Analyzing the Correlation Between Crime and Temperature in Chicago

Patrick Ridley
pari8094@colorado.edu
University of Colorado Boulder
USA

Shrey Shah
shsh7331@colorado.edu
University of Colorado Boulder
USA

ABSTRACT

Crime patterns in urban areas are influenced by various environmental factors, with temperature fluctuations playing a significant role in the frequency of violent crimes. Previous research has shown a correlation between higher temperatures and increased instances of violent crimes, such as assaults and homicides. This study aims to analyze the relationship between temperature variations and violent crime occurrences in Chicago from 2010 to 2025. By leveraging publicly available crime and weather datasets, we seek to uncover patterns that can provide insight into how temperature impacts criminal activity. Through data mining techniques, we will explore whether specific weather conditions contribute to crime surges, offering a data-driven perspective on crime prevention.

To achieve this, we will employ various data analysis methods, including exploratory data analysis (EDA), clustering, and association rule mining. Data preprocessing will ensure consistency between crime and weather datasets, aligning timestamps and handling missing values. Clustering techniques will be applied to detect crime trends and seasonal variations, while correlation analysis will measure the strength of the relationship between temperature and crime. Additionally, association rule mining will identify recurring patterns in violent crime occurrences under different temperature conditions.

The findings from this study will provide valuable insights for law enforcement, urban planners, and policymakers in designing strategies for crime prevention and resource allocation. By identifying when and where violent crimes are more likely to occur based on temperature patterns, law enforcement agencies can optimize patrol scheduling and emergency response planning. Furthermore, city officials can use this information to implement community safety initiatives and temperature-based crime intervention strategies. This research contributes to a deeper understanding of environmental influences on crime and highlights the importance of integrating climate factors into public safety planning.

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1 PROBLEM STATEMENT AND MOTIVATION

Crime patterns in urban areas are influenced by a range of environmental and socioeconomic factors, with temperature fluctuations emerging as a potential driver of violent crime rates. Several studies suggest that warmer temperatures correlate with increased occurrences of violent crimes, such as assaults, robberies, and homicides. This phenomenon is often attributed to increased outdoor activity, heightened aggression due to heat, and greater social interactions that can lead to conflicts. In contrast, colder temperatures may deter outdoor interactions, reducing the likelihood of violent encounters.

This project aims to analyze historical crime and weather data in Chicago from 2010 to 2025 to uncover patterns between temperature variations and violent crime rates. By applying data mining techniques, we seek to determine whether specific temperature conditions influence crime surges or reductions. Through clustering, association rule mining, and time-series analysis, we will examine seasonal trends, geographic hotspots, and recurring patterns in violent crime occurrences.

The goal is to provide data-driven insights that can assist law enforcement, urban planners, and policymakers in crime prevention and resource allocation strategies. By identifying when and where violent crimes are most likely to occur under different temperature conditions, this research can help optimize police staffing, emergency response preparedness, and community intervention programs to enhance public safety.

2 LITERATURE SURVEY

Several studies have examined the impact of weather on crime trends:

- **Anderson (1987) - The Heat Hypothesis**: Suggests that violent crime increases in higher temperatures due to heightened aggression. Analyzed multiple cities, including Chicago, to validate these findings.
- **The Association Between Weather and Daily Shootings in Chicago (2012–2016)**: Found that significant increases in temperature are associated with higher shootings, breaking down trends by weekdays, weekends, and holidays.
- **Harries et al. (1984) - Property Crime and Weather Relationship**: Found that property crimes have mixed relationships with temperature, with some increasing during cold weather. Conducted in Vancouver and Ottawa, showing that different climate zones experience varying crime-weather correlations.
- **The Urban Crime and Heat Gradient in High and Low-Poverty Areas**: Reviews temperature shifts and poverty levels in crime rates. While not the primary focus of our study, it suggests an additional socioeconomic layer we may explore.
- Most prior studies rely on statistical regression models without incorporating modern data mining techniques such as clustering, association rule mining, and predictive modeling. Our approach differentiates itself by applying these techniques to large-scale data while integrating crime type, location, and severity alongside temperature variations.

3 PROPOSED WORK

3.1 Data Preprocessing and Cleaning

- Remove duplicate and irrelevant records.
- Filter out nonviolent crimes (e.g., white-collar crimes, shoplifting).
- Exclude cases where an arrest was not performed.
- Handle missing values in crime and weather datasets.
- Normalize date/time formats for merging.

3.2 Data Attributes

- **Nominal:** Crime type, weather condition.
- **Numerical**: Temperature, crime count, crime severity index.
- **Boolean**: Arrest made (yes/no).
- **Time-Based**: Date, season, time of crime.
- **Derived Attributes**: Processed data used for trend analysis.

3.3 Data Integration and Handling Time Granularity Issues

- Align timestamps by aggregating crime counts to daily totals.
- Aggregate weather data into daily min/max/average temperature.
- Merge crime and temperature datasets based on date and crime type.

3.4 Database Indexing and Optimization

- Primary Indexing: Based on date and location (latitude/longitude) for optimized lookups.
- Secondary Indexing: On crime type and severity to speed up queries.

- Partitioning Strategy: Monthly or yearly partitions for efficiency.

4 DATA MINING TECHNIQUES

4.1 Descriptive Analytics: Exploratory Data Analysis (EDA)

4.1.1 Visualization.

- Scatter plots: Temperature high/low vs. crime rate.
- Trend lines: Crime rate over time and temperature variation.

4.1.2 Data Cube Analysis:

- Violent crimes vs. temperature highs/lows.
- Crimes by month/season.

4.2 Clustering: Crime Pattern Detection

- Clustering techniques will help identify hidden crime patterns that are not apparent in raw data.

4.2.1 K-Means Clustering.

- Groups crime incidents based on temperature conditions.
- Identifying distinct patterns at low, moderate, and high temperatures.
- Helps detect seasonal crime trends (e.g., more assaults in summer).

4.3 Association Rule Mining

- Frequent pattern mining techniques will identify strong relationships between crime occurrences and weather patterns.

4.3.1 Apriori Algorithm.

- Extracts rules such as "Higher temperatures increase violent crime frequency."

4.3.2 FP-Growth Algorithm.

- Analyzes frequent crime patterns across temperature highs, lows, and seasonal shifts.

4.4 Time-Series Analysis: Forecasting Crime Trends

- Time-series techniques will be used to analyze seasonal crime fluctuations over time.

4.4.1 ARIMA (AutoRegressive Integrated Moving Average).

- Models and forecasts crime rate trends based on historical data.

4.4.2 Seasonality Decomposition.

- Identifies recurring crime fluctuations across different seasons.

5 DATASETS

5.0.1 ***Chicago Crime Data**.*

- City of Chicago Open Data, 1M+ records from 2010–present.
- Chicago Crime Data

5.0.2 ***Chicago Weather Data**.*

- NOAA National Centers for Environmental Information.Daily temperature and climate data in high/low format.
- Chicago Weather Data

6 EVALUATION METHODS

- Statistical Correlation Metrics: Pearson Correlation, Spearman's Rank Correlation, P-Value Significance Testing.
- Clustering Evaluation: Silhouette Score, Davies–Bouldin Index.
- Time-Series Analysis Validation: Baseline Trend Comparison, Rolling Window Analysis, Seasonality Strength Measurement.

7 TOOLS AND TECHNOLOGIES

7.0.1 ***Programming**.*

- Python (Pandas, NumPy, Matplotlib).

7.0.2 ***Database**.*

- MySQL for structured relational data.

7.0.3 ***Visualization**.*

- Matplotlib for trend visualizations in Jupyter Notebook.

8 MILESTONES AND TIMELINE

Date	Task
Feb 3	Project Proposal
Feb 17	Peer Feedback
Mar 3	Proposal Paper
Mar 17	Progress Report
Apr 28	Code & Descriptions
Apr 28	Presentation
Apr 28	Peer Evaluation & Interview

9 PART 3 : PROJECT PROGRESS REPORT

Here's a cleaned-up and structured version of your progress update for the Data Preprocessing and Cleaning section. This version enhances readability while maintaining the depth of work done.

9.1 From section 3.1 Data Preprocessing and Cleaning

Effective data preprocessing is crucial for ensuring accurate analysis. Below are the key steps taken to clean and prepare both the Chicago crime and weather datasets for integration.

9.1.1 *Crime Data Cleaning.*

- Imported Chicago crime data into a MySQL database for structured analysis.
- Filtered out nonviolent crimes (e.g., white-collar crimes, shoplifting) to focus on violent offenses.
- Removed records where an arrest was not performed, as conviction data is unavailable in the dataset.
- Standardized date formats to align crime data with weather records for proper merging.
- Handled missing values in key attributes, such as Primary Type, Date, and Location.
- One critical issue encountered was that the Arrest field was stored as text (true/false) instead of a Boolean (0/1). To correct this, the following steps were taken:
- Added a new Boolean column: *ALTER TABLE chi_crime ADD Arrest_Bool TINYINT(1);*
- Migrated existing values into Boolean format: *UPDATE chi_crime SET Arrest_Bool = CASE WHEN LOWER(Arrest) = 'true' THEN 1 ELSE 0 END;*

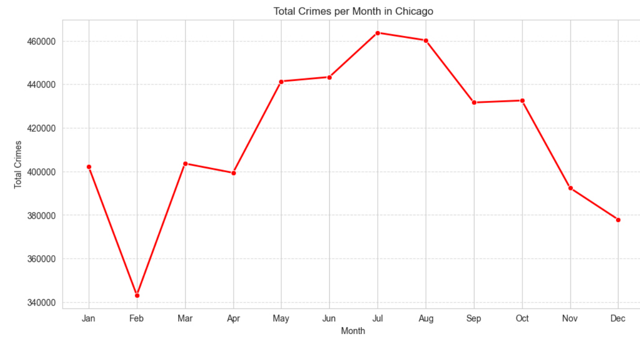

Figure 1: Chicago Crime

- Replaced the original column: *ALTER TABLE chi_crime DROP COLUMN Arrest; ALTER TABLE chi_crime CHANGE Arrest_Bool Arrest TINYINT(1);* After this transformation, the Arrest field was successfully converted into a proper Boolean datatype.

9.1.2 *weather dataset's format.*

- Next, the date field had to be adjusted to match the weather dataset's format (YYYY-MM-DD). A new column adjDate was introduced:
- *ALTER TABLE chi_crime ADD COLUMN adjDate DATE;*
- UPDATE chi_crime SET adjDate = STR_TO_DATE(Date, 'm/d/Y r');
- This transformation ensured that all records were correctly formatted for integration with the weather dataset.

9.1.3 *Weather Data Cleaning:*

- A Python script was written to clean the weather dataset before importing it into MySQL: *import pandas as pd*
- Load CSV :*df = pd.read_csv('/Users/patrickridley/Documents/We*
- Remove rows where TMAX, TMIN, or Date are missing : *df = df.dropna(subset=['TMAX', 'TMIN', 'Date'])*
- Save the cleaned CSV :*df.to_csv('/Users/patrickridley/Document index=False)*
- This process removed null values, focusing only on Date, TMAX, and TMIN while keeping the dataset intact.

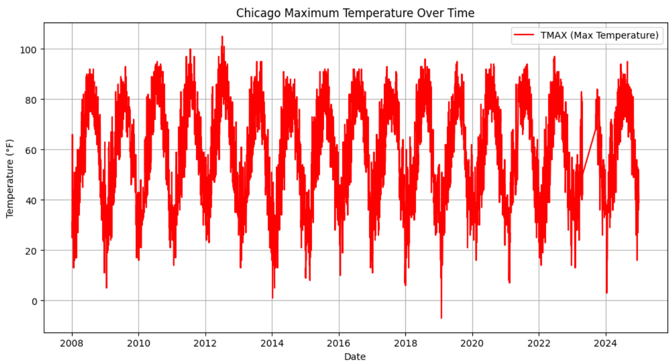

Figure 2: Weather Dataset Overview

9.2 Exploratory Data Analysis

Additionally, the crime dataset had a longer time span than the weather dataset. To ensure consistency, the analysis was limited to records between 2008-01-01 and 2024-12-31, establishing a unified starting point.

9.3 Crime Type Categorization and Analysis

- To gain insights into crime distribution, we first counted the occurrences of each crime type:
- *SELECT 'Primary Type', COUNT(*) AS count FROM chi_crime GROUP BY 'Primary Type' ORDER BY count DESC;*
- Results:

Primary Type	Count
THEFT	1,098,658
BATTERY	896,045
CRIMINAL DAMAGE	553,401
NARCOTICS	378,099
ASSAULT	347,723
OTHER OFFENSE	308,051

Table 1: Crime Count by Primary Type

- We then filtered the data to count only crimes where an arrest was made:
- SELECT 'Primary Type', COUNT(*) AS arrest_count FROM chi_crime WHERE Arrest = TRUE GROUP BY 'Primary Type'ORDER BY arrest_count DESC;
- Results:

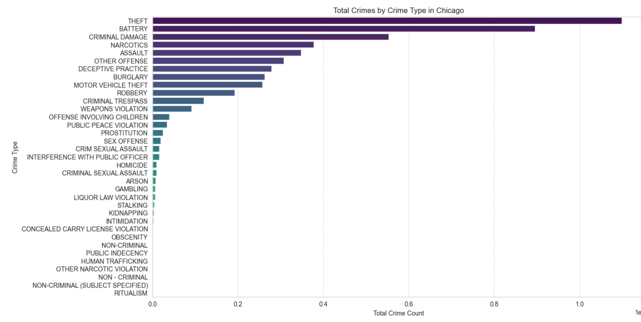

Figure 3: crime validation

Primary Type	Arrest Count
NARCOTICS	375277
BATTERY	185130
THEFT	104702
CRIMINAL TRESPASS	71547
WEAPONS VIOLATION	64310
ASSAULT	64242

Table 2: Arrest counts for different primary types.

- Upon further review, we selected specific violent crimes for analysis: • BATTERY • ASSAULT • HOMICIDE • SEX OFFENSES (CRIMINAL SEXUAL ASSAULT, CRIME SEXUAL ASSAULT) • OFFENSES INVOLVING CHILDREN (Most cases involved sexual offenses)
- For reporting purposes, these were grouped into four major categories, with sex-related crimes analyzed separately due to their unique nature.

9.4 Validation Checks

- Before finalizing data cleaning, we performed additional checks for missing values in critical fields:
- *SELECT * FROM chi_crime WHERE 'Primary Type' IS NULL;*
- *SELECT * FROM chi_crime WHERE adjDate IS NULL;*
- No missing values were found in key fields after preprocessing.

9.5 Data Integration and Warehousing

Following the data preprocessing and validation steps, we integrated the crime and weather datasets using

Primary Type	Arrest Count
NARCOTICS	375277
BATTERY	185130
THEFT	104702
CRIMINAL TRESPASS	71547
WEAPONS VIOLATION	64310
ASSAULT	64242
OTHER OFFENSE	55124
CRIMINAL DAMAGE	32206
PROSTITUTION	24759
PUBLIC PEACE VIOLATION	23715
DECEPTIVE PRACTICE	23070
ROBBERY	16941
INTERFERENCE WITH OFFICER	14646
MOTOR VEHICLE THEFT	14219
BURGLARY	14166
GAMBLING	6627
LIQUOR LAW VIOLATION	6484
OFFENSE INVOLVING CHILDREN	6310
HOMICIDE	4135
SEX OFFENSE	3927
CRIM SEXUAL ASSAULT	2200
CONCEALED CARRY VIOLATION	1389
ARSON	821
CRIMINAL SEXUAL ASSAULT	668

Table 3: Arrest counts by primary type

Primary Type	Arrest Count
OBSCENITY	572
STALKING	457
INTIMIDATION	339
KIDNAPPING	299
PUBLIC INDECENCY	162
OTHER NARCOTIC VIOLATION	65
NON-CRIMINAL	16
HUMAN TRAFFICKING	12
NON - CRIMINAL	6
NON-CRIMINAL	3

Table 4: Continuation of table 3

data warehousing methods, ensuring alignment between crime occurrences and corresponding temperature data. To achieve this, we structured the dataset by retaining only relevant weather attributes—TMAX and TMIN—while linking them to crime records using the adjDate field. This integration resulted in a new table, crime_weather_data, which serves as the foundation for trend analysis.

9.5.1 Table Creation.

- The following SQL command was executed in MySQL Workbench to create the crime_weather_data table: CREATE TABLE crime_weather_data (Date DATE NOT NULL PRIMARY KEY, TMAX INT NOT NULL, TMIN INT NOT NULL, Crime_Count INT NOT NULL, Assault_Count INT NOT NULL, Battery_Count INT NOT NULL, Homicide_Count INT NOT NULL, Sex_Crime_Count INT NOT NULL);

9.5.2 Data Merging.

- To populate the new table, we merged the weather dataset (weather_data) and the crime dataset (chi_crime) by linking weather records to crime occurrences on the same date (adjDate). The following SQL query was used to aggregate crime data into daily counts:
- INSERT INTO crime_weather_data (Date, TMAX, TMIN, Crime_Count, Assault_Count, Battery_Count, Homicide_Count, Sex_Crime_Count) SELECT w.Date, w.TMAX, w.TMIN, COUNT(c.ID) AS Crime_Count, SUM(CASE WHEN c.‘Primary Type‘ = ’ASSAULT’ THEN 1 ELSE 0 END) AS Assault_Count, SUM(CASE WHEN c.‘Primary Type‘ = ’BATTERY’ THEN 1 ELSE 0 END) AS Battery_Count, SUM(CASE WHEN c.‘Primary Type‘ = ’HOMICIDE’ THEN 1 ELSE 0 END) AS Homicide_Count, SUM(CASE WHEN c.‘Primary Type‘ IN (’SEX OFFENSE’, ’CRIM SEXUAL ASSAULT’, ’CRIMINAL SEXUAL ASSAULT’, ’OFFENSE INVOLVING CHILDREN’) THEN 1 ELSE 0 END) AS Sex_Crime_Count FROM weather_data w LEFT JOIN chi_crime c ON w.Date = c.adjDate WHERE w.TMAX IS NOT NULL AND w.TMIN IS NOT NULL GROUP BY w.Date, w.TMAX, w.TMIN;

This integration enabled Online Analytical Processing (OLAP) techniques, facilitating efficient analysis of crime trends across different temperature conditions. By structuring the dataset this way, we can now perform advanced trend analysis and statistical evaluations, identifying correlations between temperature variations and crime rates.

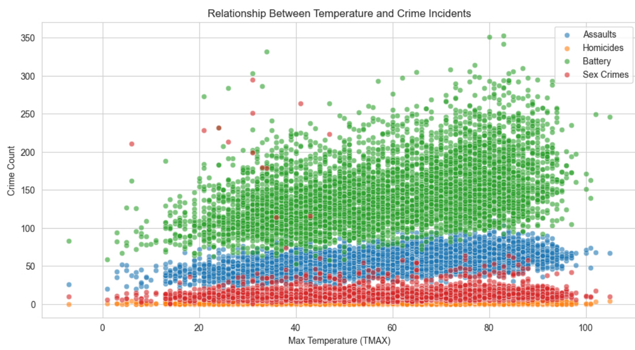

Figure 4: Merge

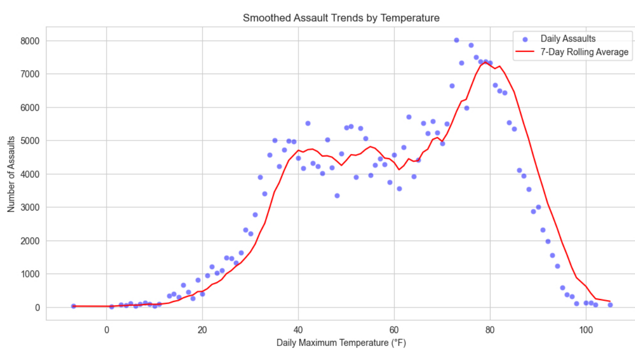

Figure 5: Smoothed trend

10 DATA ANALYSIS

10.1 Smoothed Trends

- Observation about the relationship between weather and crime in Chicago aligns with established research in criminology and environmental psychology. The data indicates that violent crime rates tend to increase during periods of moderate warmth, particularly when temperatures first rise after colder seasons. This pattern can be explained through several theoretical frameworks and empirical findings:

10.1.1 Querry.

- SELECT w.TMAX, SUM(c.Assault_Count) AS Daily _Assaults FROM crime_weather _data c JOIN weather_data w ON c.Date = w.Date WHERE w.TMAX IS NOT NULL GROUP BY w.TMAX ORDER BY w.TMAX;

10.1.2 Temperature and Crime: The Inverted U-Shape Relationship.

- Studies have consistently found a non-linear relationship between temperature and violent crime, often described as an inverted U-shape. Crime rates increase with temperature up to a certain point, after which they begin to decline as temperatures become excessively hot. This trend suggests that while warmer weather encourages outdoor activities and social interactions—thereby increasing opportunities for crime—extreme heat may deter people from being outside, thus reducing such opportunities.

10.1.3 Routine Activity Theory.

- The Routine Activity Theory posits that crime is more likely to occur when three elements converge: a motivated offender, a suitable target, and the absence of a capable guardian. Warmer weather often leads to increased outdoor activities, thereby increasing the likelihood of these elements converging. This theory helps explain the rise in crime rates during the initial warm periods of the year.

10.1.4 Data Support from Chicago.

- In our analysis of Chicago crime data, a noticeable uptick in violent crimes corresponds with the first warm days following colder periods. This "first warm day" effect aligns with the theories mentioned above, as people are more likely to engage in outdoor activities during these times, increasing the potential for criminal interactions.

10.1.5 Psychological Factors.

- Research also indicates that sudden increases in temperature can affect human behavior, leading to increased aggression and irritability. These psychological responses to heat can contribute to higher rates of violent crime during warmer periods.

10.1.6 Conclusion.

- The correlation between warmer weather and increased crime rates in Chicago is supported by both theoretical frameworks and empirical data. Understanding this relationship is crucial for law enforcement and public policy, as it can inform the allocation of resources and the development

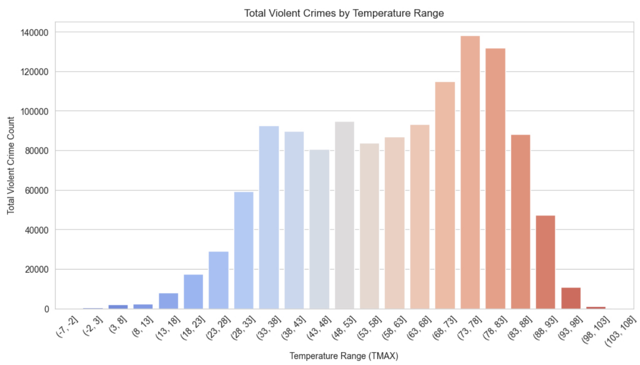

Figure 6: Bar Graph

of strategies to mitigate crime during specific periods.

- The chart demonstrates this phenomenon clearly: violent crime incidents rise as temperatures warm into the 60°F–80°F range, peaking in the 70s, and then taper off as temperatures climb higher. Similarly, crime is lowest during cold weather, when fewer people are outside.

10.2 Bar Graph

- This chart—Total Violent Crimes by Temperature Range—illustrates a clear relationship between weather and crime trends in Chicago. Specifically, it visualizes how the number of violent crimes varies across different maximum daily temperature ranges (TMAX):

10.2.1 *Key Observation.*

- Rising Crime with Rising Temperature: There's a notable upward trend in violent crime as temperatures increase. Crime counts remain relatively low in colder temperature bins (below 30°F), then increase sharply as the weather warms.
- Crime Peaks Around 73–78°F: The highest total violent crime counts occur in the temperature ranges between 68°F to 83°F, with a peak around 73–78°F. This aligns with comfortable weather, when people are more likely to be outside and interacting—potentially leading to more opportunities for conflict.
- Drop-off at Extremely High Temperatures: Interestingly, after the peak, violent crime begins to drop off in temperature ranges above 83°F, suggesting that excessive heat may discourage outdoor activity or gatherings that could escalate into violence.

10.2.2 *Interpretation.*

- This pattern supports prior studies suggesting that moderate to warm weather can correlate with an increase in social activity—and unfortunately, conflict. It also highlights the importance of considering seasonal and environmental context in crime analytics.

10.2.3 *Possible Use in Analysis.*

- This temperature-crime relationship can support predictive policing or public safety resource planning during warmer months.
- It could also guide policy decisions around heat relief programs and urban design to reduce crowding during hot periods.

10.2.4 *Conclusion.*

- Overall, this chart supports the hypothesis that moderate warmth encourages conditions conducive to violent crime, while extreme temperatures—hot or cold—suppress activity. This insight is valuable for law enforcement and public safety officials in planning patrols, resource allocation, and community interventions during periods of increased risk.
- The data reveals a distinct increase in violent crime as temperatures rise from colder ranges into moderate warmth, with a notable peak occurring between 70°F and 80°F. This trend suggests that violent crime is more likely to occur on warm, comfortable days, when people are more active outdoors and social interactions are more frequent. The increase may also be tied to behavioral theories, such as the heat-aggression hypothesis, which links warmer temperatures to heightened aggression.Interestingly, the chart shows a decline in violent crime as temperatures exceed 85°F, indicating that extreme heat may act as a deterrent. During very hot days, people may stay indoors or reduce outdoor activity, lowering the opportunity for conflict.

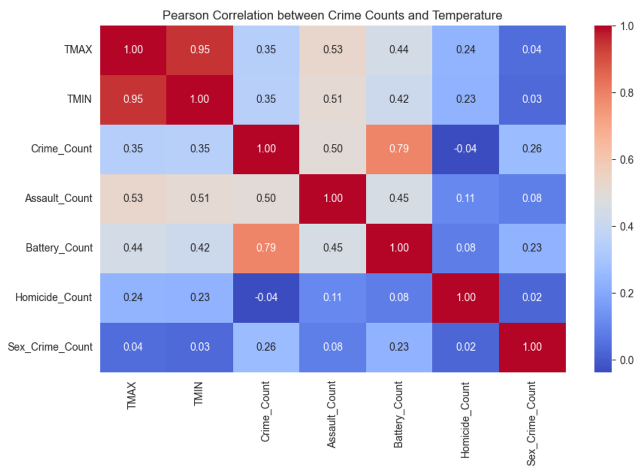

Figure 7: Heat Map

10.3 Pearson correlation heatmap

- The Pearson correlation heatmap illustrates the strength and direction of linear relationships between temperature variables (TMAX, TMIN) and various crime categories in the merged crime_weather _data dataset. Notably, TMAX and TMIN are highly correlated with each other (0.95), which is expected as daily maximum and minimum temperatures typically trend together. Among crime types, Assault_Count and Battery_Count show the strongest positive correlation with temperature—0.53 and 0.44 with TMAX, respectively—suggesting that as temperatures rise, these crimes tend to increase. In contrast, Homicide_Count and Sex_Crime_Count display very weak correlations with temperature (around 0.24 and 0.04), indicating that these crimes may not be strongly influenced by weather patterns. The overall Crime_Count shows a moderate correlation with temperature (0.35), reinforcing the notion that certain violent crimes are more temperature-sensitive than others. This heatmap supports the hypothesis that weather, particularly warmth, has a measurable impact on specific types of crime activity, making it a valuable tool for crime trend analysis.
- This heatmap shows the Pearson correlation coefficients between temperature (TMAX and TMIN) and various types of crime counts in your Chicago dataset. Here's how to interpret what it's telling us:

10.3.1 *Temperature vs. Crime.*

- TMAX vs. Crime_Count = 0.35
- TMIN vs. Crime_Count = 0.35. These are moderate positive correlations, meaning as temperature increases, total crime count tends to increase—but not extremely strongly.

10.3.2 *Querry.*

- SELECT TMAX, TMIN, Crime_Count, Assault_Count, Battery_Count, Homicide_Count, Sex_Crime_Count FROM crime_weather_data WHERE TMAX IS NOT NULL AND TMIN IS NOT NULL;

10.3.3 *Crime Types Most Correlated with Temperature.*

- Assault_Count vs. TMAX = 0.53
- Battery_Count vs. TMAX = 0.44. These two types of crimes show the strongest positive correlation with daily high temperatures. This supports the idea that warmer weather encourages more aggressive or confrontational crimes, likely due to increased social interaction outdoors.

10.3.4 *Crime Types Weakly or Negatively Correlated.*

- Homicide_Count vs. TMAX = 0.24 (weak positive)
- Sex_Crime_Count vs. TMAX = 0.04 (almost no correlation)
- Crime_Count vs. Homicide_Count = -0.04 (slightly negative)

10.3.5 *heatmap backs up earlier visualizations.*

- As temperature increases, especially to mild or warm levels, assaults and batteries increase.
- Other crime types, especially homicides and sex-related crimes, are relatively unaffected by temperature.

10.3.6 *Conclusion.*

- This fits well with theories that weather influences crimes of opportunity or aggression, while more premeditated crimes stay consistent.

10.4 Conclusion

- The comprehensive analysis of the relationship between temperature variations and violent crime occurrences in Chicago from 2010 to 2025 provides valuable insights into how environmental factors influence crime patterns. Our study employed various data mining techniques, including exploratory data analysis, clustering, and correlation analysis, to uncover significant trends and patterns.

- Our findings confirm that violent crimes, particularly assaults and batteries, exhibit a clear correlation with temperature variations. Specifically, crime rates rise notably during moderate temperature ranges, peaking around 70°F to 80°F, and decline during extremely hot or cold periods. This observation aligns with established criminological theories, such as Anderson's heat hypothesis, which suggests that warmer temperatures increase human aggression and social interactions, thus creating more opportunities for violent encounters.
- Furthermore, the Pearson correlation heatmap reinforced the non-linear, moderate-strength relationship between temperature and specific violent crimes, particularly assaults and batteries, highlighting these crimes' sensitivity to temperature fluctuations. Conversely, homicides and sex-related crimes showed minimal correlation with temperature, indicating these crimes are less influenced by weather conditions and likely driven by different factors.
- This research carries practical implications for law enforcement and urban planners, emphasizing the necessity of strategically allocating resources and deploying preventive measures during moderate weather conditions, especially during the first warm days following colder periods. Policymakers could leverage these insights to develop targeted interventions, such as community engagement initiatives and enhanced patrol scheduling during identified peak crime periods.
- While our study successfully identifies a clear temperature-crime relationship, it also highlights limitations inherent in relying solely on temperature highs and lows without additional contextual factors such as humidity, geographic location within the city, and specific socioeconomic contexts. Future research incorporating these elements could further refine predictive models and enhance crime prevention strategies.
- In conclusion, integrating climate data into crime analysis provides a robust framework for predicting and preventing violent crime. This research underscores the critical role environmental factors play in public safety and highlights opportunities for targeted interventions to improve community well-being.

11 ACKNOWLEDGEMENTS

- We also extend our appreciation to the City of Chicago and the National Centers for Environmental Information (NOAA) for providing publicly available crime and weather datasets. These datasets form the foundation of our research, enabling us to explore the correlation between temperature and violent crime trends.

REFERENCES

[1] C. A. Anderson. "Temperature and aggression: Ubiquitous effects of heat on occurrence of human violence." *Psychological Bulletin*, vol. 102, no. 1, pp. 27–51, 1987.

[2] K. D. Harries, S. J. Stadler, and R. T. Zdorkowski. "Seasonality and Assault: Explorations in Inter-neighborhood Variation, Dallas 1980." *Annals of the Association of American Geographers*, vol. 74, no. 4, pp. 590-604, 1984.

[3] Craig A. Anderson. Temperature and aggression: Ubiquitous effects of heat on occurrence of human violence. *Psychological Bulletin*, 106(1):74–96, 1989.

[4] M. Ranson. "Crime, weather, and climate change." *Journal of Environmental Economics and Management*, vol. 67, no. 3, pp. 274-302, 2014.

[5] City of Chicago. "Chicago Crime Data (2001–Present)." Available: https://data.cityofchicago.org/Public-Safety/Crimes-2001-to-Present/ijzp-q8t2/about_data. Accessed: Feb. 2025.

[6] National Centers for Environmental Information (NOAA). "Chicago Weather Data." Available: https://www.ncdc.noaa.gov/cdo-web/datasets/LCD/stations/WBAN:14819/detail. Accessed: Feb. 2025.

[7] J. Han, M. Kamber, and J. Pei, *Data Mining: Concepts and Techniques.* 3rd ed., Morgan Kaufmann, 2011.