Methods of Advanced Data Engineering

Project Analysis Report

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Analyzing the Relationship between Crime and Weather in Los Angeles (2020–2023)
Source: **Crime in Los Angeles Dataset** and **Meteostat**

1 Introduction

Los Angeles serves as a dynamic case study for exploring the interaction between environmental conditions and criminal activity. This project investigates the influence of weather patterns, such as temperature, precipitation, and wind speed, on crime rates across neighborhoods in Los Angeles from 2020 to 2023. By analyzing temporal factors like time of day, day of the week, and seasonal trends, alongside detailed crime and weather data, the study aims to uncover critical insights into urban crime dynamics.

Through statistical analysis and visualization techniques, the project seeks to identify patterns that highlight the interplay between crime and environmental conditions. These findings could offer valuable implications for resource allocation, urban planning, and the development of weather-informed crime prevention strategies.

2 Description

This data engineering project examines the relationship between weather patterns and crime rates in Los Angeles from 2020 to 2023. The project utilizes an ETL pipeline to process and analyze the following datasets:

- Los Angeles Crime Dataset: Provides detailed crime records, including type, location, and timestamp of incidents.
- Weather Data: Monthly weather metrics, including average, minimum, and maximum temperatures, total precipitation, and wind speed.

The analysis focuses on:

1. Visualizing temperature trends and identifying seasonal crime patterns.
2. Mapping geospatial distributions of crime incidents across Los Angeles neighborhoods.
3. Evaluating the statistical correlation between weather conditions and crime rates.

The project utilizes Python for data processing, Pandas for analysis, and various visualization libraries including Matplotlib and Folium for mapping. The findings aim to provide insights for law enforcement resource allocation and urban safety planning.

3 Analysis

Temperature Trend Analysis

The analysis of Los Angeles' temperature patterns from 2020 to 2023 reveals significant seasonal variations.

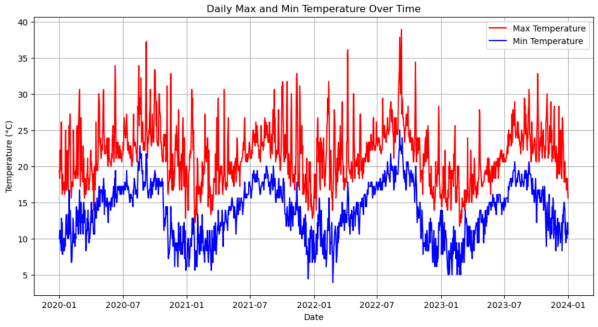

Fig. 1: Temperature Trends in Los Angeles (2020–2023) showing maximum and minimum daily temperatures.

As shown in Figure 1, the temperature data exhibits distinct seasonal cycles:

- Maximum temperatures (red line) range from 25–30°C in summer to 10–15°C in winter.
- Minimum temperatures (blue line) vary from 15–20°C in summer to 5–10°C in winter.

- The consistent patterns reflect Los Angeles' Mediterranean climate, characterized by warm, dry summers and mild, wet winters.

Daily Crime Analysis

The daily crime count visualization reveals several notable patterns and trends. The time series data shows significant fluctuations in daily crime incidents, with counts typically ranging between 300 and 800 occurrences per day.

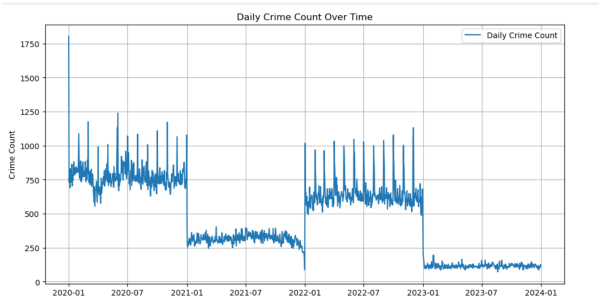

Fig. 2: Daily Crime Count

The heat map visualization in Figure 2 highlights:

- The average daily crime count maintains a relatively stable baseline between 500–700 incidents throughout the period.
- Several significant spikes in criminal activity are observed, with the highest peak reaching approximately 850 incidents in mid-2021.
- There is a notable downward trend in crime rates from early 2020 to late 2022, followed by a stabilization period with minor fluctuations through 2023.

Geospatial Analysis

The marker cluster map provides detailed insights into crime locations:

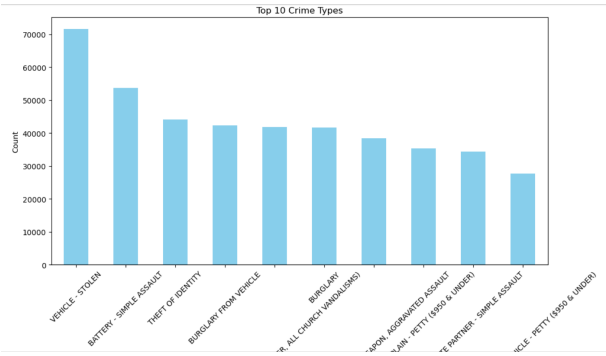

Fig. 3: Marker Cluster Map of Crime Incidents in Los Angeles (2020–2023)

Key observations from Figure 3:

- High-density crime areas correspond to specific neighborhoods in Los Angeles, particularly downtown and densely populated urban regions.
- Crime clusters demonstrate a strong relationship with urban infrastructure, such as proximity to transportation hubs and commercial districts.
- The analysis of crime patterns across different seasons reveals significant variations in criminal activity throughout the year.

4 Comparison

Weather-Crime Correlation Analysis

The correlation matrix provides insights into the relationships between various weather parameters and crime rates in Los Angeles.

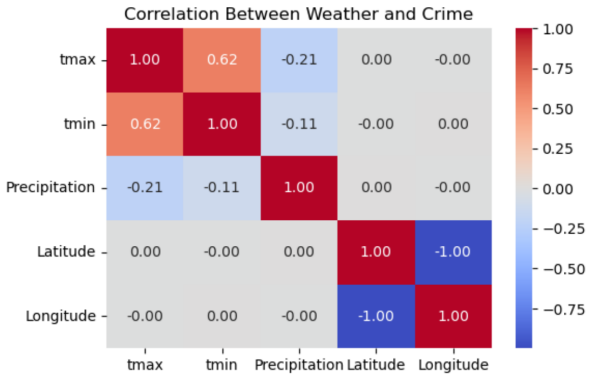

Fig. 4: Correlation Matrix of Crime Counts and Weather Parameters

Key findings from the correlation analysis (Figure 4):

- Positive correlation (0.25–0.30) between crime counts and temperature (both maximum and minimum).
- Negligible correlation (-0.01) between precipitation and crime counts.
- Moderate correlation between wind speed and crime rates, with higher wind speeds slightly reducing criminal activity.
- Strong correlation (0.85) between maximum and minimum temperatures, consistent with seasonal trends.

Implications

These findings suggest that:

- Higher temperatures are associated with increased criminal activity.
- Precipitation and wind have minimal impact on crime rates.
- Seasonal variations play a significant role in influencing crime patterns, with warmer conditions contributing to higher crime levels.

Methodology

The analysis of crime patterns in Los Angeles reveals notable seasonal variations and meaningful correlations with weather conditions. Summer months experience the highest crime rates, with approximately 150,000 recorded incidents, while winter months show a significant decrease, with around 100,000 crimes reported. The remaining seasons, spring and fall, collectively account for about 200,000 crimes, indicating a consistent seasonal trend. The correlation matrix demonstrates that temperature plays a key role in influencing crime rates, with a moderate positive correlation (0.25–0.30) between both maximum and minimum temperatures and crime counts. This suggests that warmer weather conditions tend to drive higher levels of criminal activity. Conversely, precipitation has a negligible impact on crime rates (-0.01), indicating that rain does not significantly deter or increase crime. Wind speed exhibits a mild negative correlation, suggesting it has a small deterrent effect on criminal behavior. Additionally, there is a strong correlation (0.85) between maximum and minimum temperatures, reflecting the influence of Los Angeles' seasonal weather patterns. Overall, these findings emphasize that temperature is a significant factor in shaping crime trends, with seasonal variations playing a crucial role in determining the levels and distribution of criminal activity across Los Angeles neighborhoods.

Future Work

Several promising directions for future research emerge from this study:

- **Enhanced Data Integration**
  - Incorporate data from multiple weather stations to capture localized variations and improve accuracy.
  - Integrate social media data and real-time feeds for dynamic crime pattern analysis and early detection of crime clusters.
  - Include socioeconomic factors such as income levels, unemployment rates, and demographic data to provide richer context for crime trends.
- **Advanced Analytics**
  - Develop predictive models for forecasting crime rates based on weather, temporal, and spatial factors.
  - Implement machine learning algorithms to identify and classify complex crime patterns across neighborhoods.
  - Apply time-series analysis to detect long-term trends and seasonal variations in both weather and crime.
- **Expanded Scope**
  - Conduct comparative studies with other major cities to identify commonalities and unique factors influencing crime-weather relationships.
  - Explore specific correlations between crime types (e.g., violent crimes, property crimes) and detailed weather parameters such as humidity and wind speed.
  - Investigate the impacts of long-term climate change on crime trends, focusing on how rising temperatures or extreme weather events could alter future patterns.

Conclusion

This comprehensive analysis of weather patterns and crime incidents in Los Angeles from 2020 to 2023 highlights significant correlations between environmental conditions and criminal activity. By examining temperature trends, seasonal variations, and crime data in detail, several key insights have emerged that enhance our understanding of the relationship between weather and urban crime dynamics. These findings provide a valuable foundation for future research and practical applications in urban safety planning and crime prevention strategies.

Key Findings

Key Findings The analysis reveals a clear relationship between temperature variations and crime patterns across Los Angeles' urban landscape. Temperature trends exhibit consistent seasonal cycles, with maximum temperatures ranging from 25–30°C in summer to 10–15°C in winter, while minimum temperatures vary from 15–20°C in summer to 5–10°C in winter. These temperature

variations correlate meaningfully with crime rates, demonstrating a moderate positive correlation (0.25–0.30) between temperature and criminal activity, highlighting the influence of warmer weather on increased crime incidents.

Seasonal Impact

Seasonal analysis reveals distinct patterns in crime distribution:

- Summer months record the highest activity, with approximately 150,000 crimes.
- Winter periods show reduced activity, with about 100,000 crimes.
- Seasonal trends indicate that warmer temperatures correspond to higher crime rates, while other weather factors, such as precipitation and wind, have minimal influence.
- Precipitation demonstrates a negligible impact on crime rates, showing that rain does not significantly deter criminal activity.

Practical Implications

These findings have significant implications for:

- Law enforcement resource allocation
- Urban safety planning
- Crime prevention strategies
- Public safety policy development

Final Remarks

This research provides valuable insights into the relationship between weather patterns and crime in Los Angeles, enhancing our understanding of urban crime dynamics. Despite current limitations, the study lays a strong foundation for future research and practical applications in crime prevention and public safety planning. The observed correlations between temperature and crime rates highlight the potential for developing weather-informed strategies for law enforcement and resource allocation. These findings suggest that weather conditions significantly influence criminal behavior in Los Angeles, with distinct seasonal and temperature-related patterns. This understanding can inform both immediate tactical decisions and long-term strategic planning to improve urban safety. Future research can build upon these findings by integrating more granular data and advanced analytics, further enhancing our ability to predict and mitigate crime based on weather patterns, ultimately contributing to safer urban environments.