

The survival of the property insurance industry is at risk due to forecasts of increased frequency and severity of catastrophic events [1]. Individual insurers are particularly vulnerable to insolvency as they struggle to balance the distribution of future loss liabilities between their customers and their capital reserves [5]. This challenge is exacerbated by the inherent unpredictability of extreme weather conditions [5], making the rising threat from weather-related phenomena to property insurance a complex issue that demands a comprehensive approach.

In this paper, we present a detailed proposal aimed at ensuring the sustainability of the property insurance sector through the development of innovative models. We validate the applicability of our insurance model by applying it to properties across two different continents, showcasing its wide range of effectiveness. Furthermore, we have created a preservation model designed to work in conjunction with our insurance model, ensuring that the continued viability of the property insurance industry does not come at the cost of cultural heritage preservation.

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1 Insurance Model

1.1 Model

The R code for our insurance model can be found in Appendix A. Our proposed solution to sustain the expense of projected increases in weather-related damages is fourfold: First, we tentatively propose that the estimated 60% increase in premiums required to offset said damages between now and 2040 be gradually accounted for by an annual growth rate of 3.75% (plus adjustments for inflation) [1]. Second, we propose the standardization of property policies to stratify coverage by catastrophe as a distinct add on with a claim limit commensurate with the probability used to calculate the premium [5]. This would regulate the maximum loss on behalf of the provider in the case of underestimated catastrophic loss regarding a particular geographic area. Third, we propose bundling which includes protection against multiple events for the given area to diversify sources of funding for centralized events. Finally, we propose that entities disperse property insurance provisions over extensive geographical areas such that the concentration of loss from distinct disasters is mitigated by the dissipation of collective risk per company [5].

1.2 Process

For our model, we began with the National Risk Index (NRI) data set from the Federal Emergency Management Agency (FEMA) and adapted it according to projected increases in weather-related damages [7]. To determine premium costs and claim limit, we multiplied EAL per census tract by 1.6 to accommodate for the estimated 60% increase in damages associated with natural disasters between now and 2040 [1]. We then applied a multiplier of 1.583 to account for standard industry markup (derived by dividing the provided statistic of a 35% remainder after paying out losses by the losses themselves) [9]. This was necessary, as industry markups are largely inaccessible [5]. To determine an individual policy holder's premium, we divided the value of the prospective property by the exposure total for their respective natural disaster coverage(s) desired according to the corresponding census tract, then multiplied by the decimal value by the annual premium value for that tract.

1.3 Assumptions and Limitations

Notably, our model does not operate as a decision-making system regarding whether or not to insure, but rather the cost required to do so. This effectively transfers the decision binary to customers according to willingness to assume the cost of protection. We assume that the proposed adaptations, such as claim limit adjustments and risk dissipation through geographical diversification and crowdfunded bundling, will protect the insurance industry against mass insolvency and potential customers against exorbitant premiums. We also presume that a constant multiplier across all forms of catastrophe will adequately account for the ambiguity of how and where evolving weather-related damages will manifest, as well as that increases will not surpass the high end of the predicted range, previously stated to be 60% [1]. We imagine that this restructuring will incentivize both relocation to lower risk areas as well as investments in durability among property owners, which will be reflected by a decrease in our model's calculation of EAL and, by extension, premiums. Our model also hinges on several logical assumptions regarding the data from which it was derived as well as the scale to which we hope to generalize our calculations. We rely on the assumption that geographical diversification among

coverage providers is key to developing resistance to the localization of mass destruction-inducing events and, therefore, central to the longevity of the property insurance industry. Fundamentally, we assume the relative homogeneity of elemental conditions, and thus accordant risk probabilities, within geographical regions delimited by census tracts. Tangentially, we presume that partitioning regions according to census zones reasonably accounts for variability in population density. Furthermore, since our model is based on U.S. data, its international applicability may be limited. Should our model prove successful nationally, engaging representatives from other countries or continents will be essential. These representatives would need to assess how our model's underlying logic fits within their own economic and cultural contexts and advise on necessary logistical modifications to ensure the model's effectiveness in their respective regions.

1.4 Reflection

In acknowledgment of our team's personal limitations, we felt it would be irresponsible to claim the development of an insurance model with broad international applicability. We thus decided to develop a model based on our nation's data, with the hopes that the logical structure could potentially be adapted by the proper representatives of given areas. Considering the time frame of our project in combination with the complexity of variables including but not limited to equivocal funds of the constituent insurance providers, kinds and probabilities of various catastrophic events by area, and property concentration, durability and cost distributions, we selected to isolate the variables of census tract and Expected Annual Loss (EAL), accounting for the probability and associated cost of damage per given region [6]. Reverse analysis allowed us to approximate rates for premiums across the United States by census tract. We used a joint multiplier to account for industry-standard markup and predicted increases in weather-related damages, yielding a calculation representative of the annual cost to insure all properties within a given zone.

1.5 Application

1.5.1 Cullowhee, North Carolina, USA

The model covers every census tract in the United States, determining the annual premium shared amongst the policy holders in the region. For the first application of our model, we used the city of Cullowhee, North Carolina. From there, we used a listing for a house in Cullowhee of \$550,000 [11]. The value of the building determined the percentage of total exposure value of buildings in the area, then multiplied that by the annual premium for the region. This determines what proportion of the region's EAL is attributed to this building. This process calculated a premium \$203.76 annually for riverine flood insurance. We then repeated the process for hurricane and hail coverage to implement our approach of bundling natural disaster insurance, reaching a total annual price of \$327.05. This is the premium to insure a \$550,000 house in the census tract 950600 in North Carolina.

1.5.2 Japan

To apply the model on another continent proved challenging due to lack of transparency in EAL to buildings from natural disasters. We used the Japan Statistical Yearbook of 2024 to look at the cost of loss to buildings in Japan from 2012 - 2021 [13]. These numbers were used to create an average

annual loss variable, which we applied as we used EAL in the original model, generating the annual premium value for the entire region of Japan with a plan that covers typhoons (hurricanes), heavy rain, and earthquakes. We chose this bundle of natural disasters because of their frequency in Japan and because the data for building damage amounts came from these natural disasters. The annual premium for the entirety of Japan would be ¥1,803,103,000,000. To convert this to the price for a single policy holder, we would need to divide the dollar amount of the property they would like to cover by the total dollar value of buildings exposed to these natural disasters in Japan, and multiply that number by the annual premium.

1.5.3 Tahlequah, Oklahoma, USA

When applying the model to a cultural landmark, the Cherokee National History Museum, we looked at what the NRI said would be the most destructive to the area [8]. We decided to use tornadoes, wildfires, and strong wind events. We calculated the costs of the individual policies based on the price of the building. For this metric, we used the cost of a building rated for commercial use on the same street with similar square footage to the museum. We then added the costs of these policies together to determine a \$63,639.83 annual premium for the museum's natural disaster coverage.

2 Preservation Model

2.1 Model

The Python code for our preservation model can be found in Appendix B. Our preservation model is an intuitive Python-based decision-tree designed to integrate aspects of objectivity and practicality into a model that ultimately honors the authority of the community it serves (e.g., asking “Is the prospective insurance affordable for the current stakeholders?” rather than “Does this insurance exceed X amount?”).

2.2 Process

We endeavored to incorporate considerations that are sensitive to the values of non-dominant cultures. Additionally, we designed metrics that would prioritize elements of cultural value likely to be overlooked by metrics used by our insurance model. Our specific goal was to creatively implement mechanisms for appraising properties in terms of their cultural, historical, economic, and/or community value.

2.3 Assumptions and Limitations

The design of our preservation model is built around binary yes/no responses for the sake of simplicity. However, applications in the real world will almost certainly necessitate more sophisticated handling of inputs. This includes validating a broader spectrum of responses and managing exceptions related to user input. Similar to our insurance model, the global applicability of this model may face constraints. Additionally, cultural and linguistic differences present significant limitations. The notion of employing a unified model to facilitate decision-making across diverse cultural contexts might not be advisable.

2.4 Reflection

In contrast to our insurance model, our preservation model does not employ calculated metrics. However, we deliberately chose this structure to recognize and address the potential rise in cultural insensitivity that often accompanies the use of such metrics.

2.5 Application

2.5.1 Tahlequah, Oklahoma, USA

To evaluate our model’s ability to assess cultural value, we selected a landmark of profound cultural value in a high-risk area. Given our personal connection to the Cherokee Nation, we specifically sought a property rooted in the indigenous identity. Utilizing the FEMA NRI, we pinpointed a location within the Cherokee Nation in Tahlequah, Oklahoma, that met our criteria perfectly. This site holds significance as the destination of forced relocation of the Cherokee people from the southeastern United States, a tragic event that led to the deaths of more than 100,000 indigenous people due to disease, starvation, and exposure [2]. For the particular location we selected the Cherokee National History Museum. This museum is in the original Cherokee National Capitol in downtown Tahlequah. It’s purpose is to share Cherokee narrative through a combination of exhibits and experiences [3]. This

museum entails 7,000 square-feet of timeless art and tribal heritage which helps viewers dive into the past. The artwork and artifacts displayed, some of which are on loan from institutions such as the Smithsonian, Gilcrease Museum, Oklahoma Historical Society, and Cherokee National Archives, describe and portray the history of the Cherokee and bring light to the horrors that have occurred in the past few centuries. To evaluate our model's ability to gauge cultural value, we chose a landmark of profound cultural importance located in a high-risk area, which our insurance model typically deems an unfavorable investment. Given our connection to the Cherokee Nation, we aimed to identify a property deeply rooted in the indigenous identity and culture of the region. Utilizing the FEMA NRI, we pinpointed a location within the Cherokee Nation in Tahlequah, Oklahoma, that met our criteria perfectly. This site holds significance as the terminus of the forced relocation of the Cherokee people from the southeastern United States, a tragic event that led to the deaths of many indigenous people due to disease, starvation, and exposure. Our focus settled on the Cherokee National History Museum, situated in the refurbished Cherokee National Capitol in downtown Tahlequah. This museum, with its 7,000 square feet of space, leverages immersive exhibits and augmented reality to narrate the Cherokee saga, making it an ideal candidate for our model's application. It showcases a rich collection of art and artifacts that illuminate the Cherokee history and the adversities they faced over the past centuries. The preservation and education of this history are crucial for ensuring that the legacy of the Cherokee people endures. The property, valued at approximately five million dollars, is located in an area vulnerable to strong winds, tornadoes, and wildfires[2] [8]. Based on our insurance model, the annual insurance premium for the museum was calculated to be \$63,639.83, excluding the contents within the building. However, our preservation model suggested an innovative approach to mitigate the high costs associated with safeguarding such an invaluable cultural asset 1. This approach involves enhancing the property's resilience through the addition of a basement, designed to protect the artifacts from natural disasters. The estimated cost for this renovation is about \$75,000—a figure slightly above the annual insurance premium but a worthwhile investment for the long-term preservation of the museum's cultural treasures. By proposing this renovation, we aim to not only protect the physical manifestations of Cherokee heritage but also to offer a sustainable solution to the challenges posed by the property's location. This initiative underscores our commitment to preserving cultural landmarks against the backdrop of environmental and financial risks.

```
PS C:\Users\charb> & C:/Users/charb/AppData/Local/Microsoft/WindowsApps/python3.11.exe c:/Users/charb/Desktop/Preservation_Model.py
Decision Tree for Property Insurance and Preservation
Is this property insurable in its current state? (yes/no): yes
Is this insurance affordable for the stakeholders? (yes/no): no
Is the significance of the property due to the contents of the property rather than the structure itself? (yes/no): yes
Are the measures necessary to safeguard the contents affordable for the stakeholders? (yes/no): yes
Fund improvements.
PS C:\Users\charb> 
```

Figure 1: Preservation Model Output for Cherokee National History Museum

3 Landmark Preservation Letter to Cherokee County, Oklahoma

Dear Community of Cherokee County, Oklahoma,

I am reaching out in regards to your Cherokee National History Museum. I have been looking into different Indigenous Reservations around the country and the cultural significance they hold. This is something I am passionate about because of my family history in the Penobscot Tribe of Maine. I have developed a deep interest in the preservation of your museum as you continue to teach history and continue the culture.

After looking into the opportunities and activities offered at the Cherokee National History Museum, I checked the FEMA National Risk Index to see where Cherokee County falls on the Risk Index for natural disasters. The largest concerns with this area appear to be strong wind, tornadoes, and wildfires [8]. Due to the location of Cherokee County, the threat of strong wind and tornadoes can be severe, causing damage that is expensive to repair. With the museum's collection of artifacts, storm damage can be detrimental to keeping the culturally significant items safe, especially since museum insurance policies do not cover objects within buildings [14].

The perseverance of the Cherokee people is inspiring and the artwork, personal adornments, and tools kept within the museum deserve a safe location. With this in mind, I propose a plan to create an underground exhibit where the most important artifacts can be relocated to minimize damage, also offering a safe place for visitors and employees to shelter in case of emergency. I would like for this project to be completed before next year because of the increasing amount of extreme weather as a result of climate change. Before starting any construction, the planning phase must start. Hiring a contractor to gather measurements and compile a team to start the process should only take a few weeks, assuming they have availability. From there, working with the team to create a reasonable timeline will help predict a goal deadline. Building a basement can take anywhere from four months to a year. I personally think that this project should be complete before May 2025, known as the start of tornado season.

While this is a big ask, and will cost about \$75,000, the benefits of protecting historical artifacts greatly outweigh the expenses. The total expenses of adding a finished basement for the Cherokee National History Museum covers the excavation, foundation, labor, and materials cost. Building the foundation creates concrete slabs, piers, beams, crawl space, and basement costs ranging from \$5-\$33 per square foot of material. The material and labor cost of pouring concrete respectfully is \$3.81 and \$2.60 per square foot. Contractors charge \$100 per hour on average with additional delivery fees. In terms of excavation, it takes between \$2.50 to \$15.00 per cubic yard to clear room for the foundation[10]. Keeping in mind that a basement can take around six months to build, \$75,000 is not an abnormal price.

Based on similar sized buildings in the area, an estimated policy to bundle tornado, wildfire, and strong wind protection would be \$63,639.83 annually based on projected insurance models to respond to increases in national disasters worldwide. Since this only covers the building, building a safe space for precious artifacts will essentially pay for itself in the next few years since it is only the cost of 1.18 years of insurance.

Thank you for your consideration and I hope you heed this warning to save such a treasured landmark.

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A Insurance Model RScript

```
library(readr)
NRICens <- read_csv("C:/Users/camry/Desktop/COMAP/
  NRI_Table_CensusTracts/NRI_Table_CensusTracts.csv")
library(tidyverse)

df <- NRICens |> select(
  STATE, TRACT, ends_with("EVNTS"), ends_with("EXPB"), ends_with("
    EALB"))
View(df)

variable.names(df)

df <- df |> select(order(colnames(df)))
View(df)

df <- df |> relocate(STATE, .before = AVLN_EALB) |> relocate(TRACT,
  .before = AVLN_EALB)
View(df)

df[is.na.data.frame(df)] <- 0

View(df)

# calculate annual premium for that census tract and
# the claim limit

prem_values_and_lim_tot <- df |>
  mutate(
    State = STATE,
    Census_Tract = TRACT,
    Avalanche_ExposureTotal = AVLN_EXPB,
    Avalanche_AnnualPrem = (AVLN_EALB*1.6*1.583),
    Avalanche_ClaimLimit = (AVLN_EVNTS*1.6),
    CoastalFlooding_ExposureTotal = CFLD_EXPB,
    CoastalFlooding_AnnualPrem = (CFLD_EALB*1.6*1.583),
    CoastalFlooding_ClaimLimit = (CFLD_EVNTS*1.6),
    ColdWave_ExposureTotal = CWAV_EXPB,
    ColdWave_AnnualPrem = (CWAV_EALB*1.6*1.583),
    ColdWave_ClaimLimit = (CWAV_EVNTS*1.6),
    Earthquake_ExposureTotal = ERQK_EXPB,
    Earthquake_AnnualPrem = (ERQK_EALB*1.6*1.583),
    Earthquake_ClaimLimit = (ERQK_EVNTS*1.6),
```

```

Hail_ExposureTotal = HAIL_EXPB,
Hail_AnnualPrem = (HAIL_EALB*1.6*1.583),
Hail_ClaimLimit = (HAIL_EVNTS*1.6),
Hurricane_ExposureTotal = HRCN_EXPB,
Hurricane_AnnualPrem = (HRCN_EALB*1.6*1.583),
Hurricane_ClaimLimit = (HRCN_EVNTS*1.6),
HeatWave_ExposureTotal = HWAV_EXPB,
HeatWave_AnnualPrem = (HWAV_EALB*1.6*1.583),
HeatWave_ClaimLimit = (HWAV_EVNTS*1.6),
IceStorm_ExposureTotal = ISTM_EXPB,
IceStorm_AnnualPrem = (ISTM_EALB*1.6*1.583),
IceStorm_ClaimLimit = (ISTM_EVNTS*1.6),
Landslide_ExposureTotal = LNDS_EXPB,
Landslide_AnnualPrem = (LNDS_EALB*1.6*1.583),
Landslide_ClaimLimit = (LNDS_EVNTS*1.6),
Lightning_ExposureTotal = LTNG_EXPB,
Lightning_AnnualPrem = (LTNG_EALB*1.6*1.583),
Lightning_ClaimLimit = (LTNG_EVNTS*1.6),
RiverineFlooding_ExposureTotal = RFLD_EXPB,
RiverineFlooding_AnnualPrem = (RFLD_EALB*1.6*1.583),
RiverineFlooding_ClaimLimit = (RFLD_EVNTS*1.6),
StrongWind_ExposureTotal = SWND_EXPB,
StrongWind_AnnualPrem = (SWND_EALB*1.6*1.583),
StrongWind_ClaimLimit = (SWND_EVNTS*1.6),
Tornado_ExposureTotal = TRND_EXPB,
Tornado_AnnualPrem = (TRND_EALB*1.6*1.583),
Tornado_ClaimLimit = (TRND_EVNTS*1.6),
Tsunami_ExposureTotal = TSUN_EXPB,
Tsunami_AnnualPrem = (TSUN_EALB*1.6*1.583),
Tsunami_ClaimLimit = (TSUN_EVNTS*1.6),
Volcano_ExposureTotal = VLCN_EXPB,
Volcano_AnnualPrem = (VLCN_EALB*1.6*1.583),
Volcano_ClaimLimit = (VLCN_EVNTS*1.6),
Wildfire_ExposureTotal = WFIR_EXPB,
Wildfire_AnnualPrem = (WFIR_EALB*1.6*1.583),
Wildfire_ClaimLimit = (WFIR_EVNTS*1.6),
WinterWeather_ExposureTotal = WNTW_EXPB,
WinterWeather_AnnualPrem = (WNTW_EALB*1.6*1.583),
WinterWeather_ClaimLimit = (WNTW_EVNTS*1.6)
)

```

- # Take total estimated annual loss , multiply by 1.6 to accommodate for
- # 60% increase in natural disasters between now and 2040
- # So practically speaking this will be a 3.75% increase in the

```
    premium every year ,
# and in 2040 (as this model shows) it will a 1.6 (60% increase)
# leading to a 60% increase
# 35% of a total premium is typical markup with only 65% of typical
    premiums
# going towards paying off the losses , so  $35/60 = .583$  so a 1.583
    multiplier
# to account for the markup on the premium since we only have the
    data for loss
# Take number of expected events , multiply by 1.6 to decide limited
    number of
# claims because we can only cover what is included in the premium
    costs

prem_values_and_lim <- prem_values_and_lim_tot |>
  select(STATE,TRACT,ends_with("ClaimLimit"),ends_with("AnnualPrem
    "),ends_with("ExposureTotal"))

# make new dataframe with variables for state , tract , and the claim
    limits
# and annual premium for each kind of event

prem_values_and_lim <- prem_values_and_lim |>
  select(order(colnames(prem_values_and_lim)))
prem_values_and_lim <- prem_values_and_lim |>
  relocate(STATE, .before=Avalanche_AnnualPrem) |> relocate(TRACT,
    .before=Avalanche_AnnualPrem)
# reordering columns in a way that make sense
View(prem_values_and_lim)

# To determine an individual policy holder's premium, determine
    which
# census tract they live in, the plan they would like to purchase
# (earthquake, coastal flooding, etc) and the value they would like
    to insure
# (for example, a house of $550,000). Divide the value of what they
    would like
# to insure by the Exposure Total for that natural disaster in that
    tract
# and multiply that decimal value by the annual premium value for
    that tract
# The Claim Limit is the number of claims they can make per year

#extracting the information for the state (NC) and tract(950600)
```

```

    with Cullowhee, NC in it
    cullowhee <- prem_values_and_lim |>
    filter(STATE %in% "North Carolina") |> filter(TRACT %in% 950600)
    View(cullowhee)

# The following shows the steps of insuring a $550,000 house in
  Cullowhee for Riverine Flooding
CullRFExp <- 80293825 # Total Exposure value for Riverine Flooding
  in this tract
CullIns_Building <- 550000 # The value of a house in Cullowhee on
  Zillow
# https://www.zillow.com/homedetails/3297-Caney-Fork-Rd-Cullowhee-
  NC-28723/84703673_zpid/
mult <- CullIns_Building/CullRFExp; mult # 0.006849842
CullRFPrem <- 34880.22 # the premium for Riverine Flooding in this
  tract
CullRFPolicy <- mult*CullRFPrem; CullRFPolicy # = $238.924 annually
  to insure
# against Riverine Flooding in Cullowhee, NC

# To bundle with 2 other policies:

CullHExp <- 1841251760
CullHPrem <- 167609.6
CullHailPolicy <- (CullIns_Building/CullHExp)*CullHPrem

CullHurrExp <- 1841251760
CullHurrPrem <- 127404
CullHurrPolicy <- (CullIns_Building/CullHurrExp)*CullHurrPrem

Cullowhee_Bundle <- CullRFPolicy + CullHailPolicy +
  CullHurrPolicy; Cullowhee_Bundle
# It costs $327.0475 annually to insure a $550000 house in
# Cullowhee, NC against Hail, Hurricanes, and Riverine Flooding

JPannualdmg <-
  c(397221,365918,392312,280968,1755316,
    599422,1171860,1241738,708068,414480)
# annual damage from typhoons (hurricanes), heavy rain, and
  earthquakes

JPavg <- (sum(JPannualdmg))/10; avg # = 732730.3 per year

EALYJP <- JPavg; EALYJP # Est. Annual Loss in Millions of Yen
AnnualPremJP <- EALYJP*1.6*1.538; AnnualPremJP # 1803103 in

```

Millions of Yen

```
# Calculate Average Annual Loss in Japan based on losses from
# natural disasters
# from years 2012–2021 to find estimated annual losses from natural
# disasters
#(typhoons/hurricanes, heavy rain, and earthquakes) to apply to the
# model
# This value is the annual premium for the entirety of Japan for a
# plan
# that covers typhoons (hurricanes), heavy rain, and earthquakes
# To convert this to the price for a single policy holder, we would
# need data
# on the total dollar value of buildings exposed these natural
# disasters to
# determine a multiplier to insure an individual policy holder
```

```
# Landmark: Cherokee National History Museum
```

```
landmark <- prem_values_and_lim |>
  filter(STATE %in% "Oklahoma") |> filter(TRACT %in% 978000)
View(landmark)
```

```
# Top 3 concerns (bundled policies) are Tornado, Strong Wind, and
# Wildfire
```

```
landmark_policies <- landmark |>
  select(starts_with("Tornado"), starts_with("Wildfire"), starts_with
    ("StrongWind"))
```

```
View(landmark_policies)
```

```
TExp <- 776916920; TExp
TPrem <- 107642.6; TPrem
WFPrem <- 1195013; WFPrem
WFEExp <- 98114715; WFEExp
SWPrem <- 50946.79; SWPrem
SWEExp <- 776916920; SWEExp
```

```
lm_cost <- 5138925 # cost of a building rated for commercial use
# on the same street with similar square footage
# https://www.loopnet.com/Listing/1501-S-Muskogee-Ave-Tahlequah-OK
# /29724351/
Tornado_Policy <- (lm_cost/TExp)*TPrem; Tornado_Policy
WildFire_Policy <- (lm_cost/WFEExp)*WFPrem; WildFire_Policy
```

```
StrongWind_Policy <- (lm_cost/SWExp)*SWPrem; StrongWind_Policy
bundle_policy <- Tornado_Policy + WildFire_Policy +
  StrongWind_Policy; bundle_policy
# total cost: $63639.83

# Create a dataframe with the three policies to apply to the
  landmark we chose:
# Tornado, Wildfire, and Strong Winds
# Calculate the cost of those individual policies based on the
  price of the
# building using the cost of a building rated for commercial use
# on the same street with similar square footage
# Add the cost of those policies together to determine the overall
  annual cost
# of the bundled natural disaster insurance coverage
```

B Preservation Model Python Code

```
def ask_question(question):
    """Utility function to ask yes/no questions and return True/
    False."""
    answer = input(question + " (yes/no): ").strip().lower()
    while answer not in ('yes', 'no'):
        print("Please answer with 'yes' or 'no'.")
        answer = input(question + " (yes/no): ").strip().lower()
    return answer == 'yes'

def question_5():
    if ask_question("Is the expected longevity of this property
    independent of catastrophic events significant?"):
        print("Consider taking as extensive of measures as is
        realistic to protect this property.")
    else:
        print("Take limited measures as is reasonable to preserve
        this property.")

def question_4a_4b():
    if ask_question("Is this one of limited relics of cultural,
    historical, economic or community significance?") or \
    ask_question("Is this area one of limited representations of
    your culture, history, economy, or community?"):
        question_5()
    else:
        print("Take limited measures as is reasonable to preserve
        this property.")

def question_3b():
    if ask_question("Are there improvements that could be
    reasonably made that would render the insurance affordable
    for the stakeholders?"):
        print("Fund improvements.")
    else:
        question_4a_4b()

def question_3a():
    if ask_question("Are the measures necessary to safeguard the
    contents affordable for the stakeholders?"):
        print("Fund improvements.")
    else:
```



```
        question_4a_4b()

def question_2b():
    if ask_question("Is the significance of the property due to the
        contents of the property rather than the structure itself
        ?"):
        question_3a()
    else:
        question_3b()

def question_2a():
    if ask_question("Is this insurance affordable for the
        stakeholders?"):
        print("Fund the insurance.")
    else:
        question_2b()

def preservation_model():
    print("Decision Tree for Property Insurance and Preservation")
    if ask_question("Is this property insurable in its current
        state?"):
        question_2a()
    else:
        question_2b()

if __name__ == "__main__":
    preservation_model()
```

C AI Use Report

OpenAI *ChatGPT* (Feb 1st, 2024 version, ChatGPT-3.5)

Query1: Tell us math jokes that will swoon the “Consortium for Mathematics and its Applications” judges.

Output: To charm the Consortium for Mathematics and its Applications judges and secure that money, you’ll need a mix of clever, insightful, and perhaps slightly nerdy math jokes. Here are a few that might just do the trick:

The Calculus Date: Why don’t calculus majors throw house parties? Because you should never drink and derive.

The Romantic Function: Why did the two functions stop talking? Because they had too many arguments.

The Algebraic Promise: A group of algebraic structures promised to stop arguing about their differences. They realized it was time to put an end to the pointless group theory.

The Mathematician’s Dilemma: Why was the equal sign so humble? Because it realized it wasn’t less than or greater than anyone else.

Geometry in Real Life: Why did the circle break up with the triangle? Because the triangle was too edgy, and the circle thought their relationship had no point.

The Probability Query: A statistician can have his head in an oven and his feet in ice, and he will say that on the average he feels fine.

The Mathematician’s Diet: Why do mathematicians like parks? Because of all the natural logs.

The Infinite Problem: Why don’t mathematicians argue about infinity? Because it’s a topic with no end in sight.

The Mathematician’s Love Life: Why did the mathematician break up with the calculator? Because he caught it calculating with someone else.

The Topologist’s Marriage: Why did the topologist’s marriage fail? Because he thought arbitrary unions were open to everyone.

The Pi Compliment: You must be the square root of -1, because you can’t be real.

The Prime Concern: Why was six afraid of seven? Because seven eight (ate) nine, but why did seven eat nine? Because you’re supposed to eat 3^2 meals a day!

The Mathematician's Serenade: Are you a 90-degree angle? Because you're looking right.

The Existential Math Crisis: A number theorist found a large prime number, but when he tried to show it off, it was gone. He then realized, it was just a prime example of his imagination.

The Logical Love: Why do mathematicians rarely find love? Because they always look for X without asking Y.

Leveraging humor can be a brilliant way to engage and persuade, especially when it reflects a deep appreciation for the subject. Hopefully, these jokes tickle the mathematic sensibilities of the Consortium for Mathematics and its Applications judges just right!