Exploring the Relationship between Crime Pattern, Economy and Climate Change

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1. Introduction

Climate refers to the long-term weather conditions of a place—such as average temperature, precipitation, and other atmospheric variables. Previous studies have shown that climate can influence crime patterns. For example, higher temperatures are often linked to increases in violent crimes, while the effect of precipitation on crime remains mixed (Trujillo & Howley, 2021; Burke & Miguel, 2013; Ranson, 2014). Other factors, including sunlight and wind, may also play a role in shaping criminal activity.

According to the Federal Bureau of Investigation (FBI), both violent and property crime rates have declined significantly since the early 1990s. However, seasonal patterns remain evident—violent crimes such as aggravated assault, rape, and sexual assault tend to occur more frequently during summer months, correlating with warmer weather and increased outdoor social interactions.

Given the dynamic climatic and economic landscape of the United States, this study focuses on understanding how environmental and economic factors jointly influence crime patterns across the contiguous United States (CONUS)—excluding Alaska and Hawaii.

2. Problem Statement

Texas and other U.S. regions have experienced increasingly extreme weather—from record-breaking summer heat to unusually cold winters. These climatic variations may shape behavioral patterns, including those linked to crime.

This project investigates whether and how climatic conditions (e.g., temperature, precipitation, sunlight, and wind) and economic factors (e.g., household income) interact to influence crime rates across U.S. counties. By integrating data from multiple sources, the study

aims to uncover spatial and temporal trends that reveal the joint effects of climate and socioeconomic conditions on crime.

3. Project Objectives

Purpose

To collect, integrate, and analyze multi-source datasets—census, weather, and crime—using APIs to explore relationships between environmental and socioeconomic factors and their impact on crime.

Key Objectives:

1) **Data Collection** – Retrieve climate, socioeconomic, and crime data through public APIs (NOAA, FBI, ACS).
2) **Exploratory Analysis** – Examine relationships among climate variables, household income, and crime rates.
3) **Validation** – Compare findings with established results in previous studies.
4) **Visualization** – Build interactive dashboards, maps, and charts to communicate spatial and temporal patterns effectively.

4. Scope of Work

The project will develop a **web-based dashboard** that allows users to explore the relationships among climate, economy, and crime across U.S. counties.

Functional Components:

- Interactive data visualization (maps, charts, graphs)
- Trend analysis of climate and crime through time
- Comparison of spatial and economic factors

Non-Functional Elements:

- A narrative-driven exploration of the data
- Clear communication of key findings and trends

5. Technical Specifications

Technology Stack:

- **RStudio** – Data collection, cleaning, and analysis
- **Quarto Dashboard** – Interactive visualization and public dissemination
- **GitHub** – Version control and project collaboration

Data Sources:

Climate Data: National Oceanic and Atmospheric Administration (**NOAA**)

- **Crime Data:** Federal Bureau of Investigation (**FBI**) – *Uniform Crime Reporting (UCR) API*
- **Socioeconomic Data:** U.S. Census Bureau – *American Community Survey (ACS)* via **tidycensus**

Data Characteristics:

- **Temporal Resolution:** Monthly data (30 years, starting with the past 10 years)
- **Spatial Unit:** County-level aggregation
- **Challenges:** Missing values, geographic boundary mismatches (e.g., police district vs. county)

6. Expected Outcomes

- A unified, reproducible dataset integrating crime, climate, and socioeconomic variables.
- Insights into long-term trends linking temperature, precipitation, and economic status with crime rates.
- An interactive Quarto dashboard visualizing spatio-temporal dynamics of climate-crime relationships.

7. References

1. Ranson, M. (2014). *Crime, weather, and climate change. Journal of Environmental Economics and Management*, 67(3), 274–302. https://doi.org/10.1016/j.jeem.2013.11.008

2. Trujillo, J. C., & Howley, P. (2021). *The effect of weather on crime in a torrid urban zone. Environment and Behavior,* 53(1), 60–89. https://doi.org/10.1177/0013916519845121
3. Hsiang, S. M., Burke, M., & Miguel, E. (2013). *Quantifying the influence of climate on human conflict. Science,* 341(6151), 1235367. https://doi.org/10.1126/science.1235367

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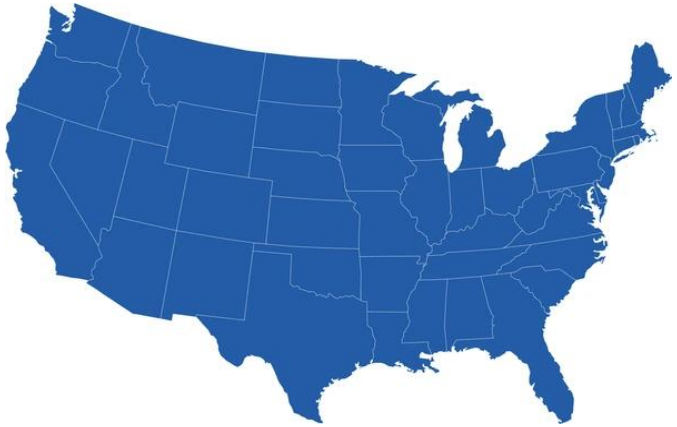
Introduction

- **Goal**: To demonstrate how **environmental** and **economic** factors together shape **crime patterns across contiguous U.S.**

- **Study area:** States in Contiguous U.S. (CONUS)
  – CONUS covers mainland U.S. except Hawaii and Alaska



Literature Review

Existing studies examined **crime rates can be influenced by climate variables**

- High temperatures are often linked to higher violent crime rates.
  - **According to the FBI,** both violent crime and property crime rates have fallen substantially since their peaks in the early 1990s.
  - **However, in terms of seasonal trend**, most violent crimes, such as aggravated assault, rape, and sexual assault, show higher incidence rates in the summer, correlating with warmer weather and increased outdoor social activity.
- The effect of **precipitation** on crime shows **mixed results.**
- **Sunlight** and **wind** may also influence criminal activity.
  (Trujillo & Howley, 2021; Burke & Miguel, 2013; Ranson, 2014)

Focus of this study

- This study explores:
  - How to process **climatic data to find a trend as well explaining crime rates for long-term time.**
    - Available data : temperature, precipitation, etc. relate to **crime rates**
  - How to process **economic data to find** interaction with **climate factors**
    - Available data: household income
- Data sources include **crime statistics** and **U.S. Census household income data** and **National Weather Services** data.

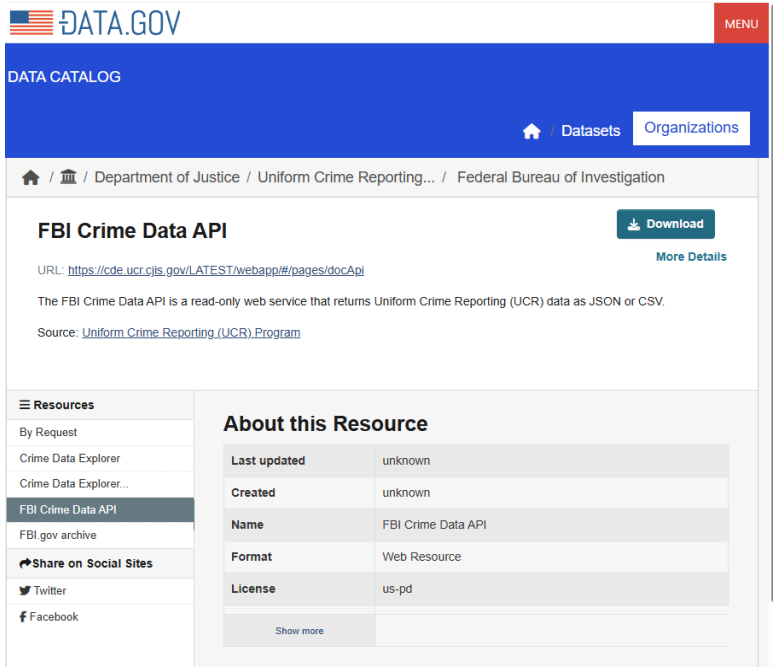
Data collection resources

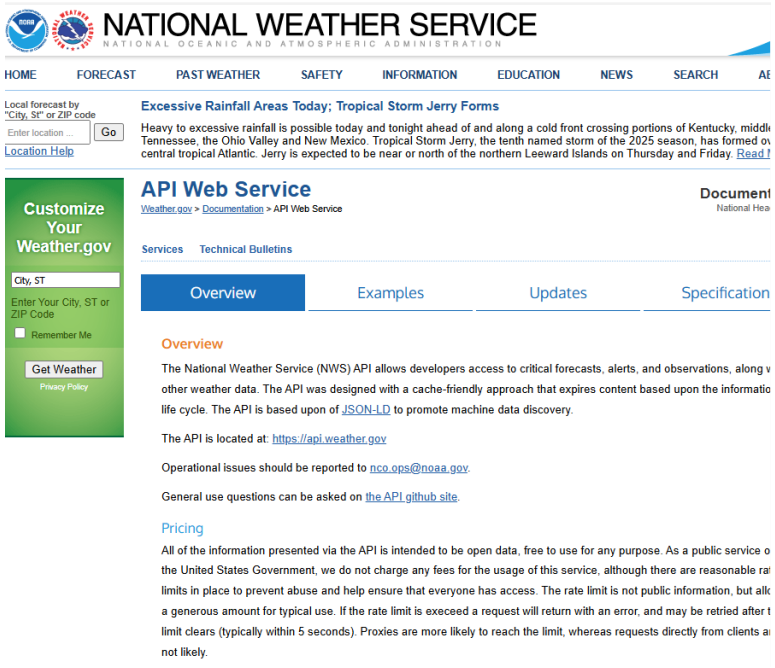
- **Technology stack**

  – **RStudio** – Data processing and analysis
  – **Quarto Dashboard** – Publicize project outcomes
  – **GitHub** – Version control and collaboration and data availability

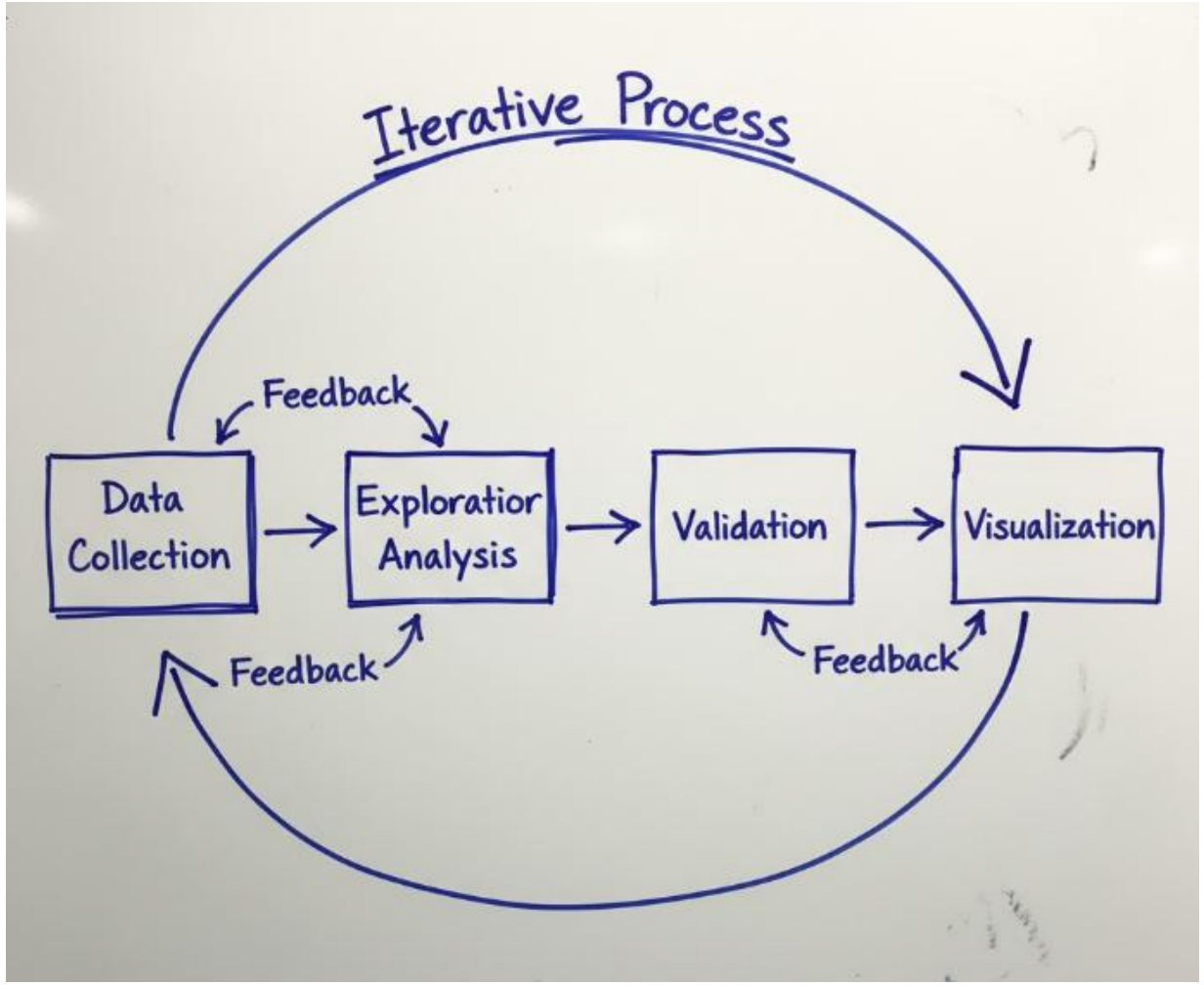
Data collection resources

- **Time resolution: monthly data for 30 yrs, Spatial unit: County**
- **Climate Data:** National Oceanic and Atmospheric Administration (**NOAA**) - API
- **Crime Data:** Federal Bureau of Investigation (**FBI**) – *Uniform Crime Reporting (UCR) API and web-scrapping*
- **Socioeconomic Data:** U.S. Census Bureau – *American Community Survey (ACS)* API via **tidycensus** package





Data collection and refinement plans



- **Data Collection**
  - Gather data from publicly available APIs (Census, NOAA, Crime datasets).
  - Data pre-processing (**Big challenges**)
    - Found a lot of missing values
    - Geographical boundary mismatch between PD boundary and County boundary
- **Exploratory Analysis**
  - Examine relationships among climatic, economic, and crime variables.
- **Validation**
  - Compare findings with established relationships from prior research.
- **Visualization**
  - Create interactive charts and maps to communicate spatial and temporal patterns.

Reference

- Ranson, M. (2014). Crime, weather, and climate change. *Journal of Environmental Economics and Management*, 67(3), 274-302. https://doi.org/10.1016/j.jeem.2013.11.008
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Thank you