Boston Crime Data Analysis (2016–2024)

Exploring Patterns, Trends, and Strategic Insights through Visualization

College of Professional Studies Northeastern University, Toronto

ALY 6070 Communicate/Visualize Data Analysis

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Submitted To:

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Purpose of Assignment

This report fulfils the initial data analysis requirements for ALY6070 by examining the Boston Crime Data from 2016 to 2024. The analysis aims to explore key variables, detect patterns and trends, propose stakeholder questions, and recommend appropriate visualization strategies. The ultimate objective is to support the design of an insightful dashboard that communicates the findings ethically and clearly.

Review of the Dataset

After reviewing the Boston Crime Data spanning from 2016 to 2024, the dataset contains valuable information related to criminal incidents reported across various police districts. Each record represents an individual crime event, with attributes capturing the type of offense, the date and time it occurred, the location, whether a shooting was involved, and other related details.

The goal of this initial review is to identify key drivers for further analysis by understanding the structure of the dataset, the meaning behind each variable, and how different attributes may correlate. By analyzing these fields, we can uncover important trends, highlight critical areas for public safety planning, and inform the design of meaningful visualizations.

Key Variables Identified

After reviewing the dataset structure, the following variables were identified as critical for the initial analysis and exploration of crime patterns:

1. **OCCURRED_ON_DATE**: Records the date when the incident occurred. This variable is essential for understanding yearly, monthly, and seasonal crime trends.
2. **OFFENSE_CODE_GROUP**: Provides a categorical classification of the crime (e.g., Larceny, Assault, Robbery). It allows grouping incidents into meaningful crime types for analysis.
3. **DISTRICT**: Indicates the Boston Police district where the crime was reported (e.g., B2, C11, D4). Useful for geographic and jurisdictional crime comparisons.
4. **SHOOTING**: Identifies if the incident involved a shooting (marked as “Y”). Important for focusing on firearm-related violence trends.

5. **LOCATION**: Provides latitude and longitude data, enabling potential spatial or map-based visualizations.
6. **Year, Month, DayOfWeek** *(derived fields)*: Created from OCCURRED_ON_DATE to explore patterns over different time frames, such as crime distribution by day of week, month, and year.
7. **OFFENSE_DESCRIPTION**: Offers a more detailed description of the crime. It helps deepen insights into specific types of offenses beyond the broader OFFENSE_CODE_GROUP.

Patterns, Trends, and Correlations Observed

After analyzing the Boston crime data from 2016 to 2024, several patterns, trends, and potential correlations were observed across time periods, crime types, districts, and incidents involving shootings. These insights provide a foundation for deeper understanding of public safety challenges and opportunities for targeted intervention.

1. **Total Crime Volume by Year:** Crime incidents have fluctuated throughout the nine-year period. There was a noticeable drop in crime counts during 2020, which aligns with the COVID-19 pandemic period. A gradual recovery in incident counts can be observed from 2021 onwards. In 2023 and 2024, a sharp spike is visible, possibly reflecting increased reporting or real growth in incidents.

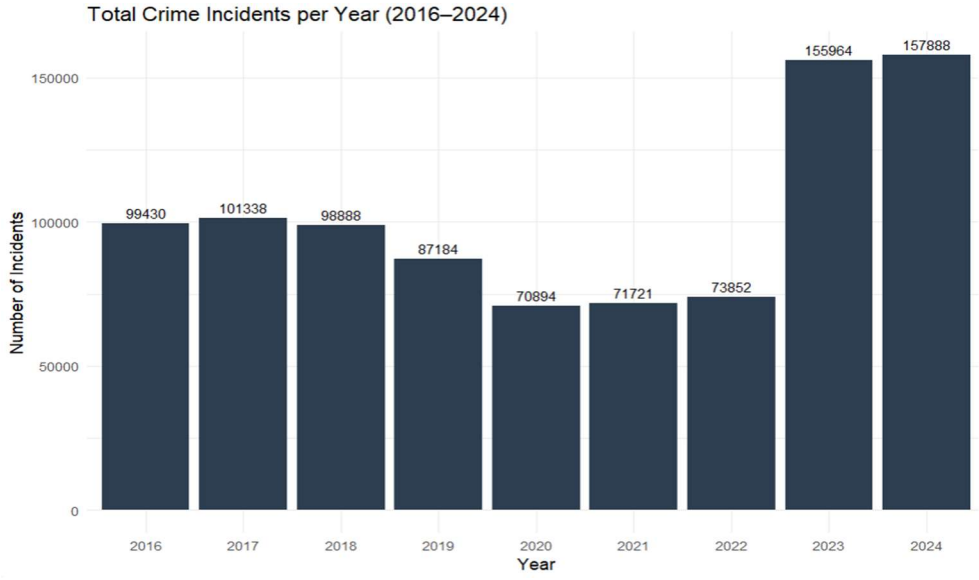

Figure 1: Total Crime Volume By year

The chart above confirms these trends, with visual clarity highlighting the significant rise in 2023 and 2024, and the dip during 2020–2021.

2. **Shooting Incidents Trend:** Shooting incidents showed consistent growth from 2016 to 2020, peaking at over 1100 in 2020. Although there was a dip in 2021 and 2022, the count peaked again in 2023 at 1272 incidents before slightly falling in 2024.

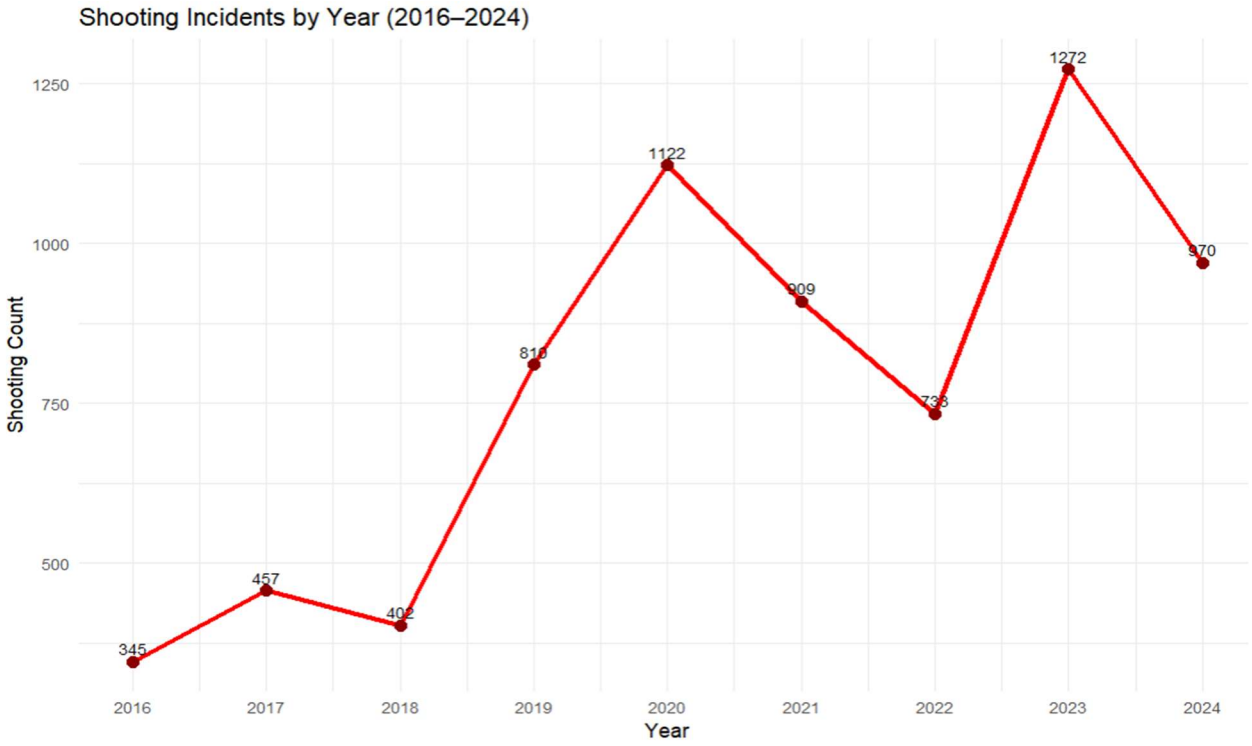

Figure 2: Shooting Trend By Year

This trend reveals not only an increasing concern in gun-related violence but also the need to verify data consistency over years, particularly in years with sharp changes.

3. **Top 10 Crime Categories:** Larceny, Medical Assistance, and Motor Vehicle Accident Response were among the most frequently reported offenses across all years. Larceny remained a dominant type, suggesting a need for preventive programs and stronger property-related enforcement.

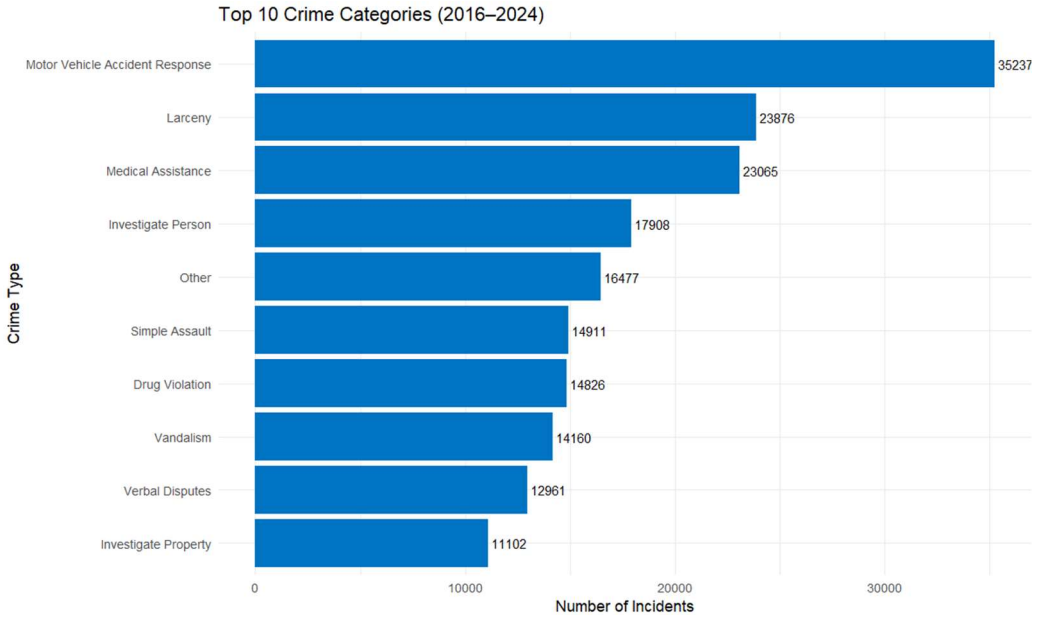

Figure 3: Top 10 crime Categories

As seen in the graph, Motor Vehicle Accident Response accounted for the highest number of incidents, possibly due to improved logging of non-criminal events or classification practices in more recent years.

4. **Crime by Day of the Week and Year:** Crimes tended to peak mid-week across all years, especially on Tuesdays and Wednesdays. The volume varied by year, with 2023 and 2024 seeing the highest weekday crime levels.

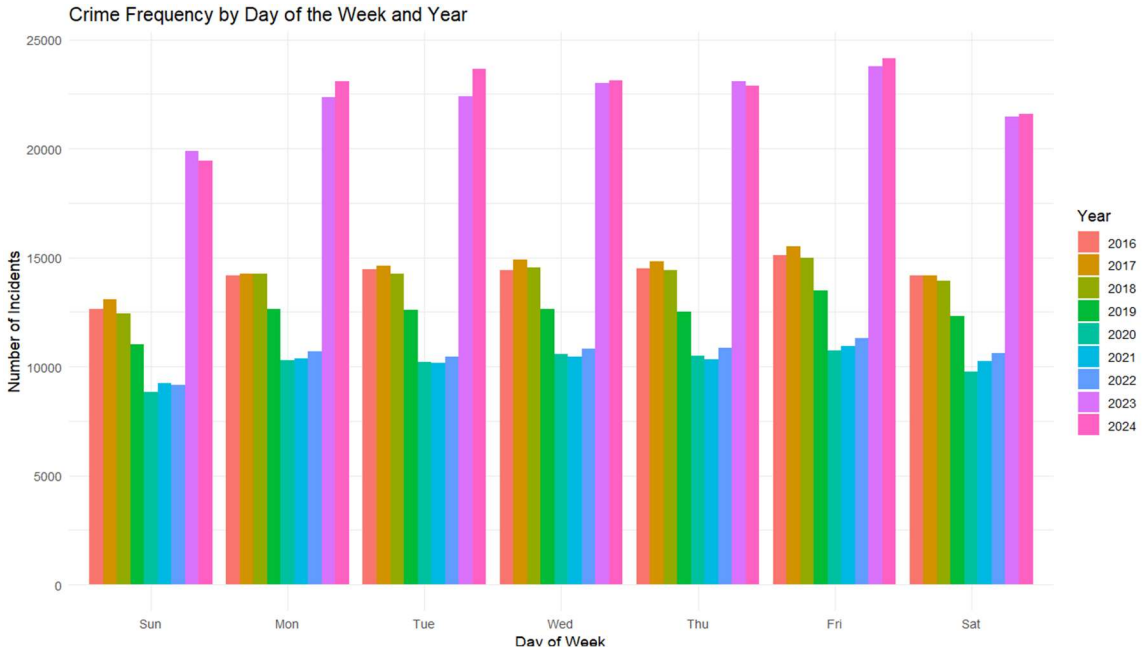

Figure 4: Crime by DayOf week & Year

This temporal pattern shows consistency across years, with weekday activity dominating overall crime distribution.

5. **District-Level Crime Distribution:** The districts with the highest number of incidents were B2, D4, and C11. These areas may reflect higher population densities, socioeconomic vulnerability, or historically underserved public safety needs.

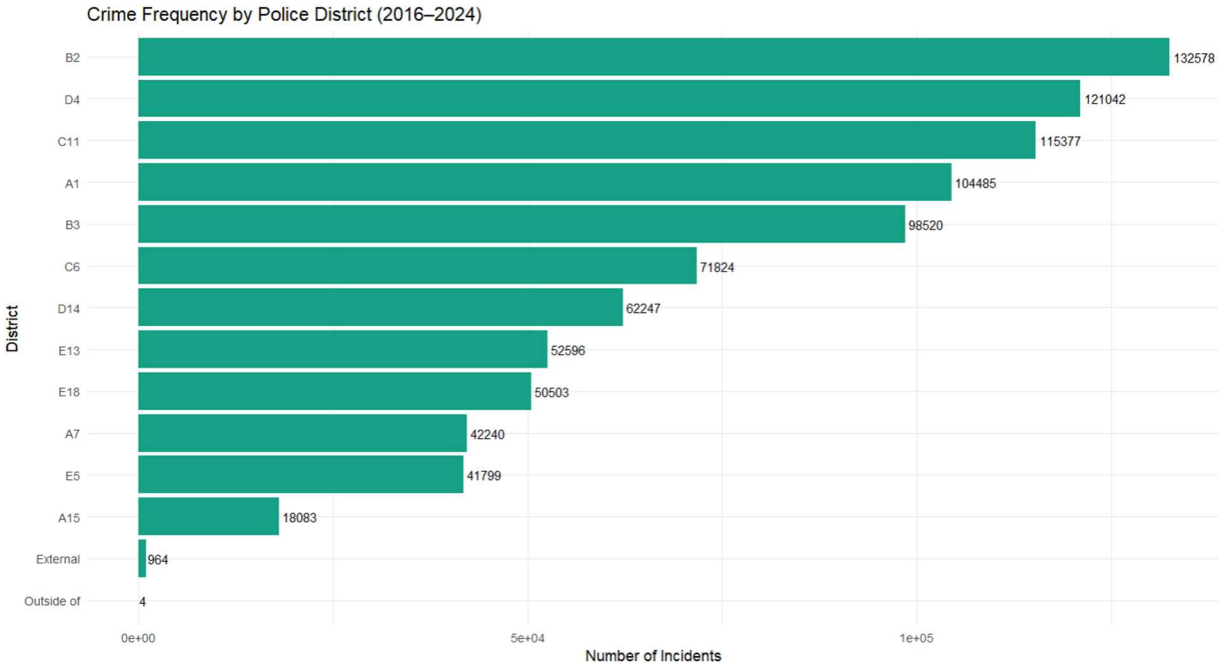

Figure 5: District Level Crime Distribution

The visual clearly identifies hotspots that could benefit from additional public safety resources and proactive community engagement.

6. **Heatmap: Crime by Month and Day (Yearly):** A heatmap comparing each year by month and weekday revealed that crimes tend to be higher during summer months (especially June, July, and August) and mid-week (Tuesday through Thursday).

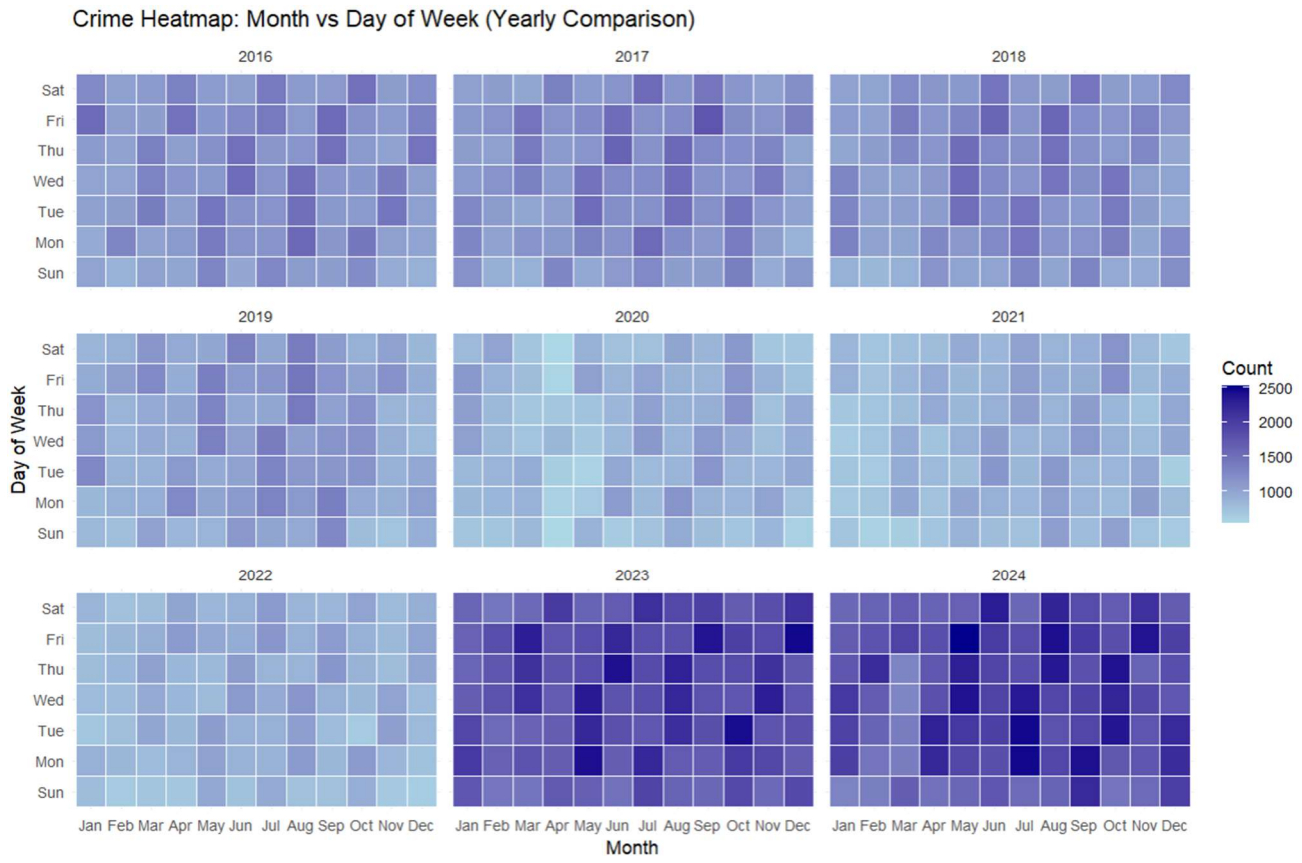

Figure 6: Heat Map Of crime By Month & Day

This multi-year view confirms stable seasonality and weekday spikes, which should inform scheduling for patrols and prevention programs.

Critical Insights: The year 2020 stands out as a unique disruption in crime patterns, likely due to pandemic-related societal changes. Additionally, the large increase in overall crime reports in 2023 and 2024 suggests a combination of increased reporting, population growth, or shifting classifications.

District-focused trends suggest that targeted deployments and localized prevention strategies could have meaningful impact. Overall, time-based factors (year, month, day), district location, and offense type emerged as the strongest drivers of crime trends.

Audience and Anticipated Questions

The primary audience for this analysis includes multiple groups that are directly involved in public safety management and urban decision-making:

- **Boston Police Department Leadership**: To plan resource allocation, patrol schedules, and crime intervention programs based on crime trends.
- **Public Safety and Emergency Response Officials**: To prioritize emergency response planning and community safety initiatives according to geographic crime concentrations.
- **City Government Policymakers**: To guide funding decisions, legislative priorities, and community investment programs aimed at reducing crime and enhancing neighbourhood security.
- **Community Outreach and Crime Prevention Units**: To design educational and preventive campaigns targeting the most affected communities and crime types.

Each of these groups will use the dashboard and data insights to support different operational, policy, and community strategies. Their specific questions would likely focus on understanding patterns, identifying areas of concern, and acting proactively to mitigate future risks.

The audience may ask the following key questions about the data:

- **How has the overall crime volume changed year-over-year from 2016 to 2024?** To assess whether current crime prevention efforts are effective.
- **Which types of crimes are most prevalent, and are any specific crime categories growing in frequency?**

  To prioritize which offenses, require immediate attention.
- **Are shootings becoming more or less frequent over the years, and are there any particular districts heavily affected?**

  To allocate special response units and violence prevention initiatives.
- **Which police districts report the highest volume of crimes?** To strategically deploy patrols and direct community programs.
- **What are the peak days of the week and months for criminal activities?** To optimize staffing schedules and focus deterrence programs.
- **Has the pandemic (COVID-19) created any noticeable shifts in crime trends, either short-term or lasting?**

To adjust long-term public policy and funding allocations.

- **Can geographic crime hotspots be identified for targeted neighborhood policing efforts?**
  To improve visibility and trust in high-risk areas.
- **What trends suggest opportunities for preventive campaigns or awareness efforts in specific communities?**

  To reduce the risk of victimization through public education.

Questions to Answer Through Data Visualizations

The visualizations are designed not just to describe the crime data but to actively answer critical questions that the audience would have. Each graph or chart provides a visual story that helps stakeholders interpret complex crime patterns quickly and make data-driven decisions. By structuring the visuals around clear, meaningful questions, the dashboard will guide public safety officials, policymakers, and community leaders in identifying trends, risks, and opportunities for improvement.

The following questions are proposed to be addressed through the dashboard visualizations:

- **How has the total number of crime incidents evolved from 2016 to 2024?** (Answered through a time-series bar chart on total crime volume.)
- **Are shooting incidents increasing, decreasing, or stable over the years?** (Displayed through a yearly shooting trend line chart.)
- **What are the top 10 most common crime categories reported during the study period?** (Highlighted in a ranked bar chart showing offense types.)
- **Which police districts consistently report the highest and lowest crime rates?** (Visualized through a district-based bar chart.)
- **How do crime patterns vary by day of the week across different years?** (Revealed through a grouped bar chart by weekday and year.)
- **Are there seasonal peaks in crime across months and days of the week?** (Displayed using a monthly-weekday heatmap for comparative insights.)
- **Where are the geographic crime hotspots located across Boston?** (Optional: If map visualization is used based on latitude and longitude data.)

How a Dashboard Could Be Used to Show Data Clearly

A well-designed dashboard provides a single, interactive view that allows users to quickly explore complex datasets without confusion. For the Boston crime data, a dashboard would help stakeholders interpret patterns, detect changes, and target high-risk areas through visual storytelling rather than raw numbers. Clarity, simplicity, and actionability should be the guiding principles behind the dashboard design.

The dashboard can achieve clarity in the following ways:

- ✓ **Interactive Filters**: Allow users to dynamically filter by year, district, crime type, shooting incidents, or day of the week to focus their analysis on specific areas of interest.
- ✓ **Summary Cards**: Display key statistics at a glance, such as total crimes reported this year, number of shootings, and most common crime types.
- ✓ **Trend Visualizations**: Use line charts and bar graphs to clearly show changes in crime volume over time, making it easy to spot upward or downward trends.
- ✓ **Geographic Mapping**: Include simple maps highlighting high-crime districts or neighborhoods, helping users immediately see where interventions might be needed.
- ✓ **Seasonal and Weekly Patterns**: Utilize heatmaps and grouped bar charts to visualize when crimes are most likely to occur, supporting better scheduling for patrols and resource deployment.
- ✓ **Clean Layout and Color Coding**: Use neutral backgrounds, consistent color schemes, and minimal text clutter so that critical insights stand out and are easy to interpret.
- ✓ **Exportable Visuals**: Enable users to export snapshots of the graphs for use in reports, meetings, or presentations without additional editing.

By focusing on intuitive navigation, minimal clutter, and targeted visual storytelling, the dashboard would ensure that both technical and non-technical audiences can quickly extract meaningful insights and make informed decisions.

Types of Graphs and Charts to Clearly Explain Future Business Questions

Based on the trends observed in the current Boston crime analysis, specific types of graphs and charts will be strategically used in future assignments and dashboard designs to communicate

insights effectively. Each visualization will be selected to match the patterns and behaviors discovered during the initial analysis, ensuring clarity, relevance, and immediate business value.

The following visualization types are recommended:

- **Line Charts**: To track overall crime volume and shooting incidents year-by-year, highlighting any major changes or disruptions such as the 2020 pandemic impact.
- **Bar Charts**: To compare the frequency of different crime types and to rank police districts by total incidents, supporting better resource allocation.
- **Heatmaps**: To uncover and communicate seasonal and weekday crime patterns, identifying peak crime periods for operational planning.
- **Stacked Bar Charts**: To display the distribution of crime across days of the week over multiple years, helping to detect weekday shifts in crime behavior.
- **Geographic Maps (Optional)**: To visualize crime hotspots across Boston, assisting in geographic targeting of patrols and community interventions.
- **Annotated Trend Lines**: To highlight significant real-world events, such as the COVID-19 pandemic, and their impact on crime trends over time.

By aligning future visualizations with the patterns found during the initial review, the dashboard and future reports will provide sharper insights, anticipate audience needs more precisely, and enhance data-driven decision-making.

Reference

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