



Crime Pattern Analysis in Indian Cities Using Data Visualization Techniques

Sector Name-Urban Safety And Crime Analysis

Team ID -Section C Group 4

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Context & Problem Statement

Sector Context :

Law enforcement agencies across Indian cities manage a large volume of crime cases annually. In the absence of centralized analytical systems, decision-makers such as police departments and urban safety planners face challenges in monitoring crime trends, investigation timelines, and efficient resource allocation.

Problem Statement :

This project analyzes historical crime data across Indian cities to understand distribution patterns across crime categories, victim groups, and temporal cycles.

Objective :

This project aims to transform historical crime data into meaningful analytical insights. It focuses on identifying crime reporting patterns and investigation timelines across cities. The analysis supports efficient resource allocation and prioritization of high-risk areas. It ultimately enables data-driven decision-making for improved policing and urban safety planning.

Data Engineering

Source:

Name: Kaggle Indian City Crime Records Dataset

Size: ~7,000 Records × 21 Columns

Time Period: 2020 – 2025 (Crime Occurrence & Case Resolution Timeline)

Cleaning :

- Handled missing values in Date Case Closed by marking unresolved cases as “Not Closed”
- Standardized inconsistent date & time formats for Date of Occurrence, Date Reported, and Time of Crime
- Cleaned categorical inconsistencies in Crime Domain, Weapon Used, Victim Gender for accurate grouping and analysis

Dictionary :

Report Number – Unique identifier for each crime case

Date Reported / Date of Occurrence – Used for temporal trend & reporting delay analysis

City – Enables spatial distribution and hotspot identification

Crime Domain – Categorization into Violent Crime, Traffic Fatality, Other Crime, etc.

Date Case Closed – Used to calculate case resolution time

Ticket Status – Indicates case status (Active / Solved) for resolution KPIs

KPI & Metrics Framework

What are we measuring?

- Crime Rate by City
- Yearly Crime Growth Rate
- Crime Category Distribution
- Monthly Crime Frequency
- Time-of-Day Crime Rate
- Victim Gender Distribution
- Victim Age Group Distribution
- Weapon Usage Rate
- Case Resolution Rate
- Active vs Solved Case Ratio
- Resolution Speed Index
- Police Deployment per Case
- Reporting Delay Time
- Case Closure Time
- Cases Closed Within 30 Days (%)

Why these KPIs? How do they link to the problem?

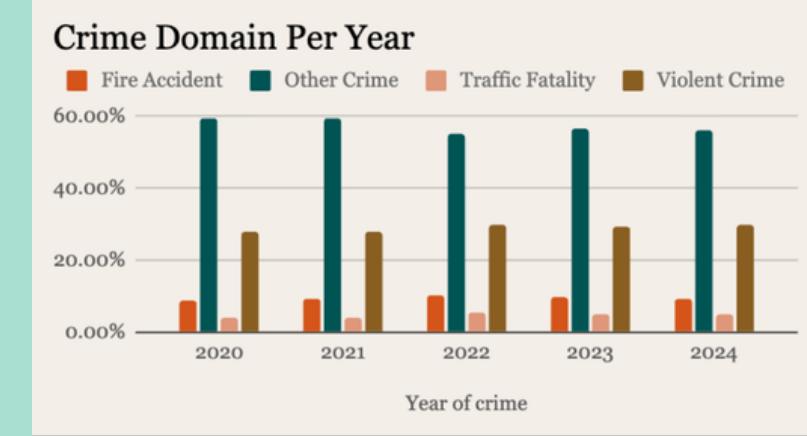
- Identify high-crime cities for targeted policing and resource allocation
- Understand crime type distribution to plan prevention strategies
- Track crime trends over time for future safety planning
- Detect peak crime periods for patrol scheduling
- Analyze victim demographics for risk-based protection policies
- Evaluate case resolution efficiency of law enforcement
- Measure reporting delays affecting investigation timelines
- Monitor closure timelines to improve justice delivery
- Assess police deployment effectiveness per incident



Key Insights

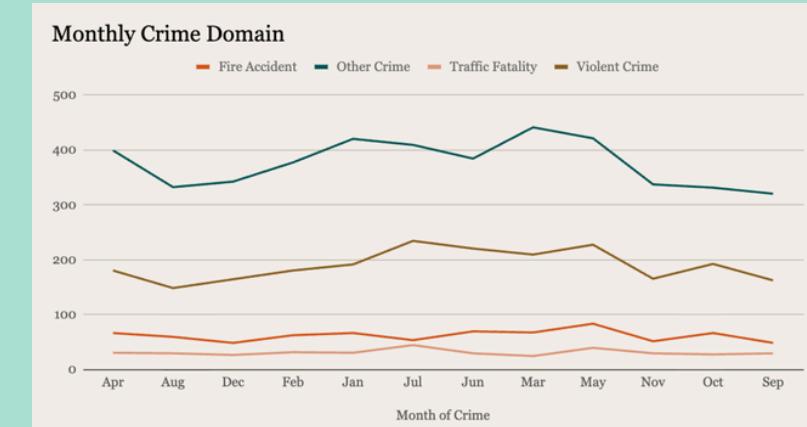
Crime Domain Per Year:

Across all observed years, Other Crimes and Violent Crimes consistently form the majority of total reported incidents, indicating recurring law enforcement challenges in non-traffic and violent offence categories.



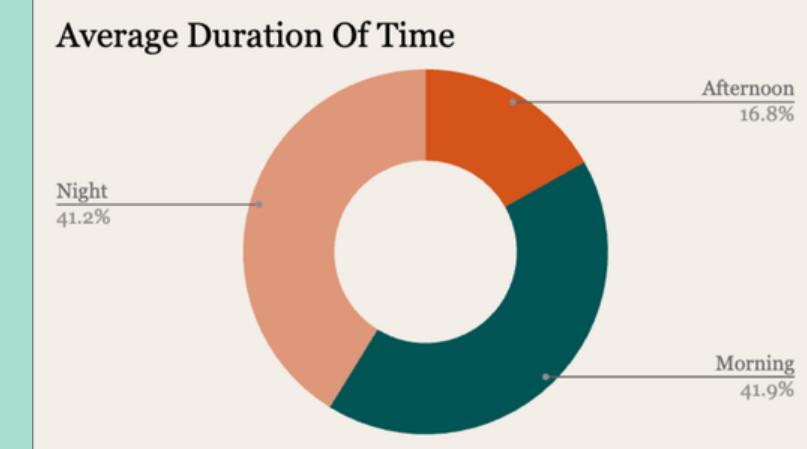
Monthly Crime Domain:

Crime reporting demonstrates noticeable monthly fluctuations, with certain months showing peak incident levels, suggesting seasonal or socio-economic influences on crime occurrence patterns.



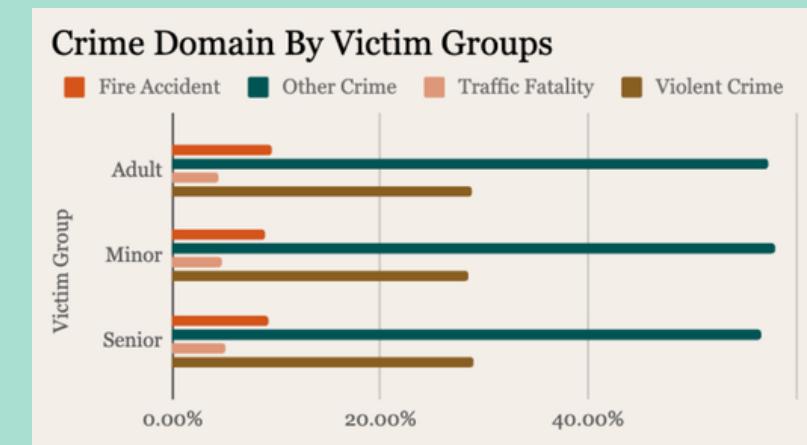
Average Duration Of Time:

A majority of crimes occur during Morning and Night time periods (~82%), indicating time-specific vulnerability windows that require targeted police patrolling strategies.



Crime Domain By Victim Group:

Adult victims account for the highest proportion of crime cases across all crime domains, suggesting increased exposure of the working-age population to urban crime risks.



Weapons Used:

The widespread use of blunt objects and firearms across cities highlights the severity of violent incidents and the need for stricter weapon control and preventive surveillance mechanisms.

Advanced Analysis

Complex Analytical Approach Implemented: Segmentation & Root Cause Analysis

To move beyond descriptive statistics, advanced analytical techniques were applied to segment crime incidents based on resolution timelines, crime domains, victim demographics, and police deployment levels. Cases were categorized into resolution-speed groups such as Fast, Moderate, Slow, and Pending to identify operational bottlenecks within investigative workflows.

Additionally, root cause analysis was conducted to examine the relationship between case resolution time and influencing factors such as manpower allocation, crime type, and reporting delays. Comparative analysis across cities and victim groups enabled identification of structural inefficiencies and demand–resource mismatches.

New Understanding Derived:

- Highlighted that delayed reporting significantly increases average case resolution time
- Identified specific crime domains consistently associated with prolonged investigations
- Revealed cities with disproportionately high police deployment but lower resolution efficiency
- Detected vulnerable victim groups experiencing slower case closures
- Enabled prioritization of operational interventions for high-delay crime segments

Dashboard Walkthrough

Executive View

The Executive View provides a consolidated snapshot of overall crime performance across cities through key performance indicators such as total reported crimes, case resolution rate, police deployment levels, and average investigation duration.

Key Metrics Included:

- Total Reported Crime Incidents
- City-wise Crime Contribution
- Case Resolution Efficiency
- Average Police Personnel Deployment
- Average Case Resolution Time

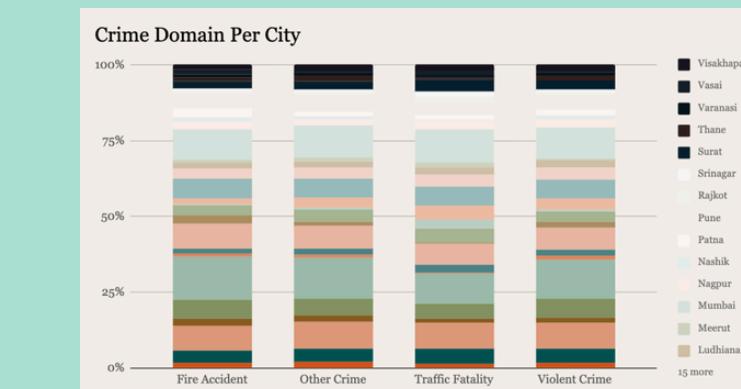
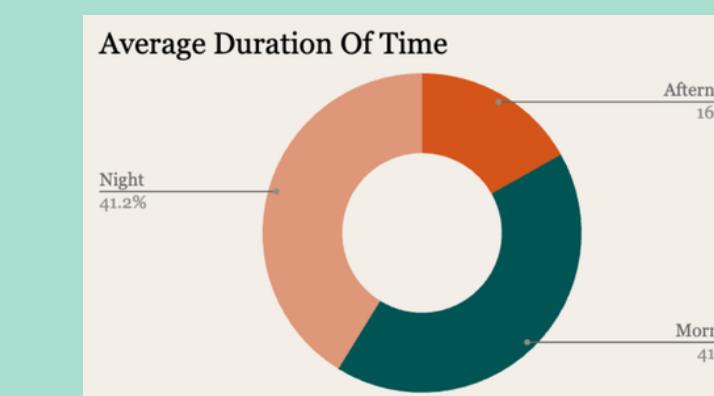


Operational View

The Operational View allows law enforcement teams to analyze crime patterns in depth through time-based, location-based, and category-level visualizations. It supports detailed monitoring of crime distribution, reporting delays, and resolution performance across different cities and time periods.

It helps operational teams to:

- Identify peak crime reporting periods
- Analyze city-wise crime concentration
- Track investigation timelines
- Optimize police deployment based on case load



Recommendations

1. Prioritize High-Crime Cities with Targeted Resource Allocation:

Given that a small group of cities contributes disproportionately to total crime volume (e.g., Delhi at 13%), law enforcement agencies should adopt a risk-based allocation model. Increased patrol units and faster case-processing teams should be deployed in high-intensity crime zones.

2. Reduce Case Resolution Time through Process Optimization:

With an average resolution time of ~91 days, investigation cycles appear prolonged. Implementing case tracking dashboards, periodic review checkpoints, and fast-track handling for recurring crime categories can significantly improve closure efficiency.

3. Strengthen Night-Time and Peak-Month Surveillance

Since crime occurrence is higher during Morning and Night periods, predictive patrolling strategies and AI-driven hotspot mapping should be implemented during high-risk windows to prevent incidents proactively.

4. Focus Preventive Policies on Dominant Crime Categories

As Violent and Other Crimes remain consistently high across years, long-term preventive strategies such as community awareness programs, surveillance expansion, and stricter weapon control policies should be implemented.

Impact & Value

The “So What?” – Business Impact

Implementation of the recommended data-driven resource allocation and investigation optimization strategies can significantly enhance law enforcement efficiency and operational performance.

Estimated Organizational Impact:

- Reduction in Average Case Resolution Time by 15–25% through process optimization and fast-track handling
- Improved Police Deployment Efficiency by identifying high-crime zones for targeted patrolling
- Potential Reduction in Crime Occurrence during peak hours via predictive surveillance strategies
- Enhanced Investigation Productivity without proportional increase in manpower
- Lower Operational Costs due to optimized resource utilization and reduced investigation backlog

Why Should Stakeholders Approve This?

- Enables data-backed strategic planning rather than reactive decision-making
- Improves public safety outcomes through faster case closures
- Maximizes utilization of existing law enforcement resources
- Supports long-term crime prevention through targeted interventions
- Strengthens accountability and performance monitoring across departments

Limitations & Next Steps

Data Gaps / Biases

- Presence of unresolved cases resulted in incomplete resolution timelines
- Limited demographic-level data restricted deeper victim profiling
- Potential inconsistencies in reporting standards across cities
- Absence of real-time data limits predictive accuracy
- Historical dataset may not reflect recent crime pattern shifts

What Can Be Improved in Future?

- Integration of real-time crime reporting systems
- Inclusion of socio-economic and demographic variables
- Application of predictive modeling for crime forecasting
- Deployment of AI-based anomaly detection for pattern recognition
- Development of automated decision-support dashboards for dynamic resource planning