PROGRESS REPORT

Good-natured project

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IFQ721 Data Analytics Capstone

Background

Good-natured is a New Zealand-based company that specialises in developing innovative traps to combat invasive pests, particularly rodents, which have long posed a significant threat to the country's ecosystems. Founded with the goal of safeguarding biodiversity, the company focuses on creating sustainable and humane pest control solutions that can effectively protect the native flora and fauna of New Zealand, particularly on offshore islands where the impact of rodents has been devastating. Rodents, introduced through human activity, have had a severe impact on bird populations and other wildlife, making the need for efficient and environmentally sound pest control solutions even more critical.

As Good-natured expands internationally, the company continues to emphasise the importance of preserving ecosystems from the harmful effects of invasive species. Despite the extensive efforts made to eradicate these pests, re-invasions continue to occur due to various methods of rodent infiltration, including swimming or accidental transport via boats. The company's challenge lies in not only creating effective traps but also in understanding the conditions that influence trap success and ensuring that their products are used optimally across diverse environments.

Data analytics has emerged as a pivotal tool for Good-natured, helping to optimise the use of traps by providing insights into how they perform in different environmental conditions. The use of data analysis allows the company to refine its product selection for customers, improve trap design, and adapt deployment strategies based on real-time feedback. Interpreting indirect data such as temperature, location, and trigger events can help inform these strategies, ultimately leading to more effective pest control. The company's commitment to leveraging data-driven insights is helping drive its mission of creating sustainable pest management solutions on a global scale.

Introduction

This project aims to optimize Good-natured's pest control strategies by analysing environmental and trap performance data, identifying key factors influencing trap success, and offering actionable insights for improving deployment methods.

The project to optimise Good-nature's pest control strategies began with a detailed examination of the environmental challenges posed by invasive rodents in New Zealand. Rodents, particularly those that invade offshore islands, pose a significant threat to New Zealand's biodiversity, where native bird populations are highly vulnerable. Despite concerted eradication efforts over the years, re-invasions remain a persistent issue, necessitating the development of more effective and sustainable control measures. Good-natured has been at the forefront of this effort, designing traps specifically aimed at controlling these invasive species while minimising harm to non-target wildlife.

To begin, the project involved the analysis of extensive data provided by Good-natured, which included metrics related to trap performance, usage patterns, and environmental conditions. The goal was to uncover insights that could help improve the efficacy of the traps, particularly in real-world conditions where numerous variables—such as temperature, geography, and time—play a crucial role in determining success. Drawing from research on rodent behaviour and movement patterns, I aimed to establish connections between these factors and the performance of the traps. This data-driven approach was essential in refining the strategies used for trap deployment. In addition to the primary dataset, the project integrated insights from previous studies on pest control, particularly those that focused on rodent management in New Zealand. Research examining landscape-scale approaches to controlling rodent populations provided valuable context for understanding the broader ecological challenges involved. These studies also helped to inform the development of best practices that could enhance Good-nature's trap deployment strategies.

Throughout the initial stages, customer feedback played a key role in understanding how the traps were being used in different environments and under varying conditions. Analysing this feedback alongside the provided data helped to highlight areas where trap designs could be improved. This information, combined with environmental data, allowed me to focus on optimising the traps for maximum effectiveness. By understanding the external factors that influence rodent activity and incursion rates, the project laid the groundwork for a comprehensive analysis of how to better deploy traps in real-world scenarios. The integration of previous studies, customer data, and environmental conditions was crucial in developing an informed strategy for improving pest control solutions.

Approach

The primary goal of this project was to analyse Good-nature's trap performance data and uncover key insights to optimise pest control strategies. The process began by cleaning and preparing the dataset, which included various metrics such as trap performance, environmental conditions, and usage patterns. Irrelevant and incomplete records were removed to ensure the analysis was based on reliable data, with the focus narrowed to variables directly impacting trap performance. This step was crucial in laying a solid foundation for meaningful insights.

After cleaning the data, the next step was to explore key variables likely to influence trap effectiveness, such as temperature, the number of traps, and date/time (seasonality). Initial visualisations were created to identify patterns and guide the focus of the analysis. One early insight revealed that certain temperature ranges were strongly associated with higher trap success rates, prompting a deeper examination of this variable. Visual exploration was essential in refining the scope of the analysis, ensuring attention was directed toward the most impactful factors.

An important aspect of the analysis involved examining Group IDs to determine which groups had the most "STRIKES" within the filtered data. By analysing the number of strikes per group, I identified those with the highest number of successful activations. However, this analysis reflects only the total strikes, not the success rate relative to the total number of traps within each group. A more comprehensive analysis would calculate the success rate to offer a clearer picture of performance.

Next, the relationship between temperature and trap performance was examined in greater detail. Bar graphs were used to illustrate the correlation between temperature and the frequency of trap activations. These visualisations confirmed that moderate temperatures, particularly around 18°C, were associated with the most successful trap activations, reinforcing the idea that temperature is a critical factor in trap efficiency. In my analysis of time, seasons, and day vs. night data, I focused on identifying patterns in occurrences across different time periods. I began by analysing hourly trends, grouping the data by hour to pinpoint peak activity times throughout the day. This allowed me to observe when occurrences were most frequent.

Next, I examined seasonal trends by assigning each month to its respective Australian season. By identifying the peak hour within each month, I gained insights into how activity levels shifted across the year. I also explored how occurrences varied between day and night. Comparing the frequency of activity during these timeframes. This approach highlighted the differences in activity based on time of day.

The techniques I used included grouping data by hour, month, and season, and categorising occurrences by day and night. I effectively handled datetime data to extract meaningful insights and used scatter plots to visually represent relationships between time and occurrences. Overall, my analysis provided a clear understanding of how activity patterns change based on time of day, seasonality, and day vs. night cycles. Key techniques included grouping by time variables (hour, month, season), creating custom categories, and handling datetime data. Scatter plot visualisations helped reveal temporal patterns, making the analysis clear and actionable. Overall, your method provided a thorough understanding of how occurrences varied by time of day and season.

To further understand trap performance, the frequency of different Group ID activations was analysed. By calculating the frequency of these activations and visualising the results with bar charts, I was able to identify the top-performing trap groups. This analysis offered valuable insights into which trap configurations were most effective, helping to prioritise resources based on performance in different environments or conditions. Visualisation was a key component throughout this process, providing a clear and interpretable view of the data. The use of bar charts, scatter plots, and heatmaps allowed for effective communication of complex insights and guided decision-making.

In addition to environmental factors, I began exploring the impact of geographical location, focusing specifically on traps deployed in Australia. I filtered the dataset to include only traps located within Australia's latitude and longitude range, providing a more localised view of trap performance. Although further analysis is required to fully understand the effect of geographical placement on trap success, this preliminary filtering created a clean subset of data for future exploration.

Ultimately, this approach focused on understanding the environmental conditions under which the traps performed best, laying the groundwork for Good-natured to optimise its pest control strategies based on data-driven insights.

Findings

The analysis revealed several significant findings that could greatly enhance Good-natured's pest control strategies. Temperature emerged as a critical factor, with traps most effective at around 18°C (Graph 1). Deployment in regions with consistent temperatures within this range can maximize trap efficiency. This finding offers clear guidance on how to optimise trap placement and timing in various environments, making temperature a pivotal factor in determining trap efficiency.

By analysing activity across months and time (hours in the day), several notable patterns emerge. Graph 3 shows that April and May were the most active months, closely followed by March and June, indicating increased rodent activity during these periods. This suggests a seasonal spike in rodent behaviour during the late summer to early winter months. Furthermore, daily activity appears to be relatively evenly distributed throughout the day, with most activity occurring between 8 AM and 2 PM, which accounts for 69% of the overall recorded activity. Despite this, there are a few outliers. For instance, Graph 6 highlights peak activity hours that mostly fall within this range, though there were some anomalies, such as 4 AM, 7 AM, and 12 AM, with 4 AM showing up twice as a peak time. This could warrant further investigation. Additionally, night-time activity was generally lower, as shown in Graph 11, where 55.8% of all activity occurred during the day—an almost even split, but with a slight preference for daytime activity.

Seasonal patterns also played a critical role in pest control effectiveness. Autumn showed significantly higher activity, recording nearly 10,000 more occurrences than the next closest season, winter. This data, combined with temperature trends, reveals that rodent activity peaks during cooler periods, aligning with the optimal temperature range of around 18°C. These seasonal variations underscore the importance of timing trap deployments to coincide with heightened rodent activity, thus maximising effectiveness. Time-series plots across Graphs 3, 5, 7, and 8 reveal key insights into the months with the highest activity, emphasising the need for strategic trap placement during these critical times.

When combining time and seasonal data, further trends become apparent. Graphs 8 and 9 show a noticeable increase in activity over recent years, particularly since 2019, suggesting that rodent occurrences have been rising steadily. This uptick could be due to environmental changes or other factors, which should be considered when refining pest control strategies.

Another key discovery relates to the effectiveness of trap configurations, represented by Group IDs. The analysis of Group ID frequency revealed that certain group configurations outperformed others. By examining the frequency of activations across various groups, to better understand trap effectiveness, future analysis will calculate the success rate by dividing the number of strikes by the total traps in each group. This will provide a clearer picture of which configurations are inherently more efficient rather than simply reflecting the quantity of traps deployed. Larger groups could simply result in more strikes due to the number of traps deployed rather than the inherent efficiency of the traps themselves.

For instance, the bar chart highlighting the top 10 and 5 Group IDs shows that groups of 2, 3, and 5 traps were particularly successful, yet it's essential to calculate the percentage success rate for each configuration. By determining the proportion of strikes to the total number of traps in each group, a more accurate picture of trap effectiveness can be established. Future analysis should include this calculation to better understand the efficiency of different group configurations. Moreover, exploring factors such as trap positioning, environmental conditions, or trap maintenance within these groups could provide further insights into why certain configurations outperform others.

Overall, the findings indicate that trap success is influenced by a combination of environmental conditions, geographical placement, and consistent maintenance. These insights provide actionable steps for refining current pest control strategies while offering a solid foundation for future research and product development. By focusing on the conditions that maximise trap effectiveness, Good-natured can significantly enhance its pest control outcomes.

However, it's important to recognise that this analysis only interprets the data at face value and may not fully capture all the factors influencing trap success. Environmental data alone doesn't account for critical aspects of animal behaviour or ecological interactions. Moving forward, a more in-depth exploration of these factors—such as rodent activity patterns, seasonal behaviour, and the broader biological context—is necessary. Integrating biological insights into the data analysis will yield a more nuanced understanding of trap effectiveness and could raise new questions about how different conditions influence trap performance.

In future phases, integrating biological data on rodent behaviour, such as movement patterns and feeding habits, will further refine trap effectiveness. Additionally, exploring environmental variables like habitat type will provide more targeted deployment strategies. For example, understanding rodent feeding habits, movement patterns, and responses to environmental changes could provide explanations for fluctuations in trap effectiveness. This approach will enable Good-natured to not only address environmental triggers but also the biological drivers behind rodent behaviour. Combining data analytics with biological research will offer a more comprehensive understanding of the problem, helping to optimise trap designs and deployment methods for even greater effectiveness.

This integrated approach—melding data-driven insights with biological expertise—will lead to more precise recommendations and improved trap efficiency. By gaining a clearer understanding of both the environmental and behavioural factors driving rodent activity, Good-natured can make significant strides in its pest control efforts. This perspective, combined with ongoing data analysis, will help refine current traps and develop new products tailored to specific conditions. These refinements will ensure Good-natured's pest control strategies continue to evolve and improve.

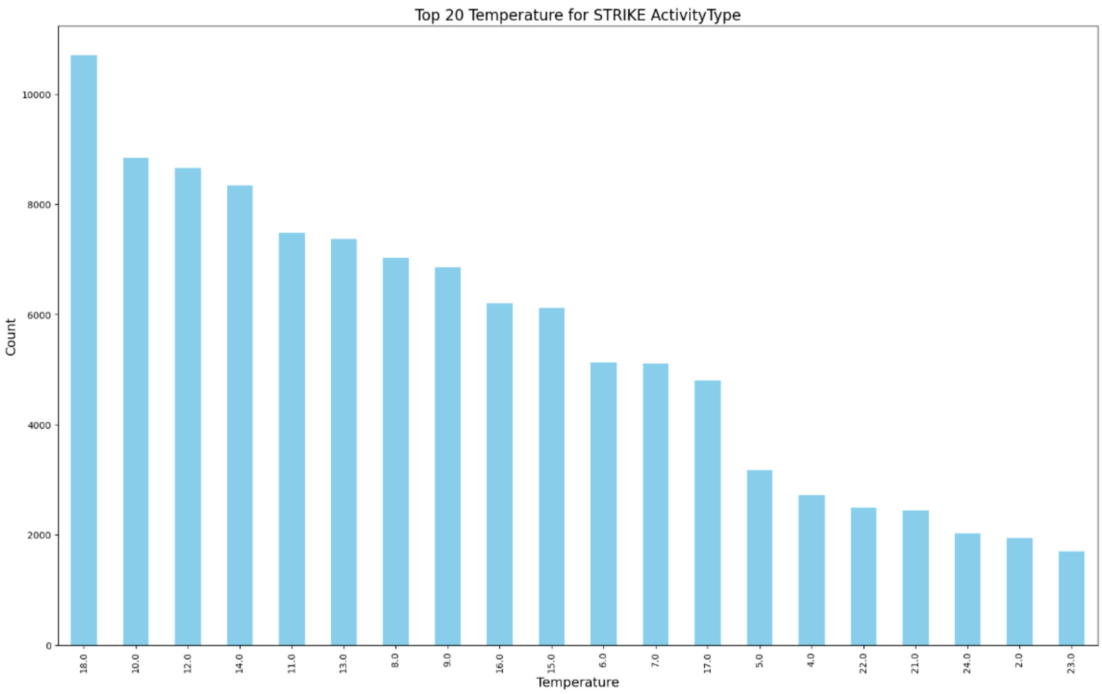
Recommendations and Conclusions

Based on the analysis, several key recommendations can be made to optimise Good-natured's pest control strategies. First, To optimize trap efficiency, focus deployment in areas where temperatures consistently fall within the optimal 18°C range, particularly during cooler months. In regions with fluctuating temperatures, deploying mobile traps or adjusting deployment schedules seasonally could further improve effectiveness. Seasonal trends also play a significant role, with rodent activity peaking in the cooler months, particularly during autumn. To capitalise on this, traps should be deployed or monitored more intensively during these periods of heightened activity. Strategic deployment in months such as April and May, where rodent activity is highest, will maximise the use of resources and increase the success rate. Time-of-day analysis revealed that most rodent activity occurs between 8 AM and 2 PM, accounting for the majority of strikes. To optimise performance, traps should be monitored more closely during these hours, and trap sensitivity could be adjusted to account for peak rodent activity. Additionally, further analysis of hourly patterns could refine this approach and lead to more precise scheduling. Group configurations also showed varying success rates. Groups of 2, 3, and 5 traps consistently recorded higher strike numbers, though future analysis should calculate success rates relative to the number of traps in each group to determine true effectiveness. Refining group configurations based on these findings could improve the efficiency of trap deployments in various environments. Lastly, geographical analysis suggests that trap success may vary by location. Future efforts should focus on identifying specific environmental factors, such as habitat type or proximity to rodent populations, which contribute to success in different regions. This will enable more targeted and effective trap placement based on regional conditions.

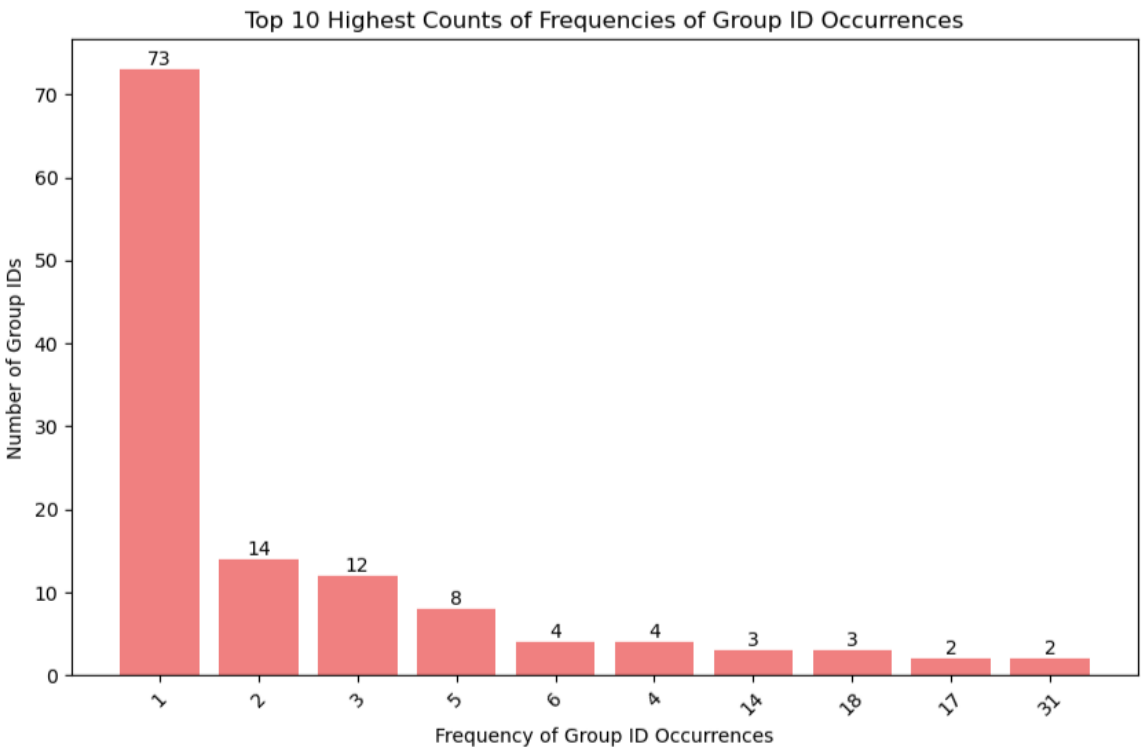
In conclusion, while the findings provide valuable insights into temperature, seasonal trends, and group configurations, further analysis is needed to explore the interactions between key variables such as temperature, time of day, and geographical factors. Additionally, integrating behavioural data on rodent activity patterns and ecological interactions will provide a more comprehensive understanding of trap performance. By combining these insights, Good-natured can refine its pest control strategies, improve trap designs, and develop more tailored solutions for effective and sustainable pest management.

Appendix

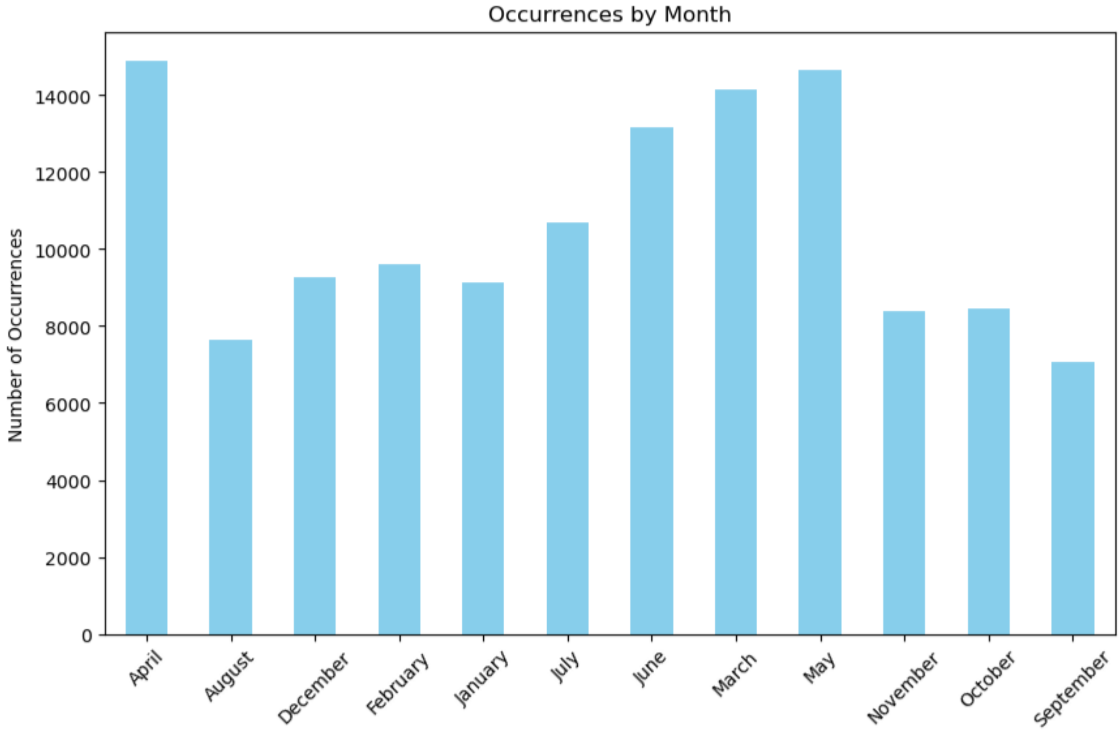
Graph 1



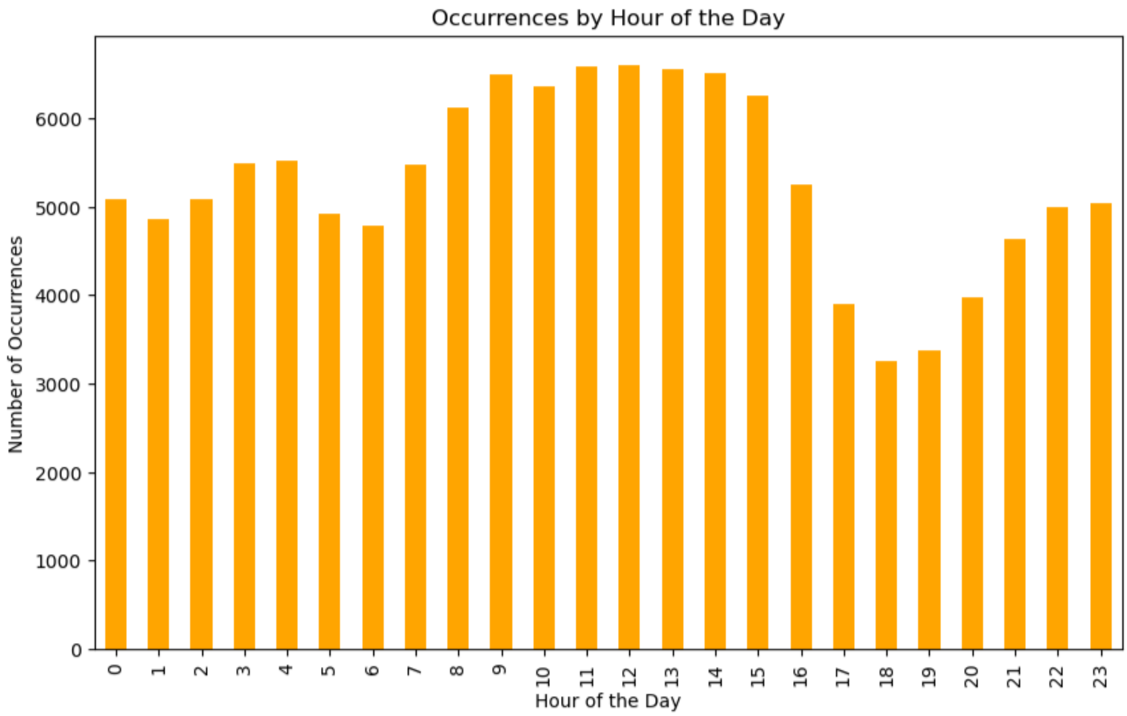
Graph 2



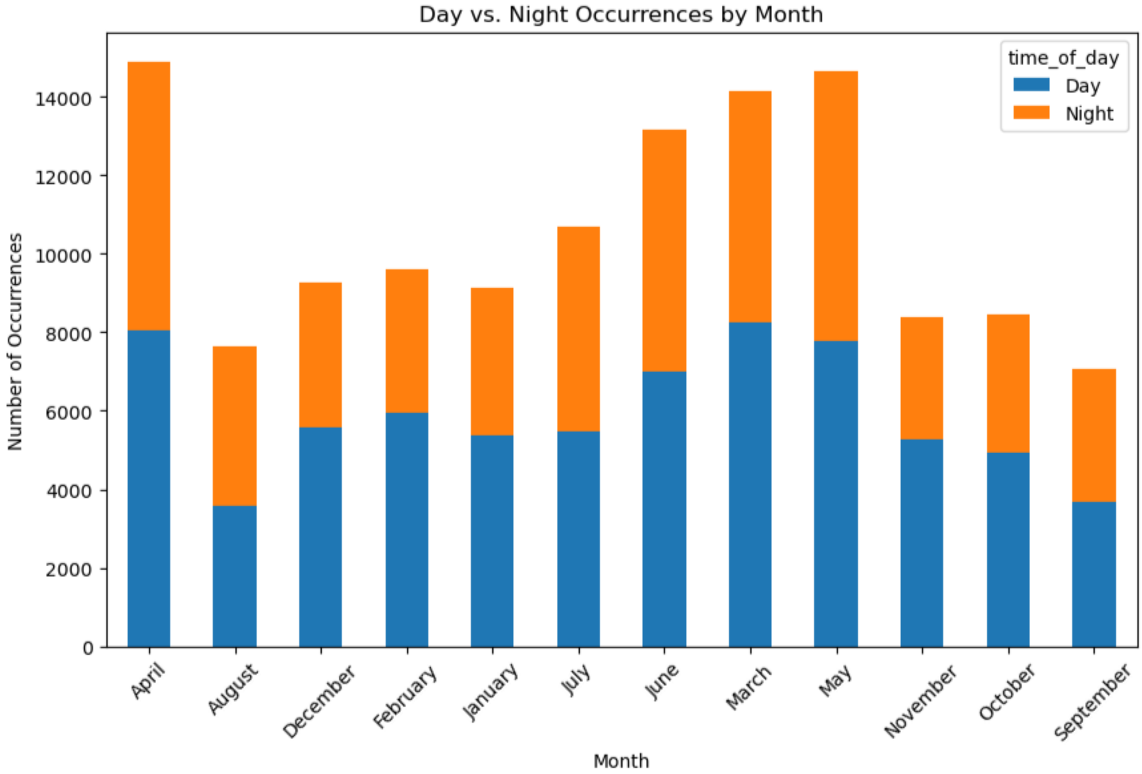
Graph 3



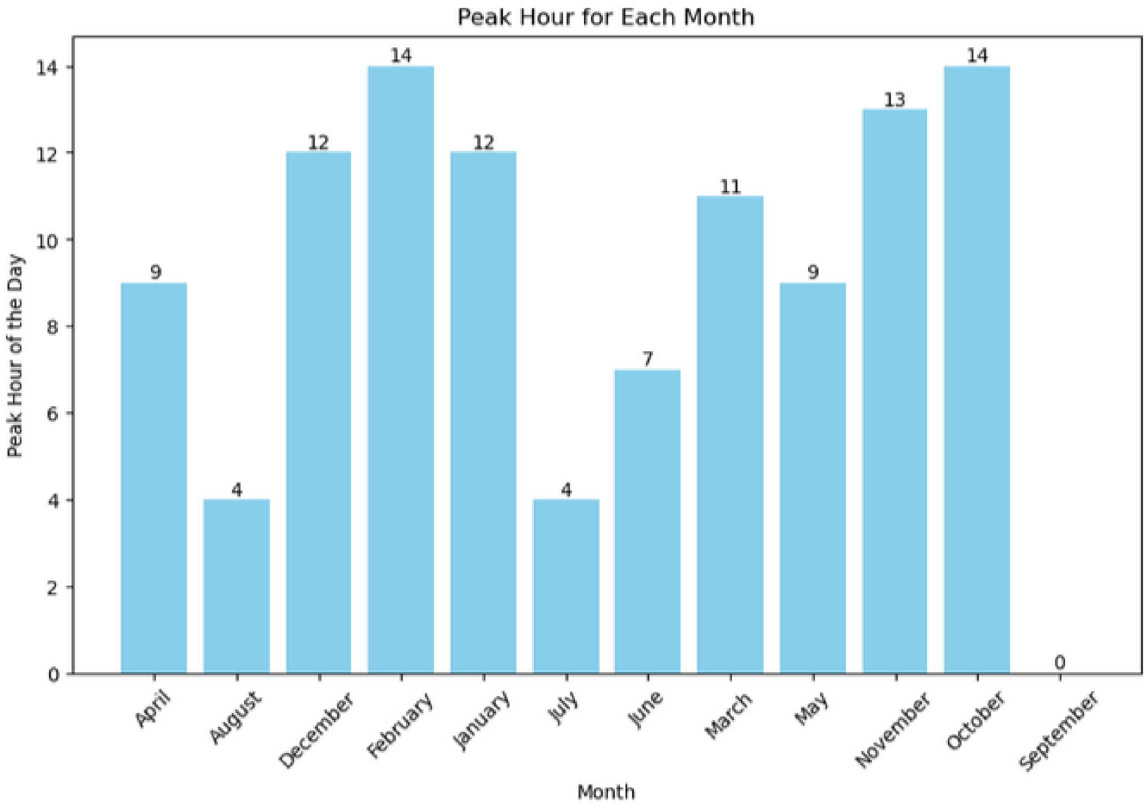
Graph 4



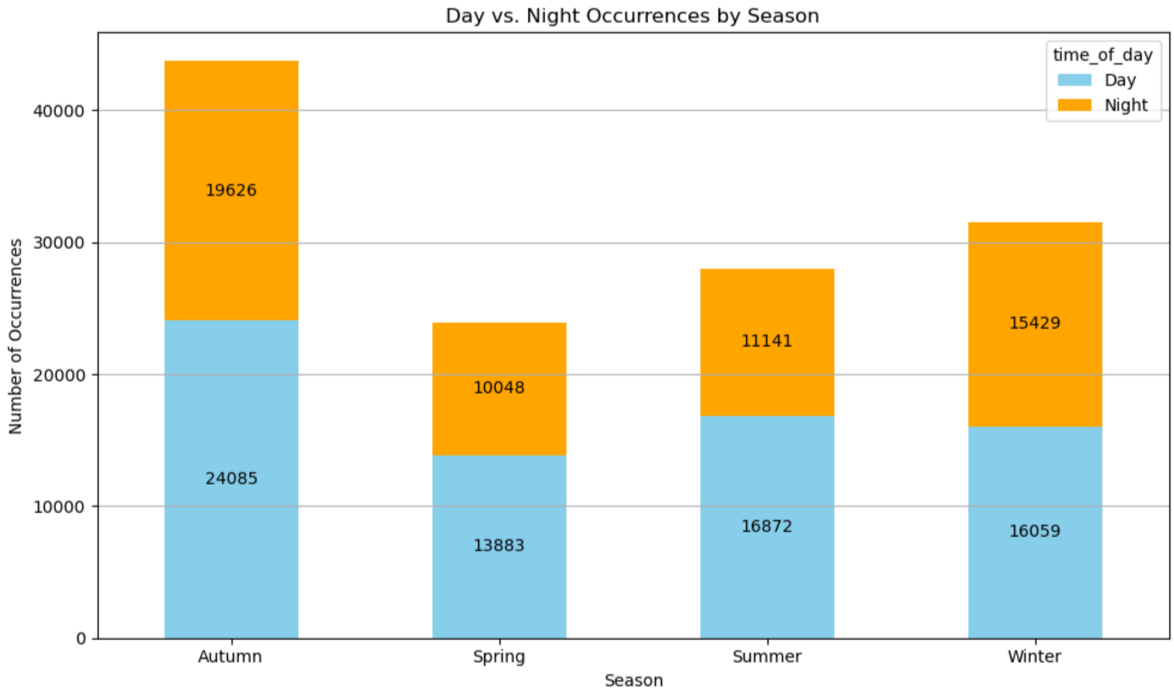
Graph 5



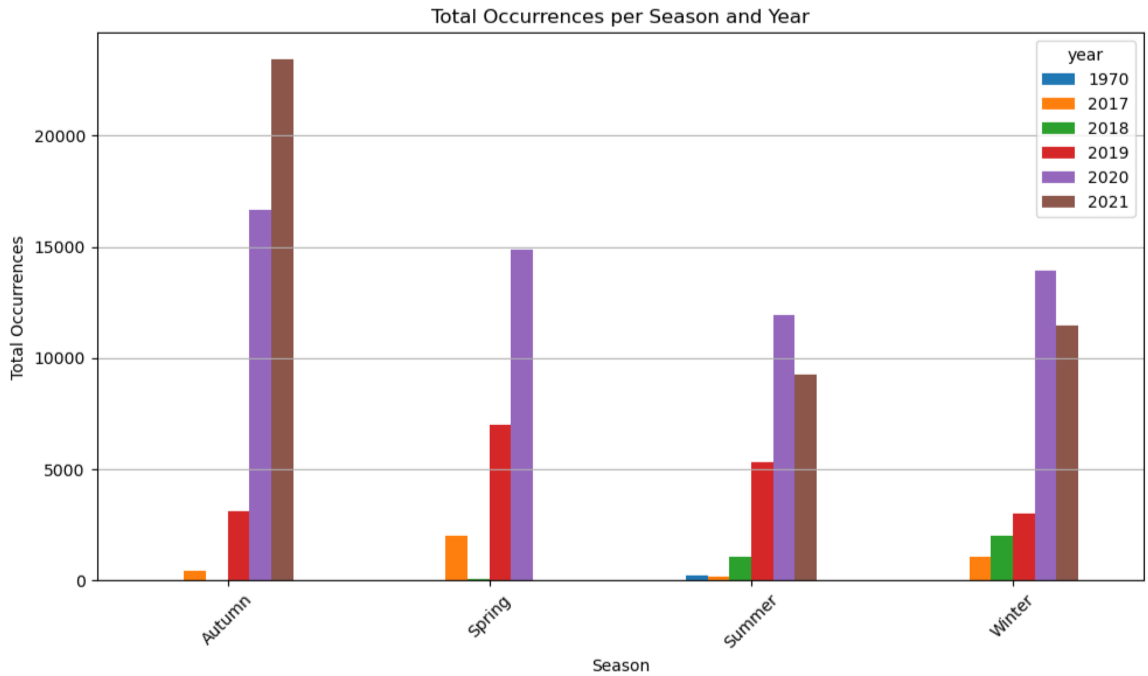
Graph 6



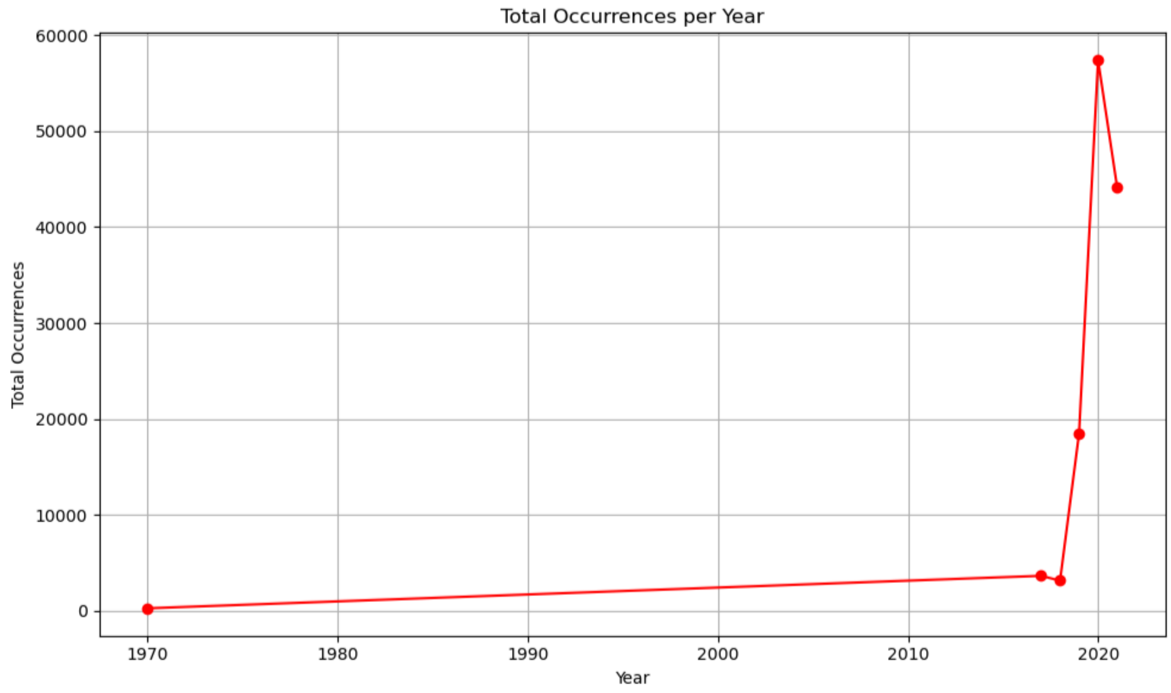
Graph 7



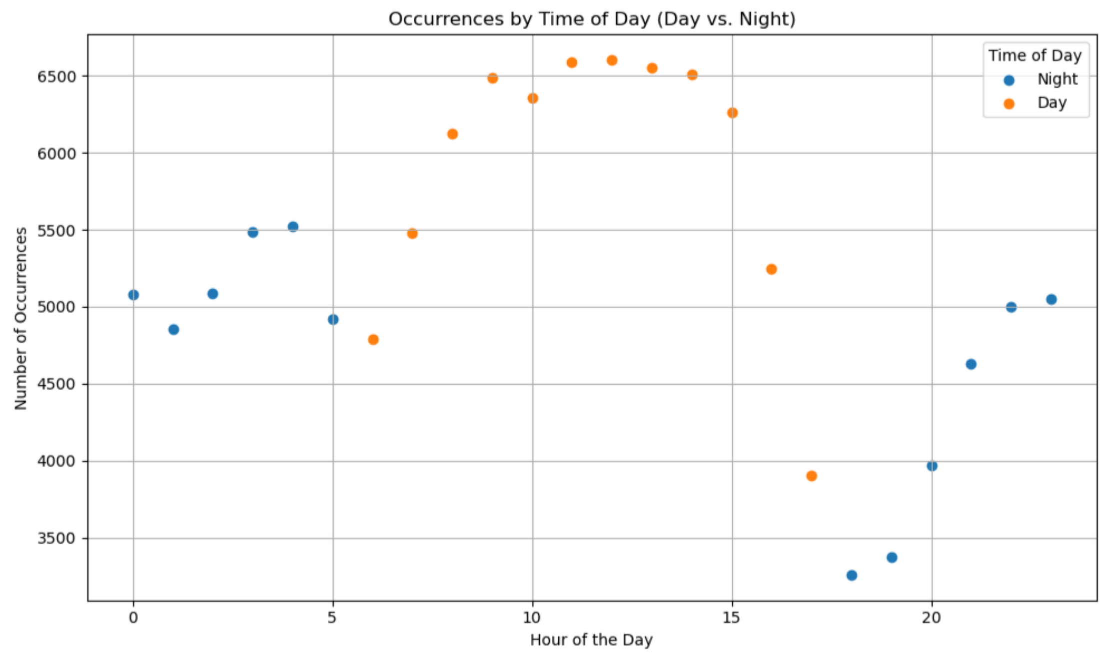
Graph 8



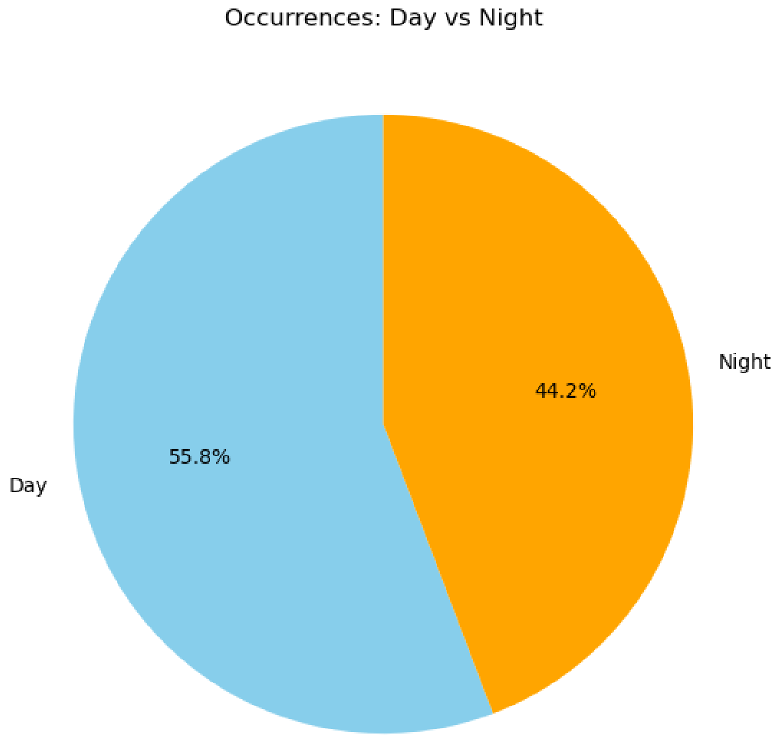
Graph 9



Graph 10



Graph 11



Graph 12