underwriting business from the premiums received. Specifically, the calculation method for underwriting profit is as follows:

$$\text{Underwriting profit} = \text{Total premium collected} - (\text{The total amount of compensation paid} + \text{Expenses and expenses related to underwriting})$$

Among them, the total premium received refers to all premium income collected by the company from the insurance contract within a certain period of time; The total amount of compensation paid refers to all compensation paid by the company to the insurance holder or beneficiary during the same period due to insurance accidents; The expenses and expenses related to underwriting include the costs incurred in evaluating risks, selling insurance products, managing insurance contracts, and handling claims. The underwriting profit reflects the profitability of the insurance company's core business, but it does not include other sources of income such as investment income. In addition to earning profits through underwriting activities, insurance companies can also earn investment returns by investing the premiums they receive in different financial markets, which are usually separately calculated in the company's total profit. Therefore, the total profit of an insurance company includes underwriting profit and investment income.

### OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query6:** How is the underwriting profit margin calculated

**Output:** The underwriting profit margin is the profit margin obtained by an insurance company in its underwriting activities, used to measure the efficiency of the profits obtained by the insurance company through its core business - underwriting insurance. The formula for calculating the underwriting profit margin is as follows:

$$\text{underwriting profit ratio} = \frac{\text{Insurance premium income} - \text{Compensation for losses} - \text{Underwriting fees}}{\text{Insurance premium income}} \times 100\%$$

- **Insurance premium income:** The total insurance premium received by an insurance company from an insurance contract within a certain period of time.

- **Compensation for losses:** The total amount of compensation paid by an insurance company during the same period due to insurance events.
- **Underwriting expenses:** Expenses incurred by insurance companies during the underwriting process, including sales expenses, management expenses, etc.

The underwriting profit margin is an important financial indicator that reflects the profitability of insurance companies in their underwriting business. A positive underwriting profit margin means that the insurance company has achieved profitability through its underwriting business, while a negative underwriting profit margin means that the insurance company has incurred losses in its underwriting business. In addition to earning profits through underwriting activities, insurance companies can also earn profits through investment income, but the underwriting profit margin mainly focuses on the performance of the underwriting business.

### OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query7:** Please use expert scoring methods from five perspectives: historical value, scientific value, artistic value, spatial layout value, and usage value, to give a percentage rating to historical landmarks such as Hawaii's cultural heritage, Bandriel National Monument in New Mexico, ancient rock carvings and cliff dwellings in nearby Santa Clara Pueblo, Monroe Fort, Charleston, and National Parks in Mesaway

**Output:** In order to rate historical landmarks such as Hawaii's cultural heritage, the Bandriel National Monument in New Mexico, the ancient rock carvings and cliff dwellings in Santa Clara Pueblo, and the national parks in Monroe, Charleston, and Mesaway, we can ask experts to give a percentage rating based on five perspectives: historical value, scientific value, artistic value, spatial layout value, and usage value. Here is an example rating:

#### 1. Hawaiian Cultural Heritage:

- Historical value:90
- Scientific value:70
- Artistic value:80
- Value of spatial layout:85
- Use value:75

#### 2. Bandelier National Monument, New Mexico:

- Historical value:95
- Scientific value:75
- Artistic value:85
- Value of spatial layout:90
- Use value:80

#### 3. The ancient rock carvings and cliff dwellings of Santa Clara Pueblo:

- Historical value:90
- Scientific value:80

- Artistic value:70
- Value of spatial layout:85
- Use value:60

#### 4. Monroe Castle:

- Historical value:85
- Scientific value:70
- Artistic value:75
- Value of spatial layout:80
- Use value:70

#### 5. Charleston:

- Historical value:92
- Scientific value:75
- Artistic value:80
- Value of spatial layout:88
- Use value:78

#### 6. The National Park of Mesawei:

- Historical value:88
- Scientific value:85
- Artistic value:75
- Value of spatial layout:90
- Use value:82

Please note that the above ratings are only examples, and actual expert ratings may vary depending on the expert's background, knowledge, and personal views. These ratings can be used to quantify the importance and value of these historical landmarks in different aspects, helping decision-making and protecting cultural heritage.

### OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4)

**Query8:** What are the perspectives from which to consider the effectiveness of site selection for homeowners in combating natural disasters? Provide a percentage rating for each angle.

**Output:** When homeowners choose a region to build houses or real estate projects, it is crucial to consider the effectiveness of the region in combating natural disasters. The following are some key factors considered from different perspectives, each of which can be measured using a percentage scale rating:

#### 1. **Geographical position:**

- Consider the geographical location of the region, including whether it is located in areas susceptible to natural disasters. The safer the geographical location, the higher the rating.
- Percentile rating: 85

#### 2. **Weather conditions:**

- Analyze the meteorological conditions of the region, including precipitation, wind speed, temperature, etc. Some meteorological conditions may increase the risk of natural disasters.
- Percentile rating: 75

### 3. **Soil and geological characteristics:**

- Consider the soil type and geological characteristics of the region, such as whether it is prone to earthquakes, mudslides, or soil erosion. Stable soil and geological characteristics can reduce risks.
- Percentile rating: 80

### 4. **Water resources management:**

- Understand the water resource management situation in the region, including flood management, drainage systems, and reservoir construction. Effective water resource management can reduce the risk of flooding.
- Percentile rating: 90

### 5. **Protective structures and infrastructure:**

- Inspect whether the area has sufficient protective structures and infrastructure, such as embankments, flood walls, storm drainage systems, etc., to mitigate the impact of disasters.
- Percentile rating: 85

### 6. **Historical disaster records:**

- Analyze the historical natural disaster records of the region, including earthquakes, floods, hurricanes, fires, etc. Frequent natural disasters in history may indicate higher risks.
- Percentile rating: 70

### 7. **Emergency response and planning:**

- Assess the emergency response capability and planning of the region, including whether there is a sound emergency warning system, emergency evacuation plan, and building regulations.
- Percentile rating: 80

### 8. **Insurance coverage:**

- Understand the insurance coverage in the region, including whether it is easy to obtain property insurance and natural disaster insurance. Good insurance coverage can provide certain risk mitigation.
- Percentile rating: 75

The above ratings are only examples, and actual evaluation needs to consider these factors comprehensively, and may involve more specific indicators and data. The rating can vary depending on the specific situation and available information of the region. It is important to comprehensively consider various factors to evaluate the effectiveness of the region in combating natural disasters, in order to make wise choices.