

# 311 Animal Reports Team B

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This report provides a comprehensive analysis of animal-related complaints in Boston over the last decade, with a focus on data from the past 2-3 years and the previous 5-10 years. The project aims to provide valuable insights into the patterns of these complaints, assisting in city planning, resource allocation, and public health initiatives. By understanding these trends, city officials and relevant stakeholders can make informed decisions to improve community living conditions and animal welfare.

The scope of the analysis is framed by several guiding questions:

1. How many reports were filed in the previous 2-3 years and 5-10 years, and are there any discernible trends in these reports, such as increases or decreases in total numbers?
2. What types of animals are most commonly reported in complaints?
3. Where are the complaints coming from geographically? Is there any trend to type of animal complaint and area?
4. How do other factors such as season impact the nature of the complaints?

Upon our initial analysis, we also came up with the following extension questions to gain further insights that can assist in understanding broader trends and inform future investigations:

1. How does the time of day impact the nature of the complaints?
2. How does the proximity to parks and green spaces impact animal-related complaints? Are there more animal-related complaints in areas closer to parks or green spaces within the city?

These questions aim to dissect the complexities of animal-related complaints in a structured manner, examining the quantitative and qualitative aspects of the data collected. The initial focus is to quantify the number of complaints and identify any significant changes in their frequency over time, thereby determining whether there is an upward or downward trend.

Furthermore, by identifying the types of animals most frequently reported and the geographic hotspots for such complaints, the analysis seeks to uncover patterns that could inform targeted interventions. For example, suppose certain areas report higher numbers of specific animal complaints. In that case, city planners can consider local factors contributing to these patterns, such as urban density, proximity to wildlife habitats, or availability of waste disposal systems.

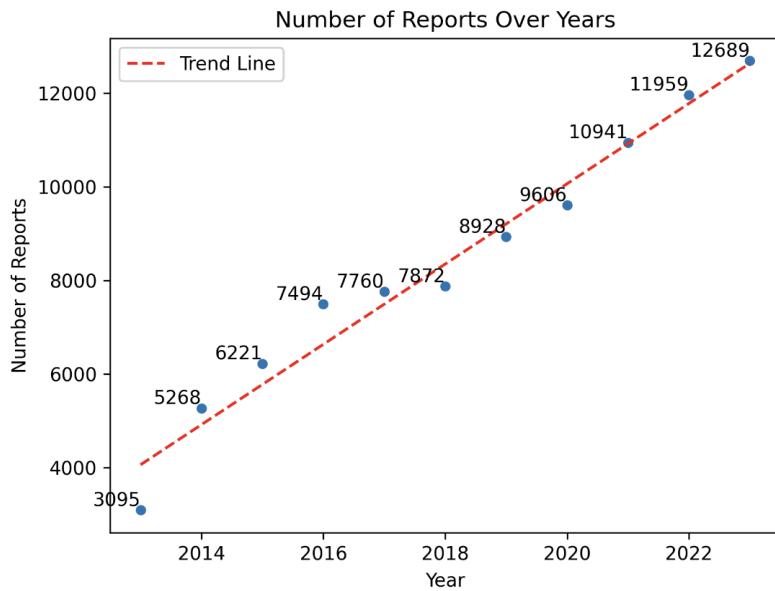
Seasonal variations are also critical, as they may influence the behavior of both humans and animals, potentially leading to an increase in interactions and, consequently, complaints. Understanding these seasonal trends helps with planning resource allocation throughout the year, ensuring that animal control services are prepared and responsive during peak times.

By addressing these foundational questions, the report lays the groundwork for a deeper exploration of how urban environments and human-animal interactions can be managed to reduce conflicts and enhance public safety and animal welfare. This big-picture analysis not only aims to address current challenges but also to predict and mitigate future issues, contributing to the city's long-term planning and sustainability efforts.

## Base Analysis

Navigating the evolving dynamics of human-animal interactions in an urban setting presents a complex array of challenges. This comprehensive analysis concentrates on the nature of animal-related complaints in Boston over the last decade, more specifically on data from 2013 to 2023. We begin by addressing the first of our guiding questions, regarding the volume of complaints in recent years. Are there discernible trends, such as an increase or decrease in the total number of reports?

By scrutinizing these trends, we aim to identify the underlying patterns that inform the frequency and nature of these complaints. This initial exploration sets the stage for a deeper investigation into the types of animals involved, the geographical distribution of complaints, and their seasonal variations, ultimately shedding light on the multifaceted relationship between urban inhabitants and the wildlife that inhabits their city. This analysis not only informs strategic responses but also fosters a balanced coexistence that enhances public safety and animal welfare.



**Figure 1.** This scatter plot shows a clear ascending trend in animal-related complaints in Boston from 2013 to 2023, with a trend line highlighting the steady increase in reports over time.

The analysis of animal-related complaints in Boston from 2013 to 2023 reveals a significant and sustained upward trend in the number of reports filed annually. There has been a noticeable

increase in the last two to three years, with reports escalating from 11,959 in 2021 to 12,689 in 2022. This increase is not an isolated occurrence but a consistent pattern observed over the last decade. Specifically, when examining the previous 5 to 10 years, the data demonstrates a steep rise in complaints, from 3,095 in 2013 to 7,872 in 2018, indicating an over 150% increase. Such a pronounced and steady rise prompts many potential inferences and underlying causes, ranging from heightened public awareness and reporting to demographic changes in the city's human and animal populations.

Moreover, this increase could reflect evolving societal attitudes towards animal welfare and rights. The persistence of this trend over a prolonged period strongly suggests the necessity for a strategic response from relevant city authorities, which may include enhancing animal control resources, implementing more rigorous enforcement of existing regulations, or developing proactive community outreach programs aimed at reducing the incidents leading to complaints. Further, it underscores the importance of dissecting this trend into more granular temporal segments, such as monthly or seasonal analyses, to understand better and address peak times of concern, thus optimizing resource allocation and policy intervention.

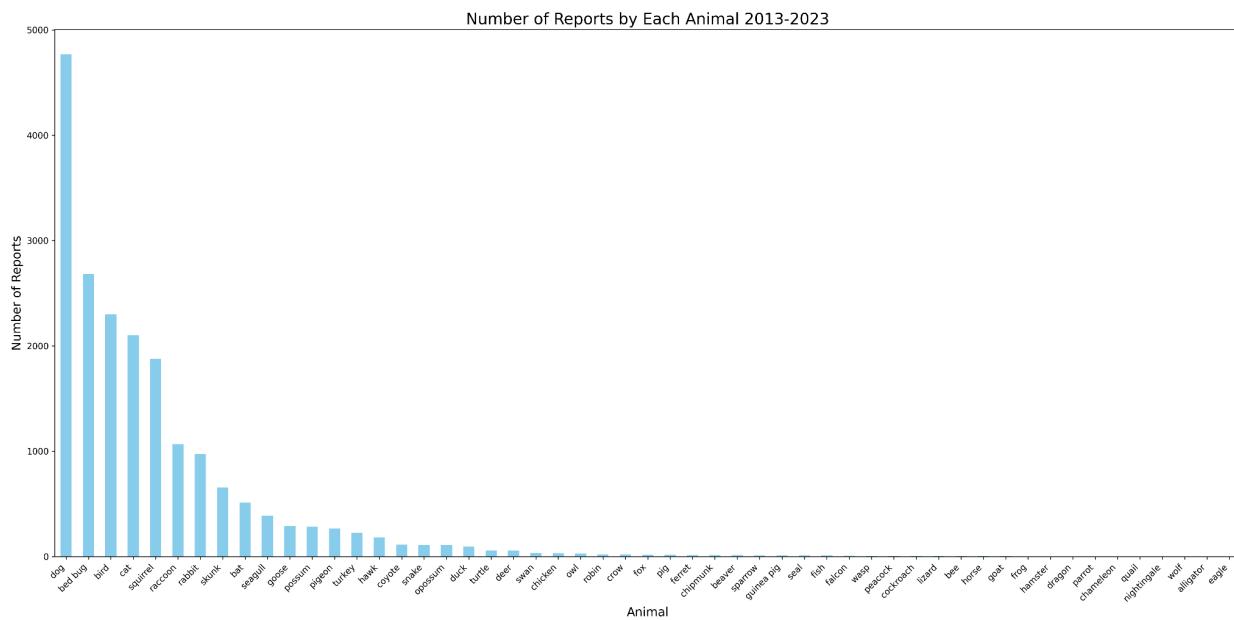
To validate the trends observed in our preliminary visual data review, we employed a linear regression analysis, the results of which are depicted in Table 1 below. This statistical approach helps to quantify the influence of time on the volume of animal-related complaints reported annually, offering a more rigorous understanding of the underlying patterns.

| OLS Regression Results |                  |                     |          |       |           |           |
|------------------------|------------------|---------------------|----------|-------|-----------|-----------|
| Dep. Variable:         | Reports          | R-squared:          | 0.969    |       |           |           |
| Model:                 | OLS              | Adj. R-squared:     | 0.965    |       |           |           |
| Method:                | Least Squares    | F-statistic:        | 278.1    |       |           |           |
| Date:                  | Sat, 06 Apr 2024 | Prob (F-statistic): | 4.48e-08 |       |           |           |
| Time:                  | 15:11:57         | Log-Likelihood:     | -83.693  |       |           |           |
| No. Observations:      | 11               | AIC:                | 171.4    |       |           |           |
| Df Residuals:          | 9                | BIC:                | 172.2    |       |           |           |
| Df Model:              | 1                |                     |          |       |           |           |
| Covariance Type:       | nonrobust        |                     |          |       |           |           |
|                        | coef             | std err             | t        | P> t  | [0.025    | 0.975]    |
| const                  | -1.721e+06       | 1.04e+05            | -16.595  | 0.000 | -1.96e+06 | -1.49e+06 |
| Year                   | 857.1455         | 51.400              | 16.676   | 0.000 | 740.870   | 973.421   |
| Omnibus:               | 0.314            | Durbin-Watson:      | 1.208    |       |           |           |
| Prob(Omnibus):         | 0.855            | Jarque-Bera (JB):   | 0.224    |       |           |           |
| Skew:                  | -0.267           | Prob(JB):           | 0.894    |       |           |           |
| Kurtosis:              | 2.548            | Cond. No.           | 1.29e+06 |       |           |           |

**Table 1.** This linear regression output table validates the significant yearly increase in animal complaint reports, with a high *R*-squared value indicating the model's explanatory solid power for the trend observed from 2013 to 2023.

The linear regression results outlined in the table demonstrate a high explanatory power, with an  $R$ -squared value of 0.969. This implies that nearly 96.9% of the variability in the number of annual reports is accounted for by the progression of years. The model reveals a positive yearly coefficient of approximately 857.146, indicating that each year is associated with an increase of about 857 reports. The  $F$ -statistic further supports the statistical significance of this model ( $p < 0.001$ ), affirming the robustness of the observed upward trend. Such a consistent increase in complaints may reflect growing interactions between urban wildlife and the city masses or an enhanced public propensity to report such encounters.

Following the exploration of trends in the volume of animal-related complaints over recent years, our analysis now shifts focus to the second guiding question regarding the types of animals that are most commonly reported in complaints. This question seeks to unveil the specific species that frequently find themselves at the center of urban human-animal interactions, providing insights into which animals are most affecting the community and requiring attention in Boston's urban landscape.

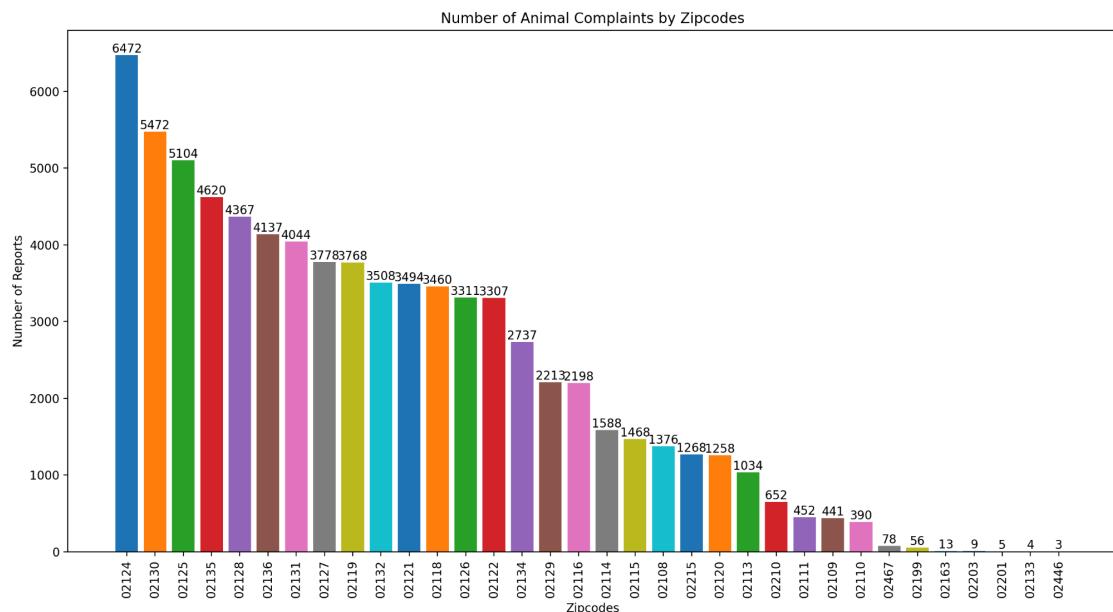


**Figure 2:** This bar graph illustrates the frequency of animal-related complaints, highlighting dogs, bedbugs and birds as the most commonly reported issues over the selected time frame.

The bar graph provides a comprehensive breakdown of the types of animals most commonly reported in complaints from 2013 to 2023, revealing the focal points of public concern in Boston. Dominating the graph, dogs lead considerably, reflecting their prevalence in urban settings and the likelihood of encountering issues where human and canine lives intersect. Dogs, bedbugs, and birds represent the most significant categories, indicating a pressing concern for pest control and wildlife interactions within the city's milieu. The prevalence of bedbugs suggests a notable

challenge in urban pest management. At the same time, the high number of bird-related complaints could point to various factors, from the impact of bird activity on public spaces to the possibility of protected species nesting in human-inhabited areas. The graph underscores the diverse nature of animal-related complaints in an urban environment, revealing that public concerns extend beyond traditional pets to encompass a broad spectrum of urban wildlife and pests. Therefore, the city's response mechanisms must be multi-faceted and adaptable to the complex dynamics of urban animals. Understanding these trends is essential for resource planning in animal control, public health, and community education efforts to mitigate negative human-animal interactions.

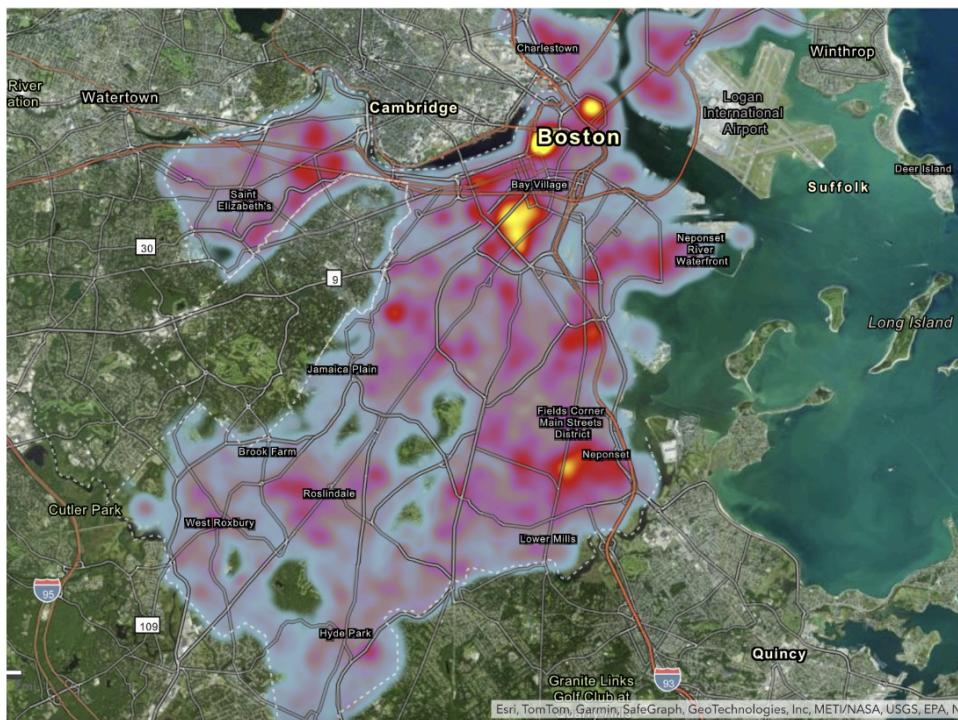
After examining the types of animals commonly reported in complaints, we turn our attention to another vital aspect of our analysis — the geographic origins of these incidents. Addressing our third guiding question, we delve into where the complaints are mainly originating from across Boston and whether specific types of animal complaints are more prevalent in certain areas. This segment of our analysis aims to map out the spatial distribution of complaints, highlighting areas with heightened frequencies and exploring potential trends related to the nature of these complaints.



**Figure 3:** The bar chart of animal complaints by zip code reveals a significant variation ranging from a high of 6,472 in the 01224 area to a low of 3 in the 02446 area.

The geographic distribution of animal complaints in Boston, as depicted in the bar chart, provides insightful data on the varying intensity of these issues across the city. The most striking observation is the concentration of complaints in certain areas, with the zip code 02124 standing out with a significant 6,472 reports, a figure that is notably higher than the rest. Interestingly, all top five zip codes share 'Pick up Dead Animal' as the most common complaint, suggesting a

citywide concern particularly pronounced in these areas. The dense reporting in these locations could be attributed to factors such as higher traffic areas where animal-vehicle collisions are more likely or regions with larger wildlife populations. Conversely, the almost negligible number of reports in places like the 02446 zip code, with just three complaints, indicates a stark contrast in the distribution of incidents and possibly reflects differences in population density, urban planning, or community awareness. This spatial disparity in animal complaints underscores the need for targeted, location-specific approaches to animal management and public education programs. Furthermore, city resources for addressing such complaints might be more efficiently allocated if they are informed by the geographic patterns observed in the data. Understanding these trends not only assists in more effective resource distribution but also offers the potential to identify underlying causes specific to certain areas, such as the need for improved road safety measures to reduce wildlife casualties.

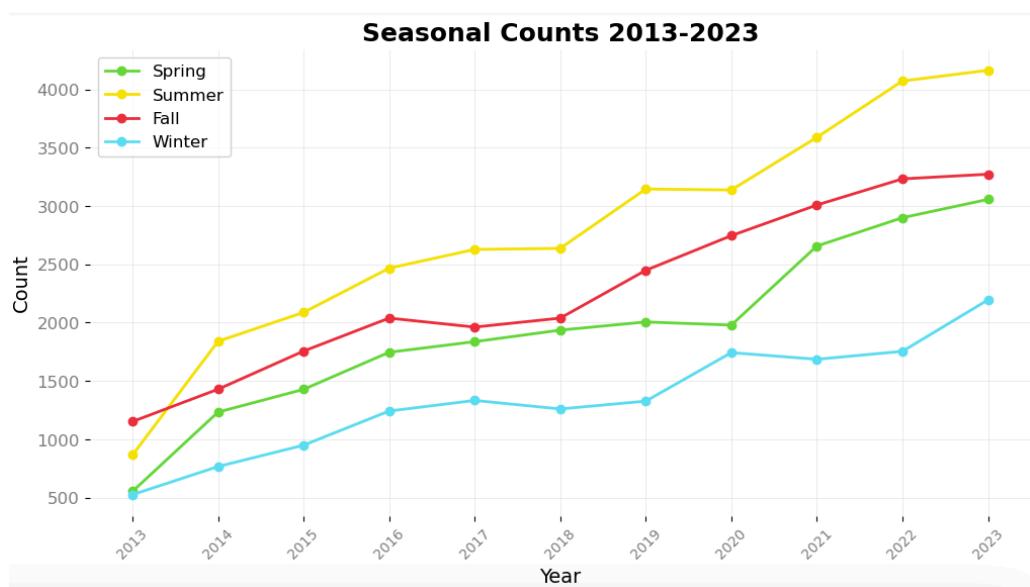


**Map 1.** This heatmap displays the distribution of animal-related complaints in Boston, highlighting hotspots and allowing interactive exploration of specific incidents.

To further enhance our understanding of the geographic distribution of animal complaints across Boston, the data from the bar chart was transformed into an interactive heatmap (<https://arcg.is/1H0ea9>). This visualization technique highlights areas with higher concentrations of complaints through varying color intensities, making it easier to identify hotspots of activity. The heatmap allows users to interactively explore the data by clicking on specific points on the map. For example, clicking on a particular spot reveals detailed information about the incidents recorded there, such as the total number of complaints and the ability to toggle between different

incidents. This interactive feature not only makes the data more accessible but also provides a powerful tool for city officials and policymakers to examine the specific details and patterns of complaints within distinct areas, thereby aiding in targeted interventions and resource allocation.

Continuing our analysis, we now explore how seasonal variations influence animal-related complaints, examining the impact of seasonal factors on the frequency and nature of these incidents throughout the year. By understanding these seasonal trends, we can better align public awareness initiatives and resource distribution with the specific needs of each season, enhancing the effectiveness of our response strategies.



**Figure 4:** This line graph shows seasonal variation in counts from 2013 to 2023, with spring consistently having the lowest counts and summer showing the highest, indicating a possible correlation between seasonality and the recorded metric.

The line graph presented delineates a clear seasonal pattern in animal-related complaints in Boston from 2013 to 2023, providing valuable insights into the temporal dynamics of these incidents. Over these years, summer stands out with the highest complaints frequency, while spring consistently shows the lowest. This could be attributed to many factors, including increased outdoor activities during the warmer months that may lead to more human-animal interactions and, consequently, a higher number of incidents. Additionally, the breeding cycles of many species coincide with the warmer months, potentially leading to a surge in animal population and visibility. On the other hand, the relative decrease in spring may reflect a period where less human-animal conflict occurs, possibly due to the transition from hibernation or low activity levels of animals during the cold to their active periods. Winter and fall show intermediate counts, suggesting that while activity does decrease in colder months, issues persist, possibly due to migration patterns or the search for shelter by urban wildlife. The discernible

seasonality trend indicates that the numbers of complaints fluctuate, and the nature of the complaints likely varies with the seasons. This understanding is crucial for planning and implementing seasonal public awareness campaigns, allocating animal control resources efficiently, and preparing mitigation strategies synchronized with these natural rhythms.

The data-driven analysis of animal-related complaints in Boston underscores a complex interplay of factors that influence human-animal interactions in an urban setting. Over the past decade, there has been a notable increase in such reports, with distinct patterns emerging regarding the types of animals involved, the geographical origins of the complaints, and the seasonal fluctuations in their occurrence. These patterns speak to the need for adaptable, informed responses that address the immediate concerns and the underlying drivers of this rise in reports. As urban spaces continue to grow and change, proactive and targeted approaches, underpinned by robust data analysis, will be essential to foster a harmonious coexistence with the city's diverse animal population.

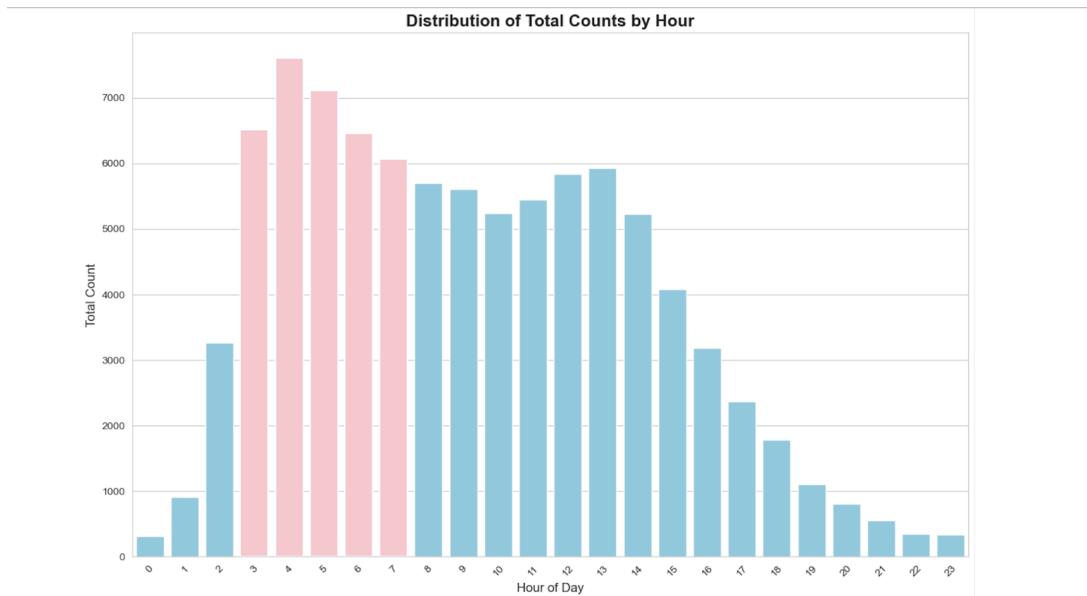
### Extension Analysis

Following our initial exploration of the patterns and trends in animal-related complaints within Boston from 2013 to 2023, we identified the necessity to examine more granular aspects of the data to further enhance our understanding and the strategic responses required. The base analysis highlighted a notable and sustained upward trend in complaints, urging a deeper dive into the temporal dynamics that influence these incidents. This led to the formulation of our first extension question focusing specifically on the impact of the time of day on animal-related complaints. This inquiry aims to decipher the temporal patterns of these complaints to better align city resources with peak times of animal-human interactions, thus optimizing response strategies and potentially mitigating conflict.

The decision to investigate how the time of day affects animal complaints was motivated by several factors:

1. **Daily Human Activity Cycles:** Human activities vary significantly throughout the day, impacting when and how frequently individuals encounter animals. Insights into these variations can help develop targeted management strategies that address specific time-sensitive challenges.
2. **Animal Behavior:** Different species exhibit distinct patterns of activity; for instance, some are nocturnal while others are diurnal. By analyzing complaint data over time, we can gain a clearer understanding of which animals are most likely to cause disturbances at various times of the day.
3. **Resource Allocation:** Identifying times with peak complaint volumes allows for more effective allocation of resources, such as animal control personnel, which can be critical in managing the overall number of incidents.

To facilitate our analysis of how the time of day impacts animal-related complaints, we utilized a series of scripts to process extensive datasets spanning from 2013 to 2023. Our methodology involved extracting the time data from each report to categorize and count complaints based on hourly intervals throughout the day. This approach allowed us to pinpoint specific times when complaints peaked and declined, providing a clear picture of daily patterns in animal-related incidents. The processed data was then used to create visualizations, such as a bar graph and scatter plot which illustrate complaint frequencies across different times of the day. These graphs effectively highlight key periods of increased and decreased complaint activities, informing our analysis and subsequent recommendations.



**Figure 5:** Display the number of complaints made at different hours throughout the day.

This graph provides a clear visual representation of how temporal factors align with the daily patterns of human and animal activity, influencing the frequency and timing of these incidents. Here's a breakdown of the key times during which incidents are reported:

### Morning Peak

The attached bar graph highlights a significant peak in complaints during morning hours, corresponding with increased human and animal activity. This time coincides with the start of the typical workday and school runs, increasing pedestrian and vehicle traffic, which may lead to more frequent animal sightings and interactions.

### Midday Lull

Post-morning, there is a noticeable dip in complaints, likely due to reduced human presence outdoors during the typical workday hours, as well as a decrease in animal activity.

### **Evening Uptick**

As the graph demonstrates, there is another increase in complaints in the evening hours. This uptick correlates with people returning home and engaging in outdoor activities such as walking dogs or visiting parks, which increases the likelihood of animal encounters.

### **Nighttime Quiet**

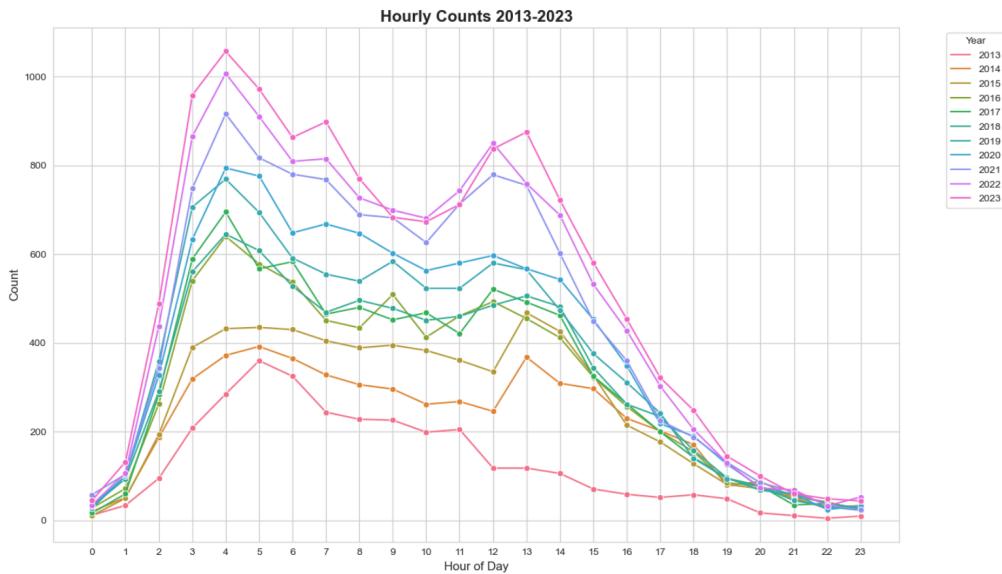
The frequency of complaints drops significantly during nighttime hours, as most indoor activities reduce human-animal interactions.

One potential factor contributing to the significant increase in complaints during the morning hours could be the presence of street cleaners and trash collectors, who are particularly active in these early hours. The operations of these services often coincide with the timing of peak complaints observed between 7 AM and 9 AM. Street cleaners and trash collectors not only move through the city extensively during these times but also possess a heightened awareness of their surroundings, making them more likely to notice and report animal-related issues via the 311 service. Their active engagement in the city's maintenance could inadvertently lead to increased encounters with animals, especially in areas where trash collection might attract wildlife or stray animals. Thus, their reports could substantially contribute to the morning peak in animal-related complaints, highlighting an interesting intersection between city operational schedules and animal activity patterns.

Additionally, the likelihood that city workers such as street cleaners and trash collectors are more familiar with and trained to use the 311 reporting service could further explain the morning peak in complaints. Being city employees, they are typically better informed about the municipal resources available for addressing public issues, including animal disturbances. This awareness and ease of access to the 311 service means that they are not only more likely to observe and report animal-related issues but also more equipped to do so efficiently. This suggests a possible underreporting by the general public, who may not be as aware of or inclined to use the 311 service to report similar issues. Highlighting this disparity underscores the need for increased public awareness and education on the availability and utility of such municipal services, which could lead to a more accurate representation of animal-related complaints across all hours of the day.

Following our initial exploration of the patterns and trends in animal-related complaints within Boston from 2013 to 2023, we developed a more detailed understanding of how these issues fluctuate throughout the day. However, to discern whether these patterns have been consistent each year or are more reflective of a cumulative trend over the entire decade, we created a time-series graph. This analysis allows us to compare the hourly distribution of complaints year by year, providing insights into any shifts that may have occurred over time. The time-series approach not only highlights specific years with higher or lower complaint volumes but also

helps us identify any external factors or city developments that might influence these trends. By examining each year individually within the broader decade-long framework, we ensure that our strategies and recommendations are based on comprehensive and precise data, enhancing the city's ability to effectively manage and respond to animal-related incidents.



**Figure 6:** This bar chart depicts the count of animal-related complaints received in Boston on an hourly basis over the span of ten years.

Yearly trends indicate some variation in the volume of complaints but maintain a consistent pattern in their distribution throughout the day. This consistent daily pattern across ten years suggests stable animal behavior and human activity cycles, although the total volume of complaints may fluctuate due to various factors such as population growth, urban development, or changes in animal population dynamics.

The temporal analysis provided by our data extraction process and visualized through the graphs underscores specific times when interventions could be most effective. Strategic recommendations to enhance public safety and urban living quality include:

1. **Public Worker Engagement:** Enhance training for city workers active during peak complaint times to handle and report animal encounters effectively. This training could include identifying animal behavior and safe intervention techniques.
2. **Smart Lighting in Key Areas:** Implement smart lighting in areas identified as high-risk during evening and night hours to deter animals and enhance public safety. These lights could be motion-activated to increase efficiency and reduce light pollution.
3. **Urban Planning Adjustments:** Adjust urban design to mitigate animal-human conflicts, especially in areas with high morning or evening complaints. This could include better trash management systems to reduce animal scavenging and creating barriers that prevent

animals from entering busy pedestrian areas during peak times.

4. **Targeted Time-Specific Interventions:** Based on our findings, we recommend implementing time-specific interventions that address the unique dynamics of different periods in the day. For example, deploying animal control units strategically during morning and evening rush hours in areas with high traffic volumes could significantly reduce the number of animal-related incidents.
5. **Integration of Weather Data:** To further refine our understanding of complaint patterns, integrating weather data could offer additional insights, particularly on how adverse weather conditions affect animal behavior and complaint frequency.
6. **Community Education Programs:** Developing community education programs that focus on peak complaint times could inform residents about how to avoid negative interactions with animals, such as securing trash during times when animal activity peaks.
7. **Policy Development for Pet Management:** Policies that regulate pet activities in public spaces, such as leash laws during peak times, could reduce incidents, particularly during the evening uptick.

The temporal analysis of animal-related complaints provides a foundation for developing more nuanced and effective strategies to manage human-animal interactions in Boston. By aligning intervention strategies with specific times of day when complaints peak, we can not only address current issues more effectively but also anticipate and mitigate potential future conflicts. This proactive approach is essential for maintaining the safety and quality of life for all Boston residents, ensuring that the city's policies evolve in tandem with its changing urban landscape.

As we explored the intricate patterns of animal-related complaints within Boston, another vital question emerged: How does the proximity to parks and green spaces influence these complaints? This inquiry extends our understanding beyond mere temporal variations to include spatial dimensions, which could significantly affect the distribution and frequency of these incidents. Investigating the proximity of animal complaints to parks and green spaces not only enriches our comprehension of urban ecology but also serves as a lens through which we can examine human-animal interactions across different urban landscapes.

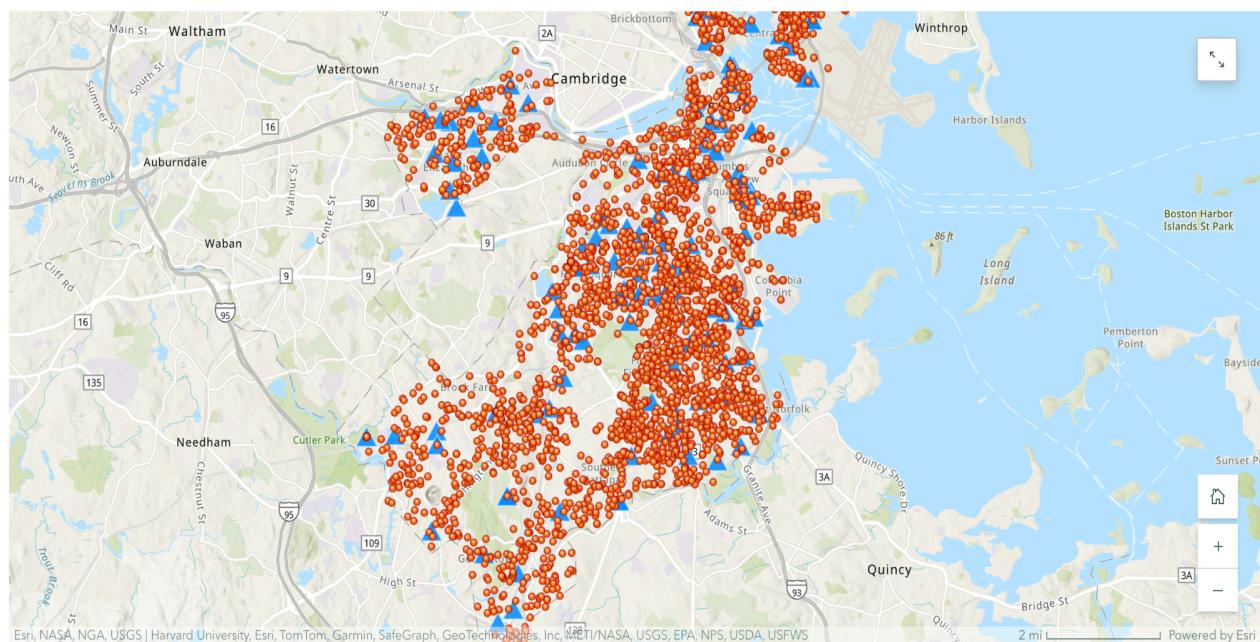
The decision to investigate how proximity to parks and green affects animal complaints was motivated by several factors:

1. **Habitat Influence on Complaints:** Investigating the proximity to natural habitats helps us understand if areas closer to parks report more wildlife encounters, such as with birds or deer. This correlation can guide effective strategies to manage these interactions, potentially reducing conflict.
2. **Influence of Urban Planning:** The data on complaints near parks could influence urban design, suggesting how the integration of green spaces within the city can mitigate or exacerbate wildlife encounters. These insights are pivotal for planning future urban

developments that harmonize human and animal spaces.

3. **Effectiveness of Green Space Management:** Analyzing complaint patterns may reveal whether current park management practices are effective or if adjustments are needed. For instance, establishing buffer zones around parks could minimize negative encounters, enhancing safety and enjoyment for all park-goers.
4. **Public Education Needs:** Should a significant correlation between complaints and park proximity be found, it highlights the need for public education about safely cohabitating with local wildlife. This could involve community outreach initiatives to raise awareness and promote peaceful coexistence.

To analyze the impact of parks and green spaces on animal-related complaints within Boston, we employed a geographical information system (GIS) approach using ArcGIS. This advanced mapping tool enabled us to visually plot all reported animal-related incidents across the city. Each incident was geocoded based on the location data provided in the complaint reports, ensuring precise spatial representation. In addition to the incidents, we also integrated layers representing all parks and green spaces within Boston. This overlay allowed us to visualize the spatial relationship between the incidents and these natural areas. By examining the proximity of complaints to parks and green spaces, we were able to assess patterns and correlations that may not be evident from data tables alone. This methodological approach not only enhanced our understanding of the spatial dynamics involved but also provided a clear visual tool for presenting our findings and supporting our analysis with empirical evidence.



**Map 2.** This map visualizes the distribution of animal-related complaints across Boston (denoted by orange circles), overlaid with the locations of parks and green spaces (denoted by blue triangles) to analyze proximity and spatial patterns.

The visual representation of animal-related complaints across Boston, as shown in the above map, provides compelling evidence of the spatial dynamics influencing these incidents. This detailed GIS analysis underscores several critical observations:

1. **Density of Reports Near Parks:** There is a discernible concentration of complaints in areas adjacent to parks and green spaces. This pattern supports the hypothesis that proximity to such areas correlates with higher instances of animal-related complaints. Parks and green spaces naturally attract a variety of wildlife due to the availability of food, shelter, and breeding sites, which increases the likelihood of encounters between humans and animals. Additionally, these areas often attract pet owners who bring their domesticated animals for recreation, which can further contribute to the incidence of complaints, whether due to loose pets, noise, or other disturbances.
2. **Concentration in Urban Areas:** The map also highlights a significant clustering of complaints within densely populated urban areas. This observation suggests that other urban factors, such as high population density and increased rates of pet ownership, significantly contribute to the volume of complaints. Urban areas typically have more restricted living spaces, which might lead to more frequent interactions between humans and animals, both domestic and wild. The presence of more pets can also lead to issues such as noise complaints, waste management problems, and the occasional aggressive behavior, contributing to the overall complaint density in these regions.
3. **Implications for Urban Planning and Public Policy:** The insights drawn from this map are invaluable for urban planning and public policy making. They suggest that while green spaces are essential for urban quality of life, their design and management need careful consideration to minimize negative wildlife interactions. This might include designing parks that have natural barriers or buffer zones that can help reduce the frequency of animal-human interactions that lead to complaints. Furthermore, targeted public education campaigns could be implemented to inform residents living near parks about how to safely and responsibly interact with wildlife and manage pets.
4. **Strategic Resource Allocation:** For city management, this spatial analysis can guide more strategic allocation of resources such as animal control units and public awareness officers, especially in areas identified as hotspots for animal-related complaints. By focusing efforts on these high-density areas, particularly around major parks and densely populated urban centers, the city can improve its responsiveness and efficiency in handling such issues.

Based on the insights derived from the heat map of animal-related complaints in Boston, particularly focusing on the density near parks and green spaces, we propose the following recommendations to optimize park management and urban planning:

1. **Improved Park Management:** The evidence from the map suggests the necessity for improved management of parks to mitigate the frequency of animal-related complaints. Implementing more visible and informative signage can help educate park-goers about wildlife in the area, safe interaction practices, and park regulations. Enhancing fencing can prevent animals from entering residential areas nearby and reduce unwanted interactions. Additionally, designated areas for off-leash pets could centralize pet activity to specific parts of the park, reducing disturbances across broader areas. Stricter enforcement of park rules, such as leash laws and waste disposal, should also be considered to maintain order and safety within these green spaces.
2. **Comparative Analysis Between Parks:** A detailed comparative analysis between various parks could provide deeper insights into how different park features influence the rate of animal-related incidents. Factors such as the size of the park, the availability of off-leash areas, the type of wildlife habitats present, and the recreational activities permitted could all play significant roles. By comparing parks with high and low complaint volumes, city planners can identify successful features and practices that could be implemented across other parks to reduce conflict.
3. **Temporal Changes:** Monitoring changes in the volume of complaints over time can provide valuable information about the effectiveness of management practices and the impact of urban development on animal-related incidents. This assessment should focus on whether modifications in park management or the development of areas surrounding parks correlate with increases or decreases in complaints. Such temporal analysis can help determine if certain interventions are successful or if further adjustments are needed to adapt to changing urban and ecological dynamics.

These recommendations aim to leverage the spatial data on animal-related complaints to enhance the quality of life for city residents and improve the coexistence of urban dwellers with local wildlife. By addressing these issues proactively, city officials can create more harmonious urban spaces that cater to the needs of both people and animals.

## Future Scope

While our analysis provides valuable insights into animal-related complaints in Boston, it is essential to acknowledge several limitations. Firstly, the lack of causal analysis in our study means that while we can observe trends and quantities, we cannot definitively explain the underlying reasons for these patterns. Additionally, although we recognize the importance of demographic context in understanding variations in complaints across different areas, our dataset may not fully capture these nuances. Furthermore, there is a possibility of reporting bias, as rising complaint numbers could reflect increased public engagement in reporting rather than a genuine rise in incidents. Moreover, the potential for underreporting cannot be ignored, as certain populations or areas may not report complaints as frequently, leading to skewed data and

potential inaccuracies in our analysis. These limitations underscore the need for caution in interpreting our findings and highlight avenues for further research to address these gaps in our understanding of urban animal populations and their interactions with human communities.

The future scope of this project on animal-related complaints in Boston holds significant potential to expand our understanding of such issues, leading to more effective solutions for managing urban animal populations and enhancing public health and safety. Building on the current analysis, several directions for further research and development can be explored:

1. **Advanced Predictive Analytics:** Employing more sophisticated predictive models, such as machine learning algorithms, could refine our forecasting abilities regarding trends in animal complaints. This could help predict seasonal peaks, identify emerging patterns, and anticipate the impact of urban development on animal behavior.
2. **Expansion of Geographic Scope:** While the current project focuses on Boston, expanding the study to include comparisons with other cities could provide insights into how urban planning decisions impact animal-related complaints. A comparative study could highlight best practices and innovative solutions employed elsewhere that might be adapted for Boston.
3. **Longitudinal Studies:** Conducting longitudinal studies over extended periods can provide insights into the long-term effects of urbanization on animal populations and the efficacy of implemented interventions. These studies could track changes over time, providing a dynamic view of how urban evolution affects human-animal interactions.
4. **Integration of Demographic Data:** Expanding the dataset to include demographic information can provide critical insights into variations in animal-related complaints across different areas. Understanding factors such as population density, age distributions, socioeconomic status, and cultural attitudes toward animals can help explain why certain neighborhoods might experience higher incidences of specific types of complaints.

In conclusion, the data-driven insights provided by our analysis have the potential to significantly influence the strategic decisions made by the city of Boston. By utilizing this information, the city can take a proactive stance in addressing the challenges presented by urban wildlife, ultimately improving the quality of life for its residents and ensuring a healthier coexistence between urban environments and the animals that inhabit them.

Moreover, by integrating advanced analytical tools and expanding the scope of data collection to include behavioral studies and public perceptions, Boston can develop more nuanced strategies that address the specific needs of different communities and wildlife species. These strategies could include targeted wildlife management practices, community education programs tailored to local needs, and infrastructure changes that help mitigate negative interactions between humans and animals.

As the city continues to evolve, ongoing monitoring and adaptation of strategies will be essential. The insights gained from this project could be viewed as a starting point for a dynamic improvement process. Future research can build on the current findings to refine interventions and adapt to new challenges as they arise. The goal should be to create a living, responsive system that enhances the ability of the city to manage its wildlife in ways that are respectful, ethical, and effective, promoting a balance that benefits all residents—human and animal alike.

## **Individual Contribution**

Alexandra Rodriguez - Wrote a Python script using pandas to create filtered versions of each 311 Service Request dataset for the desired report/reason(s). Ran a linear regression for the number of reports throughout the years. Compiled all the graphs and wrote the early insights report, extracting valuable insights and discussing our initial findings. Created heat maps using ArcGIS, visualizing all animal reports in the past decade, dog reports in the past 5 years, and animal reports in the past 5 years with parks and green spaces around Boston. Made client slides, mid-semester presentation slides, and final presentation slides. Wrote introduction and future scope/conclusion for the final report and proofread and edited the rest of the paper.

Mussie Abraham - Wrote a Python script, utilizing the pandas library, to clean the filtered 311 Service Request datasets and extract information regarding the number of reports filed in the previous 2-3 and 5-10 years. Proofread and edited the early insights report, the client slides, and the mid-semester presentation slide decks. Wrote a Python script to determine neighborhoods and zip codes complaints were coming from. Updated Github with deliverables and made all pull requests. Delegated tasks to group members and kept track of weekly scrum reports. Reviewed all scripts for bugs or faulty logic. Wrote the extended analysis section and edited the rest of the paper for the final report.

Tharin Ahmed - Was the team representative, created weekly scrum reports, and noted assigned tasks on Trello. Presented all slides to client and PM. Wrote Python scripts that utilized pandas library to create graphs for the number of reports filed in the previous 2-3 and 5-10 years and to determine neighborhoods and zip codes complaints were coming from. Proofread and edited the early insights report, the client slides, the mid-semester presentation slides and the final presentation slide decks. Wrote and edited the basic analysis section for the final report.

Honghao (John) Zhao - Wrote a Python script using pandas to clean data and extract information about the most common animals mentioned in complaints. Created a script to investigate how seasons influence the nature of complaints. Developed a script to explore the impact of the time of day on the nature of complaints, taking into account the possible influence of street cleaners. Corrected any errors within the scripts and wrote test code to ensure they ran correctly and generated accurate data for creating graphs.

Junyu Chen - Wrote Python scripts to process data and generate visualizations using pandas and matplotlib. Enhanced further visual aesthetics using seaborn. Deliverables included a bar chart for the number of reports by each animal from 2013 to 2023, a pie chart highlighting the top 10 reported animals proportion, a line chart for seasonal counts trends from 2013 to 2023, a pie chart for the seasonal total counts, a line chart for hourly counts trends from 2013 to 2023, a bar chart illustrating the distribution of total counts by hour.