



**University of California, San Diego**  
Department of Electrical and Computer Engineering  
ECE 143 - Programming for Data Analysis

# **The Impact of Natural Disasters on U.S. Real Estate Prices**

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# Significance

- **Increasing Frequency of Natural Disasters**
- **Informed Policy-making**
- **Urban Planning**
- **Investment Strategies**



# Significance: Our Aim

- **Fill the Gaps in Current Knowledge:**
  - **Comprehensive Overview of the Correlation**
  - **Short- & Long-term Impacts**



# Data: Sources

- **Housing**
  - **Federal Housing Finance Agency**
    - **House Price Index (HPI) Datasets (1980-2022)**
- **Natural Disasters**
  - **National Oceanic and Atmospheric Administration (NOAA)**
    - **Storm Events Database (1950-2023)**



# Data: Acknowledgements

- **Access Limitations**
- **Limited to Continental United States**
- **Storm Events Include Most Natural Disasters**



# Data: Storm Events Database

## Preprocessed Natural Disasters Data Loaded Into Pandas

|   | EVENT_ID | STATE     | STATE_FIPS | YEAR | MONTH_NAME | EVENT_TYPE        | CZ_TYPE | CZ_FIPS | CZ_NAME  | WFO | BEGIN_DATE_TIME    |
|---|----------|-----------|------------|------|------------|-------------------|---------|---------|----------|-----|--------------------|
| 0 | 10046120 | LOUISIANA | 22.0       | 1980 | April      | Hail              | C       | 79      | RAPIDES  | T   | 13-APR-80 00:30:00 |
| 1 | 10065016 | NEBRASKA  | 31.0       | 1980 | May        | Hail              | C       | 107     | KNOX     | NG  | 29-MAY-80 14:10:00 |
| 2 | 10065375 | NEBRASKA  | 31.0       | 1980 | July       | Thunderstorm Wind | C       | 57      | DUNDY    | ATA | 22-JUL-80 00:10:00 |
| 3 | 10054907 | MINNESOTA | 27.0       | 1980 | September  | Thunderstorm Wind | C       | 129     | RENVILLE | NG  | 03-SEP-80 18:30:00 |
| 4 | 9975991  | ALABAMA   | 1.0        | 1980 | September  | Thunderstorm Wind | C       | 7       | BIBB     | TS  | 17-SEP-80 08:30:00 |
| 5 | 9975992  | ALABAMA   | 1.0        | 1980 | November   | Tornado           | C       | 3       | BALDWIN  | NaN | 23-NOV-80 14:30:00 |
| 6 | 10075651 | NEW YORK  | 36.0       | 1980 | June       | Hail              | C       | 37      | GENESEE  | RY  | 26-JUN-80 18:50:00 |
| 7 | 10058560 | MISSOURI  | 29.0       | 1980 | May        | Thunderstorm Wind | C       | 39      | CEDAR    | T   | 26-MAY-80 16:55:00 |

**-1,027,339 Events**

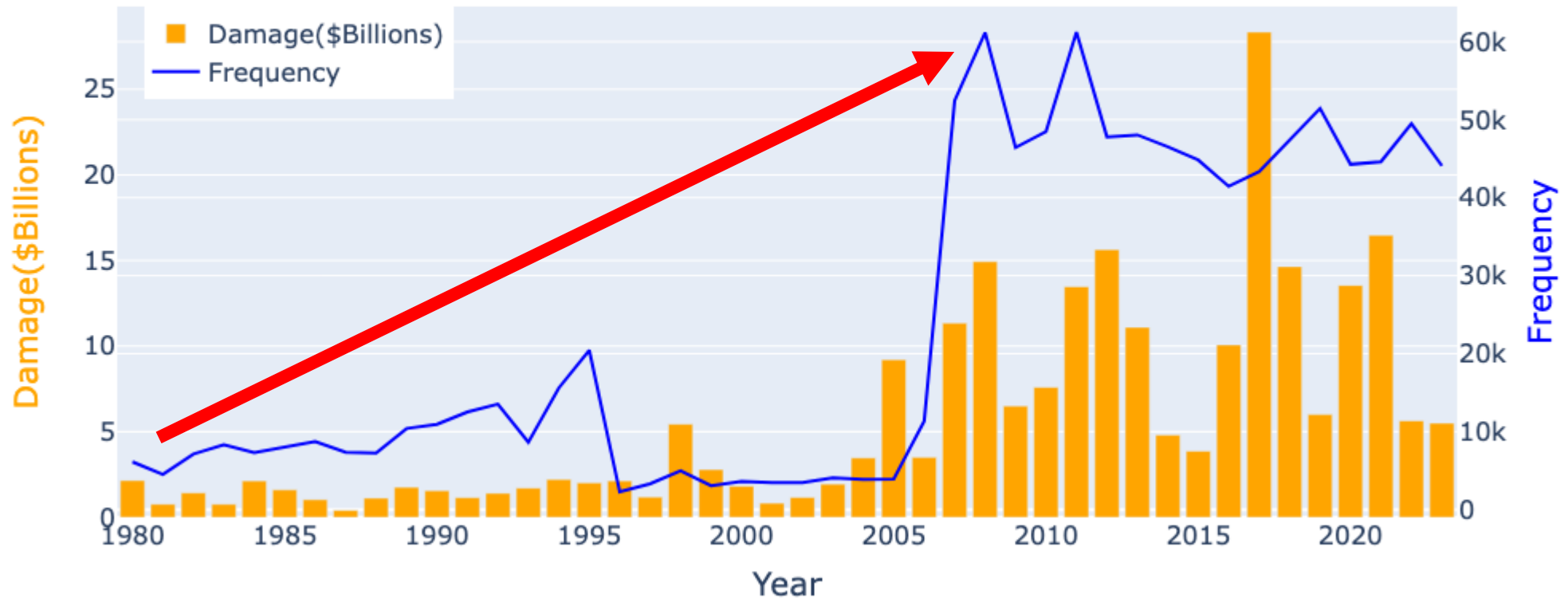
**-Events Without Damage Value Dropped**

**-Events Outside Continental US Dropped**



# Data: Storm Events Database

## Frequency and Damage of Natural Disasters 1980-2023



- Indeed, Damage and Frequency Increase Over Time
- Matches Expectation from Research



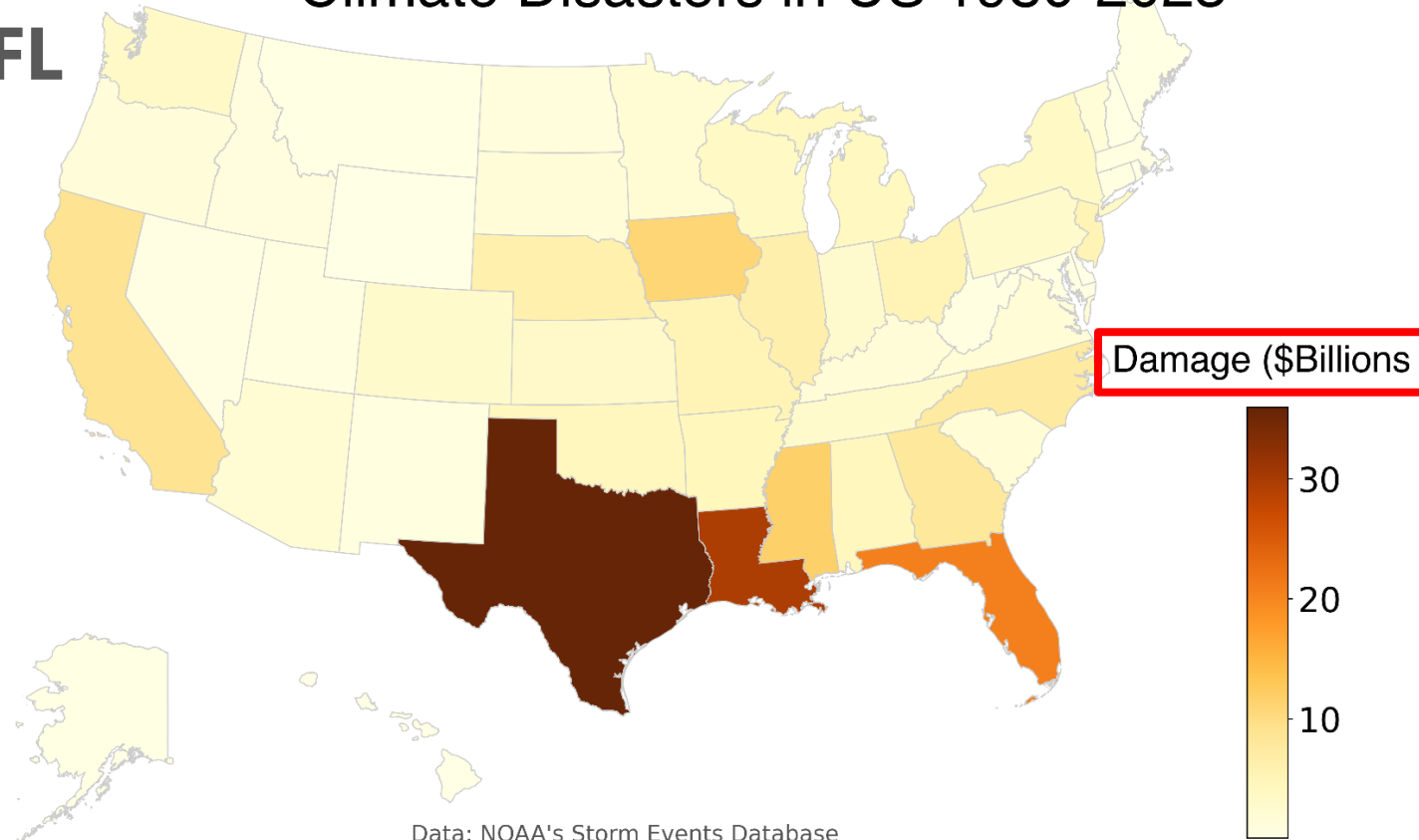


# Data: Storm Events Database

## -Locations with Most Costly Disasters

Climate Disasters in US 1980-2023

## -TX and FL



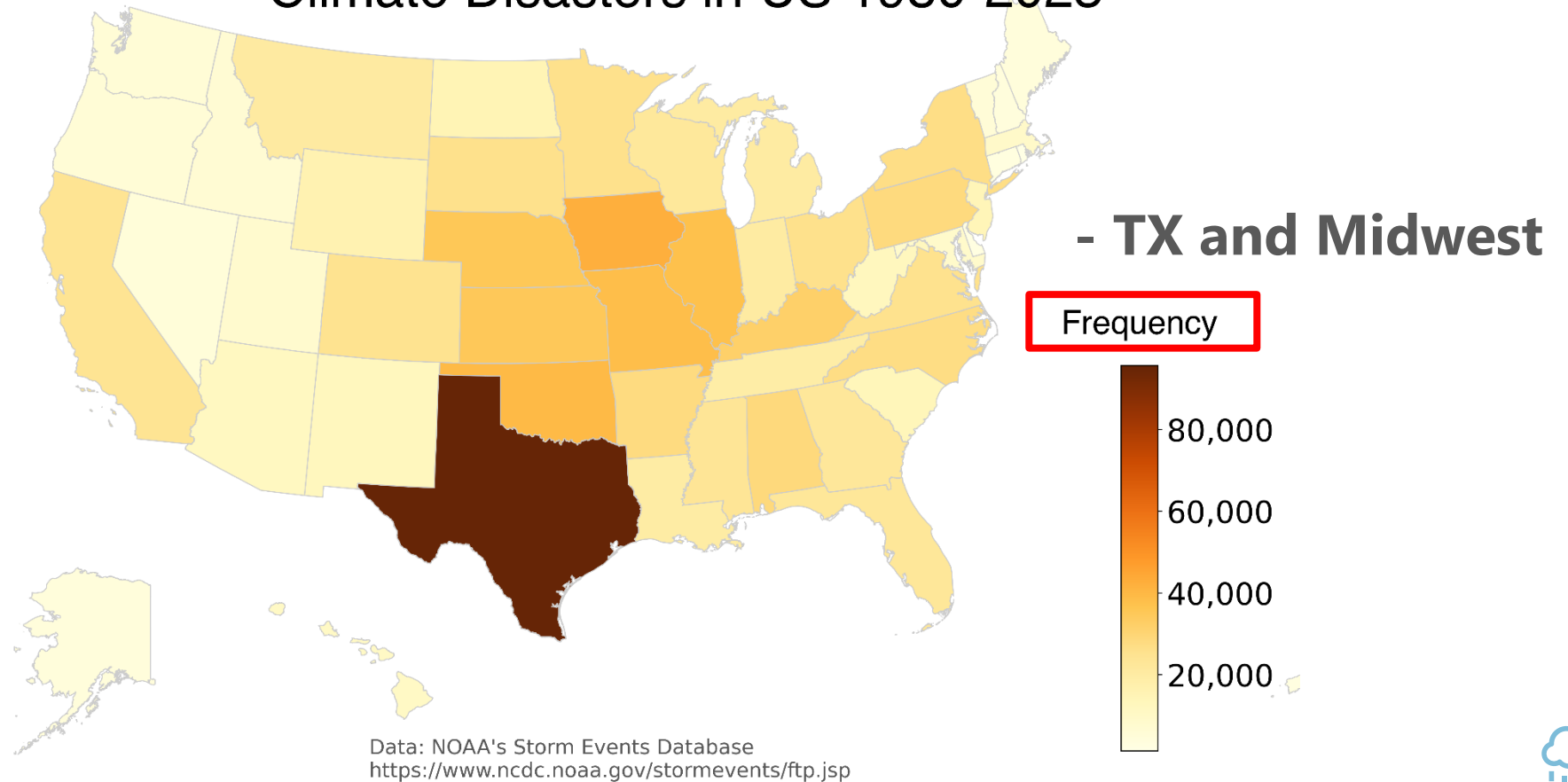
Data: NOAA's Storm Events Database  
<https://www.ncdc.noaa.gov/stormevents/ftp.jsp>



# Data: Storm Events Database

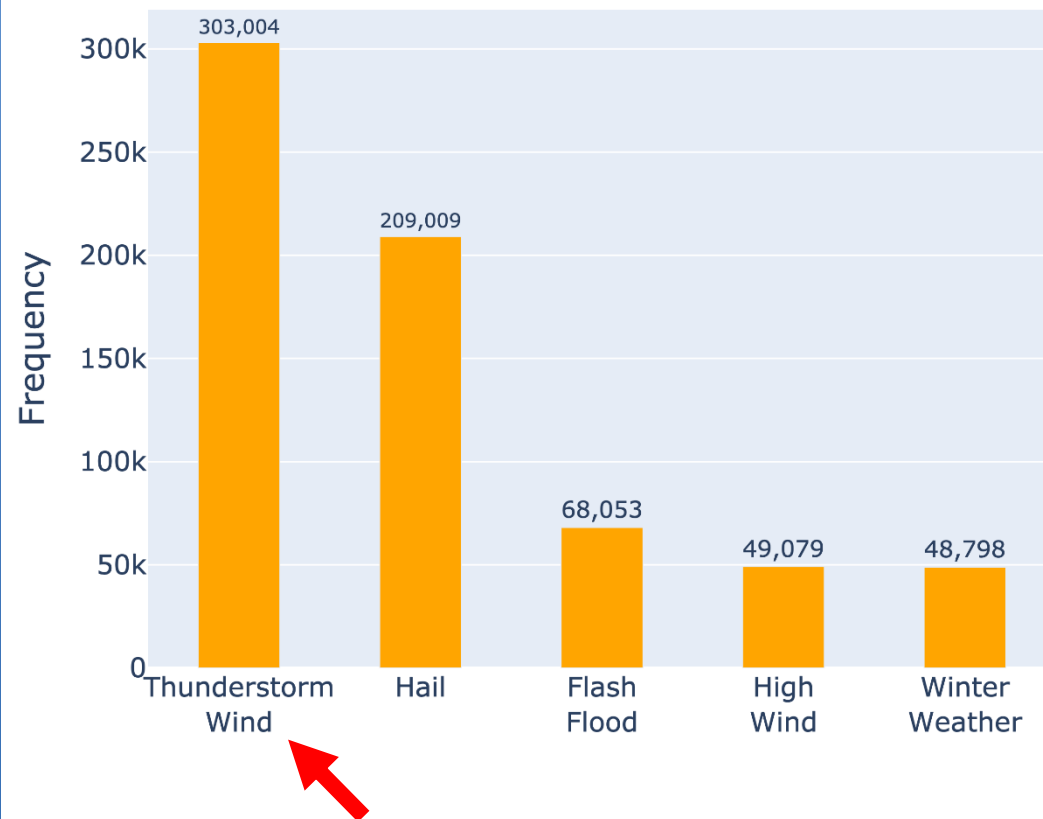
## -Locations with Most Disasters

Climate Disasters in US 1980-2023

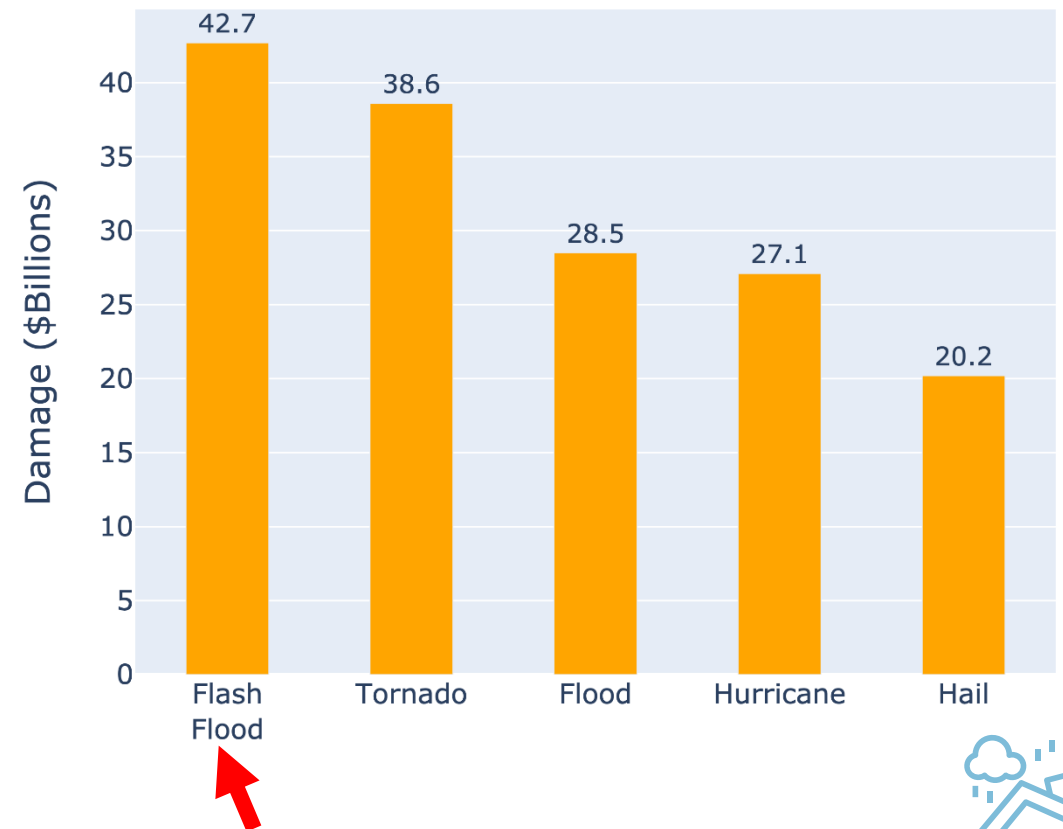


# Data: Storm Events Database (1980-2023)

Top 5 Most Common Climate Disasters



Top 5 Damage-causing Climate Disasters



# Data: House Price Index Datasets (1980-2022)

## Preprocessed Housing Price Data Loaded Into Pandas

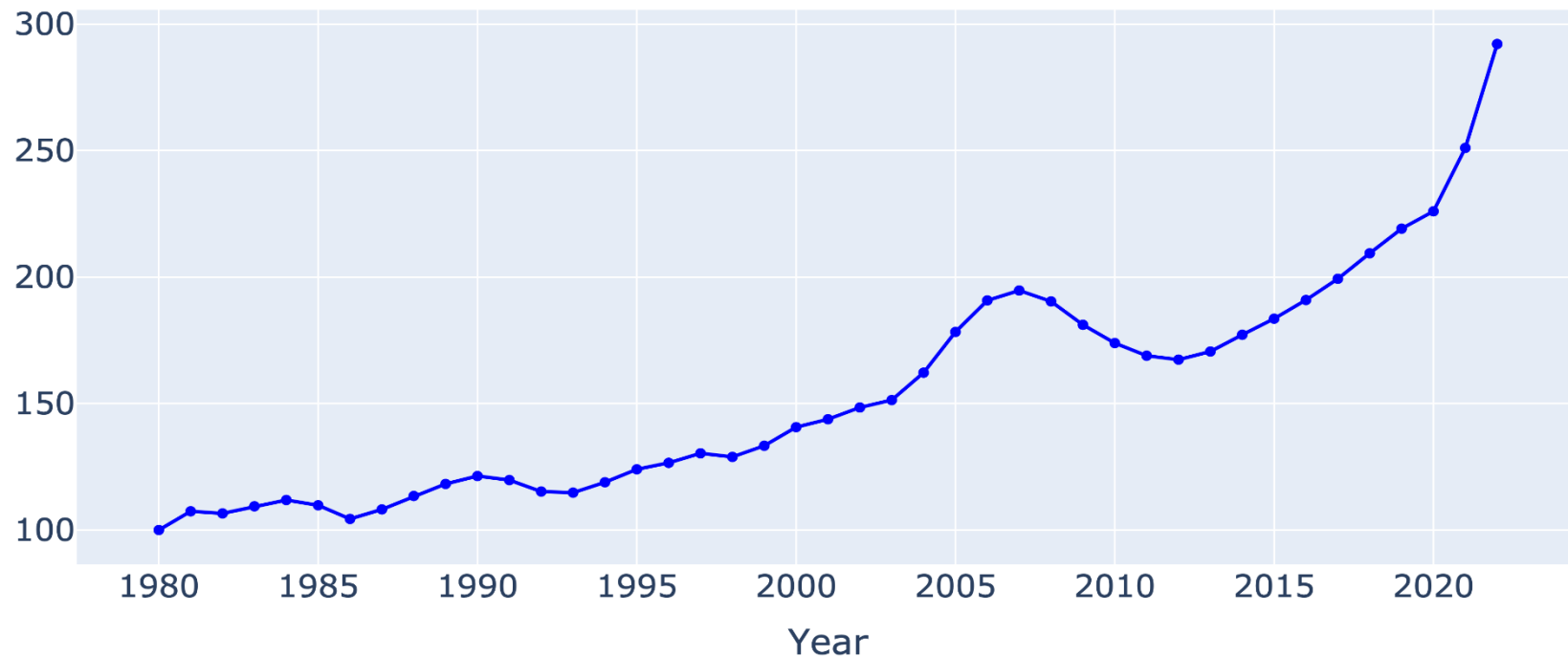
|       | State | County  | FIPS code | Year | Annual Change (%) | HPI    | HPI with 1990 base | HPI with 2000 base |
|-------|-------|---------|-----------|------|-------------------|--------|--------------------|--------------------|
| 0     | AL    | Autauga | 1001      | 1986 | .                 | 100.00 | 94.92              | 70.22              |
| 1     | AL    | Autauga | 1001      | 1987 | -2.22             | 97.78  | 92.81              | 68.66              |
| 2     | AL    | Autauga | 1001      | 1988 | 3.80              | 101.49 | 96.33              | 71.26              |
| 3     | AL    | Autauga | 1001      | 1989 | 4.33              | 105.88 | 100.51             | 74.35              |
| 4     | AL    | Autauga | 1001      | 1990 | -0.51             | 105.35 | 100.00             | 73.97              |
| ...   | ...   | ...     | ...       | ...  | ...               | ...    | ...                | ...                |
| 97656 | WY    | Weston  | 56045     | 2018 | -1.01             | 201.28 | .                  | 185.31             |
| 97657 | WY    | Weston  | 56045     | 2019 | 8.88              | 219.16 | .                  | 201.77             |
| 97658 | WY    | Weston  | 56045     | 2020 | 4.44              | 228.88 | .                  | 210.72             |
| 97659 | WY    | Weston  | 56045     | 2021 | 5.06              | 240.46 | .                  | 221.39             |
| 97660 | WY    | Weston  | 56045     | 2022 | 10.68             | 266.15 | .                  | 245.04             |

**-2,783 Counties**



# Data: House Price Index Datasets

Average House Price Index of US Counties 1980-2022

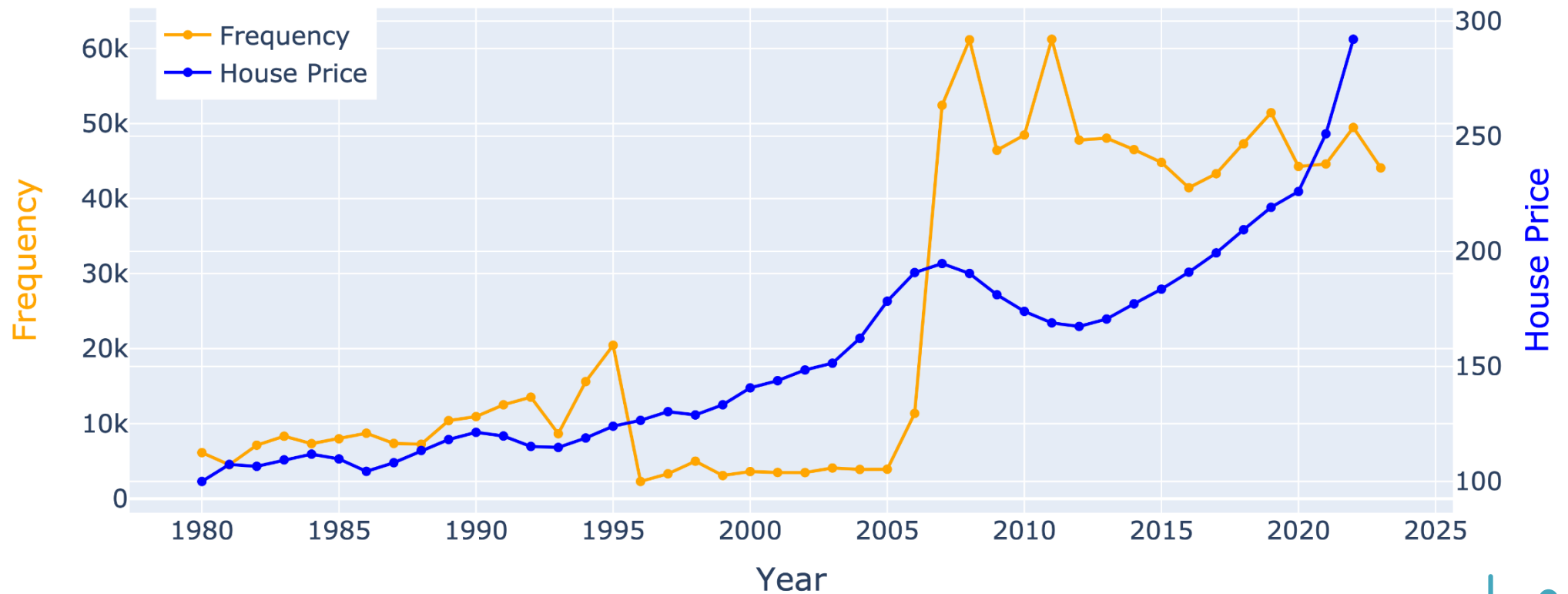


- Indeed, Average US HPI Increase Over Time
- There are Some Dips in the Graph



# Key Findings: Correlation

## Disasters Frequency & House Price Index of US 1980-2023

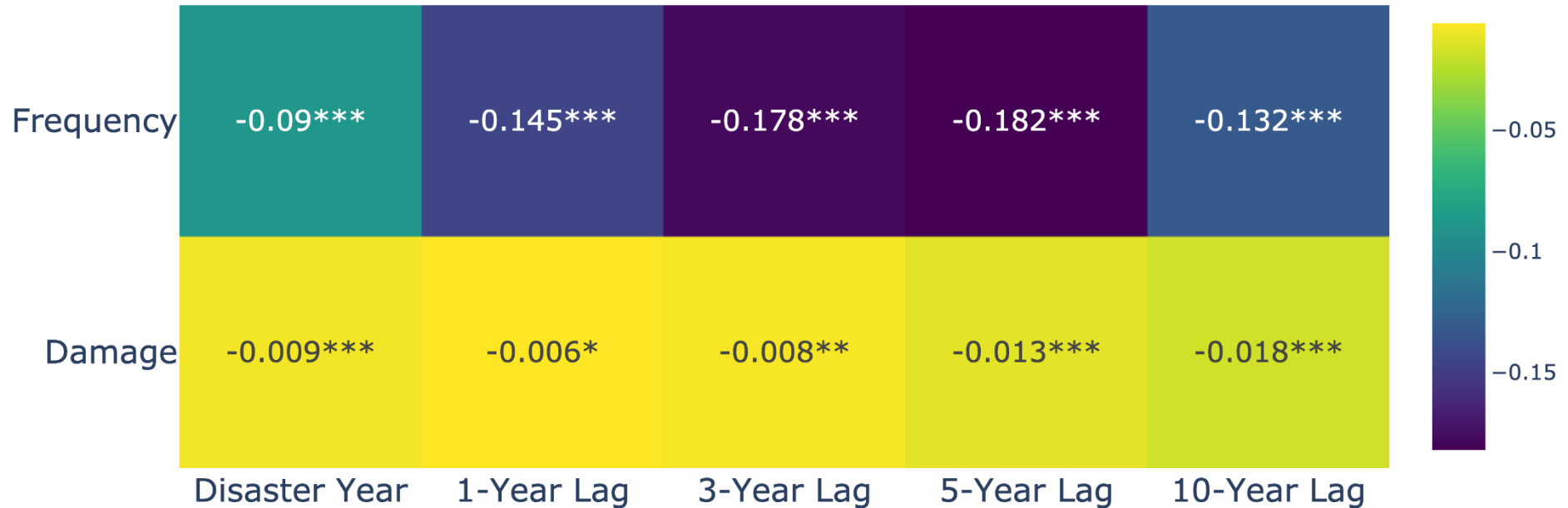


- Hard to See Correlation Using Plot Only
- Further Calculations Needed



# Key Findings: Correlation

## Correlation Coefficient of Disasters & House Price Change



\*\*\* p-values less than 0.01

\*\* p-values less than 0.05

\* p-values less than 0.1

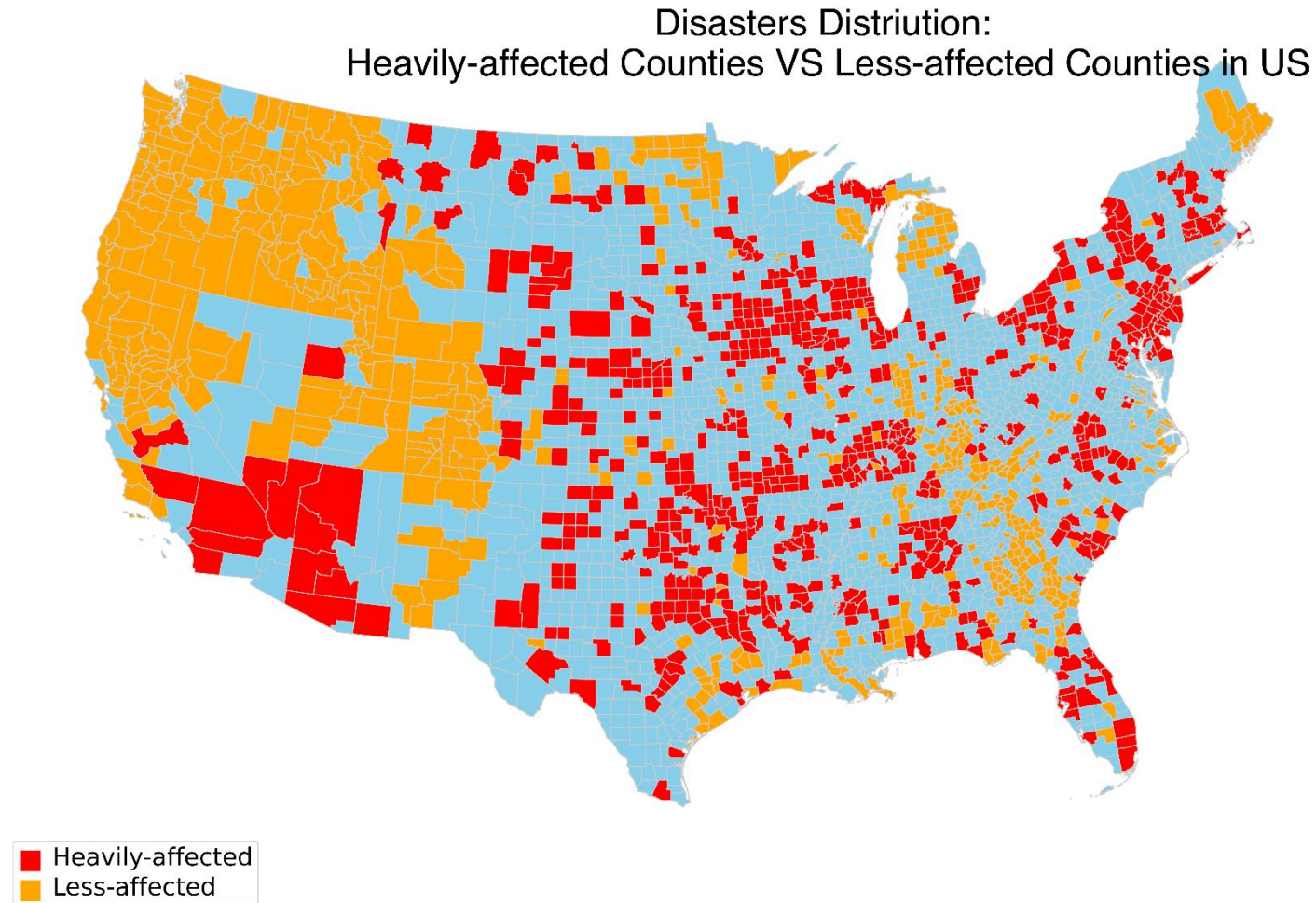
- Damage and Frequency have Significant Negative Impact on House Price

- Frequency has Higher Correlation and Smaller p-value

- Negative correlation is higher as the years increase



# Key Findings: Less-affected Neighboring Counties t-test



-Heavily-affected = High Frequency of Natural Disasters (75th percentile)

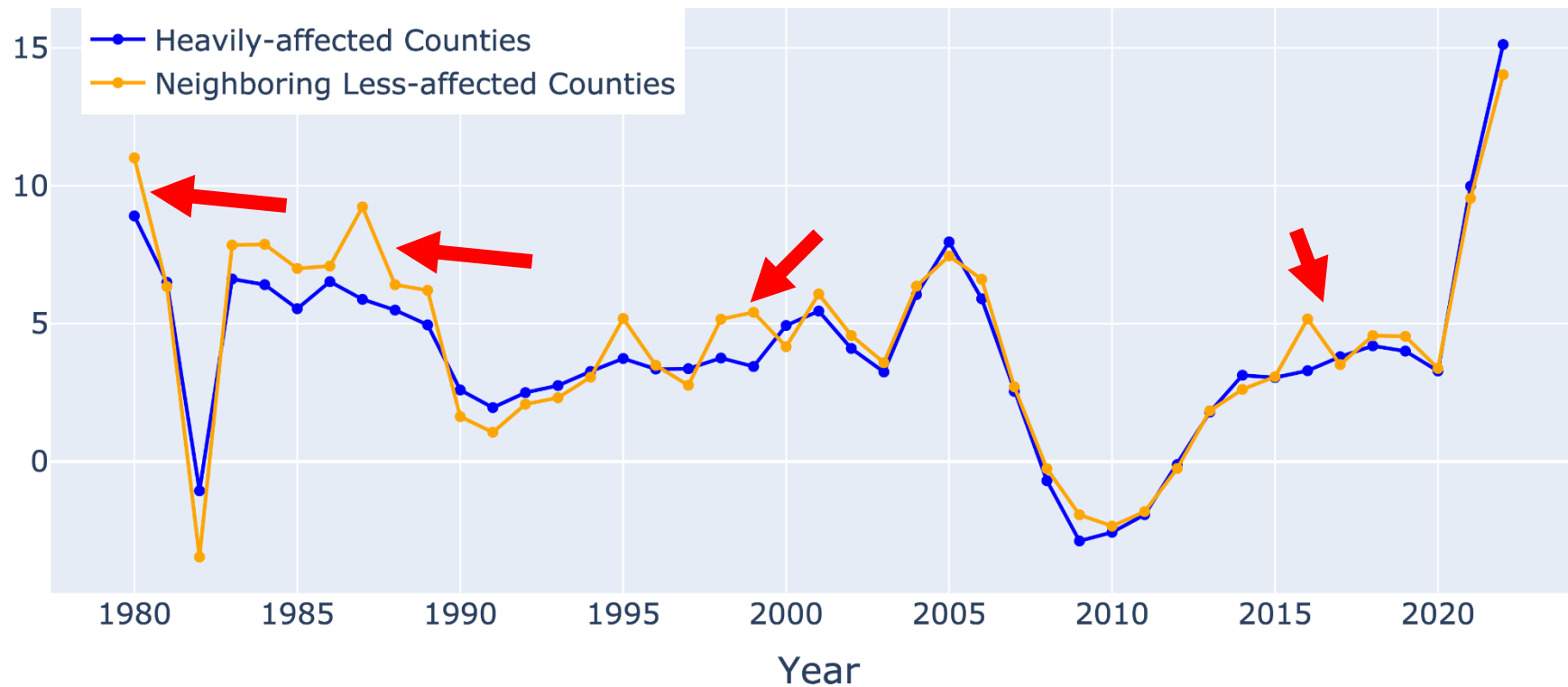
-Less-affected = Lower Frequency of Natural Disasters (25th percentile)





# Key Findings: Less-affected Neighboring Counties t-test

## Average House Price Change (%) of Year of Disaster's Occurrence

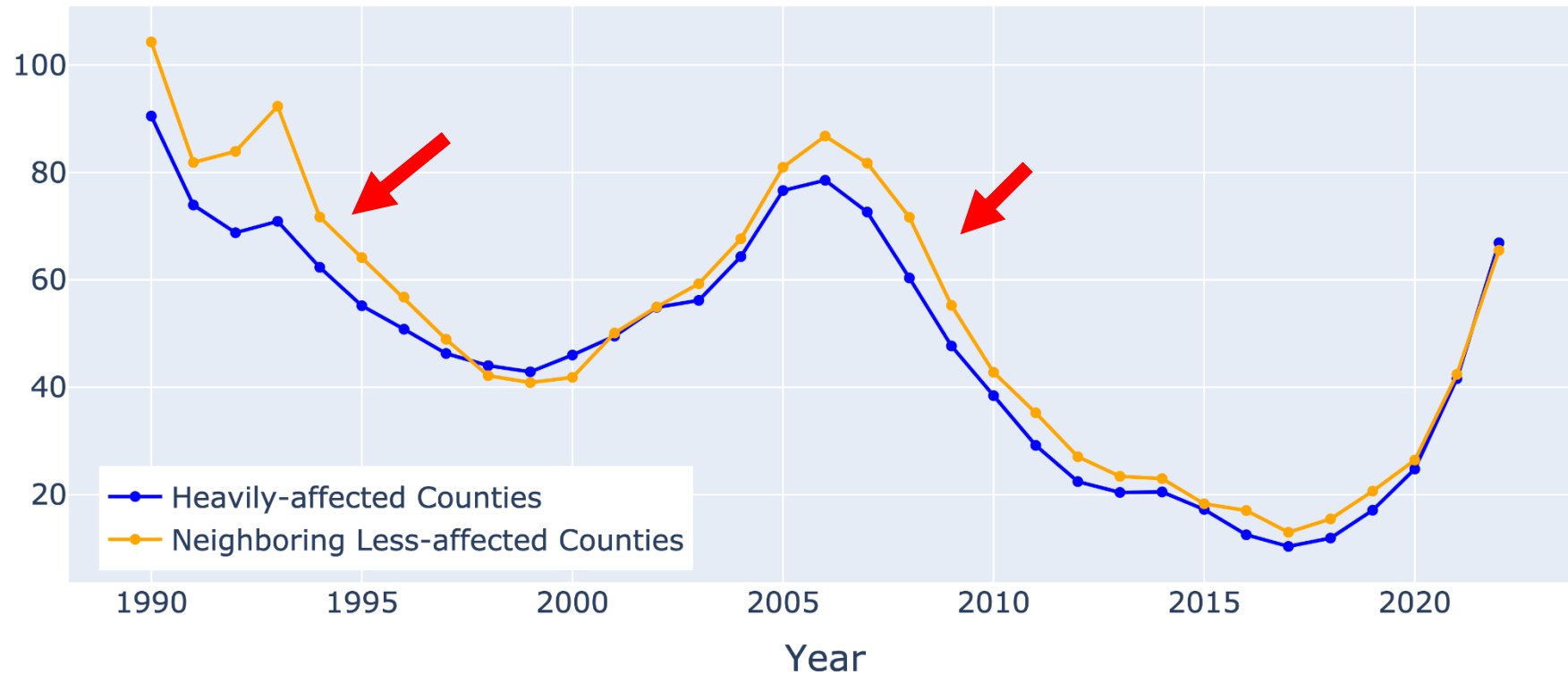


- Price Change Of Heavily-Affected Counties is Negative Compared With Less-affected Counties



# Key Findings: Less-affected Neighboring Counties t-test

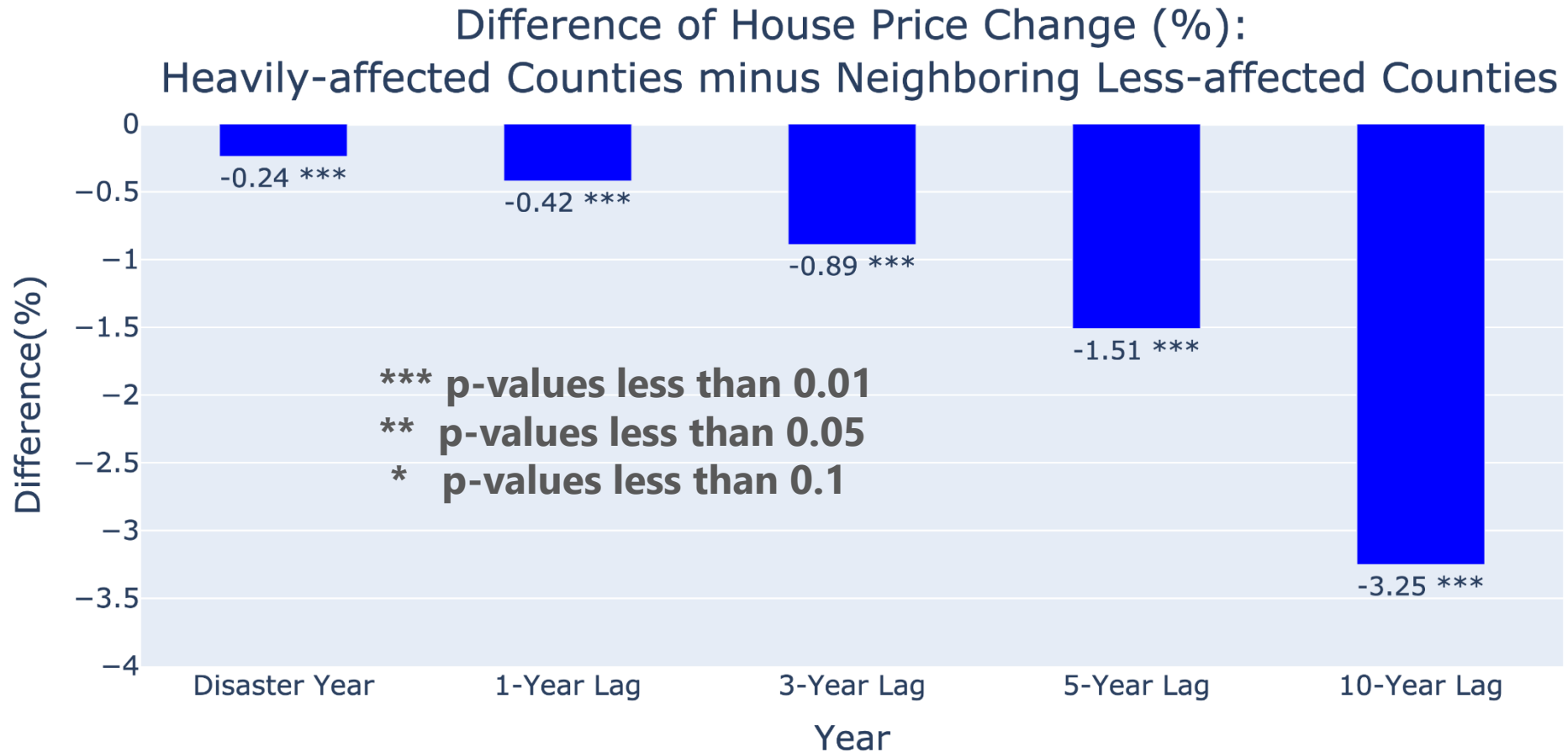
Average House Price Change (%)  
of 10-Year Lag after Disasters' Happened



- Price Change Of Heavily-Affected Counties is Negative Compared With Less-affected Counties
- More Visible in This Long-term Plot



# Key Findings: Less-affected Neighboring Counties t-test



- Paired Sample T-test: Compares the Means of Two Related Groups
- Assesses if Their Differences are Statistically Significant
- The Impact is Long-lasting and Difference Goes Up to 3.25%



# Conclusion

- **Significant Negative Correlation**
- **Long-term Impact is more visible**
- **Less-affected Neighbouring Counties Price Rise More**
- **For Future Work:**
  - **More Variables: Population, Economic Factors, Insurance**
  - **Machine Learning Models**





**Thank You**