**Analyzing the Impact of Climate Risk in House Prices**

Jahnavi Maddhuri

Xiangyu Wang

Zihan Xiao

Atreya Tadepalli

Written for: IDS 789 (Fundamentals of Finance Business Models)

Fall 2024

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# Abstract

### [To be filled in with results]

# Introduction

## Background

### Mainly driven by hurricanes in the Gulf of Mexico and wildfires in California, the increasingly frequent and catastrophic pattern of natural disasters in the United States has prompted a renewed quantitative focus on appropriately pricing in such disaster risk on property insurance premiums. Indeed, from 2018-2022, the United States experienced 89 natural disasters causing over USD 1 billion in damage, adjusted for inflation, compared to just 55 such incidents from 1990 to 1999, a timespan twice as long.[[1]](#footnote-2) Additionally, this trend seems likely to only persist: McKinsey estimates that while climate-related risk only affects two percent of world GDP today, it stands to double in impact in the next thirty years.[[2]](#footnote-3) Given this surge in the occurrence of natural disasters, property insurers have sought to rapidly advance climate-change related modeling and appropriately price in climate risks when assessing reinsurance rates and premiums. Figure 1 below shows the recent spike in homeowner insurance premiums, primarily driven by the additional money necessary for insurers to cover expected damages from natural disasters without incurring losses.[[3]](#footnote-4) Over the last three years, homeowners experienced a rise in home insurance premiums by 33% on average over the last three years across the United States. In some areas such as California, insurers have gone one step further and have canceled property insurance policies due to the inability to cover such houses without expecting to incur a loss.[[4]](#footnote-5)

### Furthermore, the impact stemming from the surge in natural disasters is not isolated to the insurance markets.[[5]](#footnote-6) The acute focus on climate resilience now finds itself in every industry as a major factor governing investment value, from civil engineering to technology to energy. In this paper, we choose to continue examining its effects on the housing industry, and specifically explore how climate-related risks could potentially transcend insurance rates and impact house values as well. Does the surging risk of floods, wildfires, hurricanes, and other natural disasters have a statistically significant impact on house prices, or is this risk primarily captured solely in the property insurance rates?

**Figure 1: Time Series of Nominal Average Homeowners Insurance Premiums**

A line graph with numbers and a line

Description automatically generated

Source: Keys, B., & Mulder, P. (2024). “Property Insurance and Disaster Risk: New Evidence from Mortgage Escrow Data.”

## Model Proposal and Hypotheses

### In this report, our goal is to create an efficient and interpretable model that can accurately predict the average house price in a given county, using the characteristics of the county as predictor terms. It is our hypothesis that by incorporating climate-related factors associated with the county, the accuracy of prediction stands to significantly increase. This would indicate that house prices are indeed sensitive to the climate risks native to the region in which the houses are situated.

### To test the significance of climate factors, we propose to develop two separate models: one including quantified climate indices for each county, and one excluding these metrics. We will then evaluate the difference in model performance to identify the impact of incorporating climate-related factors when predicting house prices. We propose to test multiple types of models, including generalized linear models, generalized additive models, and linear regression models, to observe which type best predicts house prices. To assess model performance and fine-tune our models, we utilize metrics such as accuracy, precision, recall, and F-1 score.

# Methodology

## Data Selection

### To quantify and understand the area-specific climate risks impacting house value, we decided to collect data on a county basis. This would ensure variability of climate conditions between different geographic areas while retaining a large lens for which data, especially government data, was readily available and accessible.

## Cleaning and Preprocessing

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## Model Preparation

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# Results

## Without

### I

**Table 2: Model Metrics Comparison**

**Figure 2: Comparison of Confusion Matrices**

## With Climate Factors

[=

**Figure 3: Confusion Matrices**

## Model Types

### A

**Table 4: Model Metrics Comparison**

**Figure 4: Confusion Matrices for**

# Conclusion

## Takeaways

### Using

## Possible Overfitting of Training Data

1. “2022 U.S. Billion-dollar Weather and Climate Disasters in Historical Context”, *Beyond the Data*, National Oceanic and Atmosphere Administration, 10 January 2023. [↑](#footnote-ref-2)
2. Antonio Grimaldi and Kia Javanmardian, “Climate Change and P&C Insurance: The Threat and Opportunity”, *McKinsey and Company Insights*, 19 November 2020. [↑](#footnote-ref-3)
3. Keys, B., & Mulder, P. (2024). Property Insurance and Disaster Risk: New Evidence from Mortgage Escrow Data. https://doi.org/10.3386/w32579 [↑](#footnote-ref-4)
4. Roher, C. J. C. “More homeowners getting dropped by insurance companies due to wildfire risk” *NBC Los Angeles*, 13 December 2022. [↑](#footnote-ref-5)
5. Rojanasakul, Mira and Christopher Lavelle. “Find Out How Your Home Insurance Costs Compare in Our Interactive Map”. *New York Times*, 8 July 2024. [↑](#footnote-ref-6)