Aviation Risk Analysis for Business Expansion

A Data-Driven Approach to Aircraft Selection and Risk Mitigation

Introduction:
Business Understanding

- The **objective** of this project is to determine which are the most secure types of airplanes for acquisition for commercial and private entities for the company.
- The **business problem** is that the current industry of operation the company is moving into is the aviation industry, but the company has inadequate risk data on aircrafts
- Data Source: The dataset includes aviation accident data from 1962 to 2023, sourced from the National Transportation Safety Board (NTSB).
- The **goal** is to identify low-risk aircraft for potential acquisition and determine strategies to mitigate operational risks.
- The **tool** used is Python for data cleaning, aggregation and visualization.

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Data Description and Analytical Approach

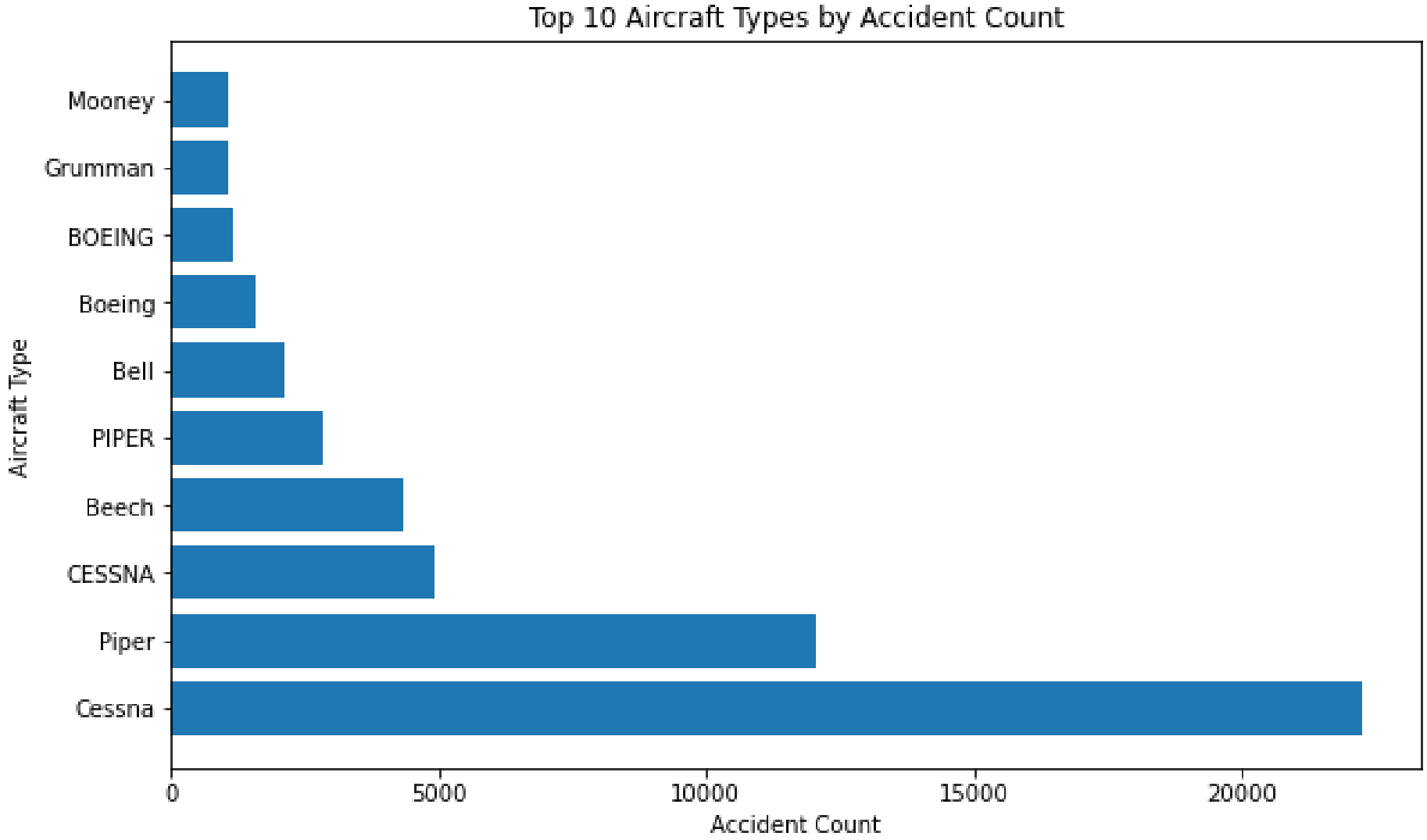
- The analysis was conducted with a large sample data extracted from the large data base of the NTSA that contains data on civil aviation accidents and incident exceeding 50000 records. Key variables from the dataset are:
  Aircraft type: Differentiating which type of aircraft have been involved in the accident.
  Accident count: Recording the frequency by which some kinds of plane types are associated with accidents.
  Fatality count: compares severity of accidents, whether fatal or non-fatal.
  Seasonal trends: finds out whether some months of the year are more prone to accidents than other months.
- The analysis used both descriptive and inferential statistical techniques to uncover risk patterns in the aviation data. The focus was on Descriptive Statistics which summarizes the accident frequency, severity, and distribution of accidents across different aircraft types. This helped identify aircraft types with higher risks based on historical accident records. Inferential Statistics helped in Investigating seasonal patterns and correlations between accident rates and specific months. This allowed for more proactive recommendations around scheduling maintenance and safety checks during peak risk periods.

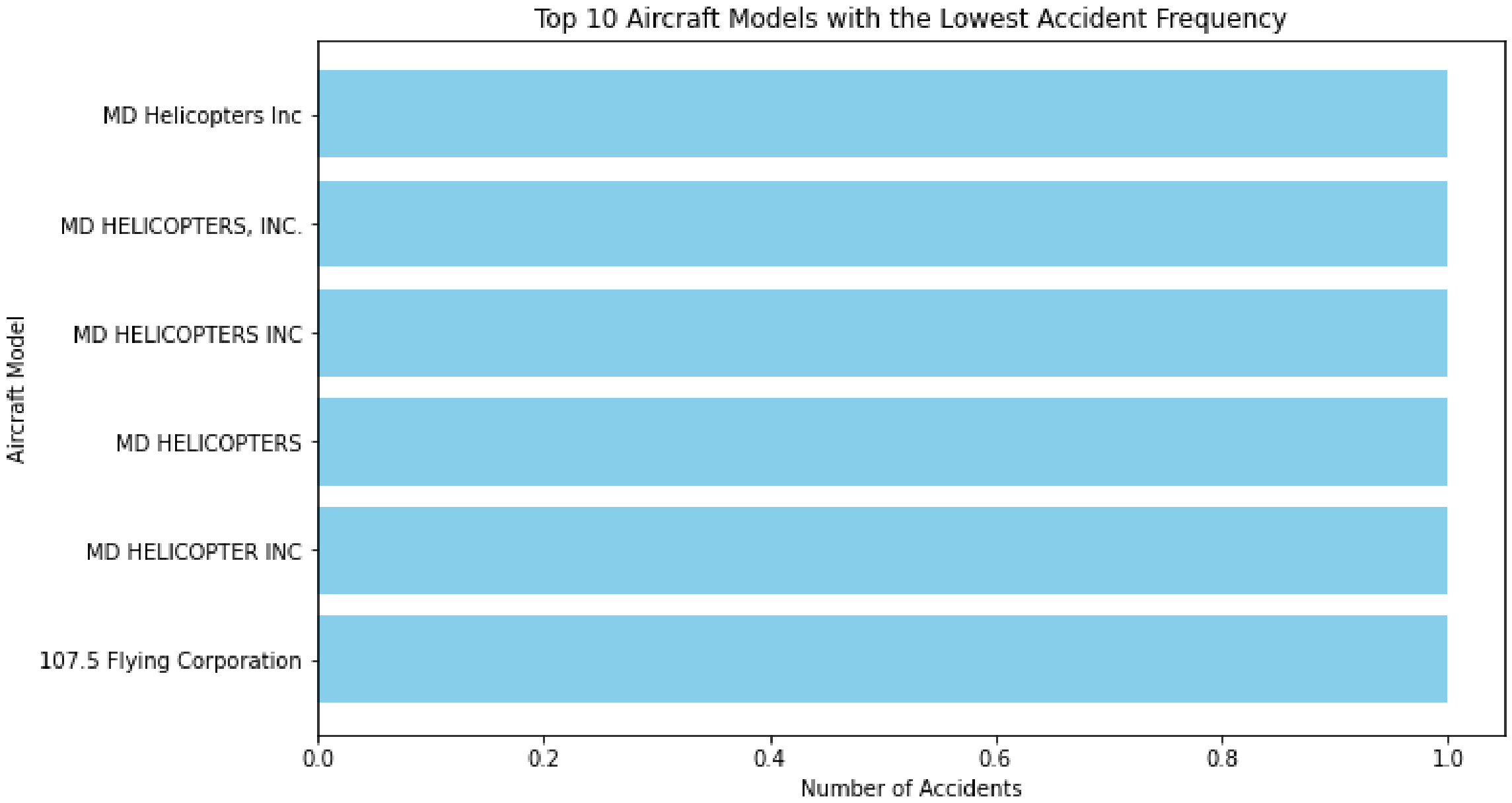
Data Cleaning

- I searched for missing values in some critical parameters including accident count, and the type of aircraft involved.
- I filled missing fields where possible with the word “Unkown”, and omitted records in some columns like Make and Model.
- Restricted errors such as duplicates, erroneous entries and outliers which affected the data cleanliness.
- I reduced the dataset to focus on relevant fields, such as aircraft type, accident fatality, date, and accident frequency .

Data Analysis

Accident Frequency by Aircraft Type

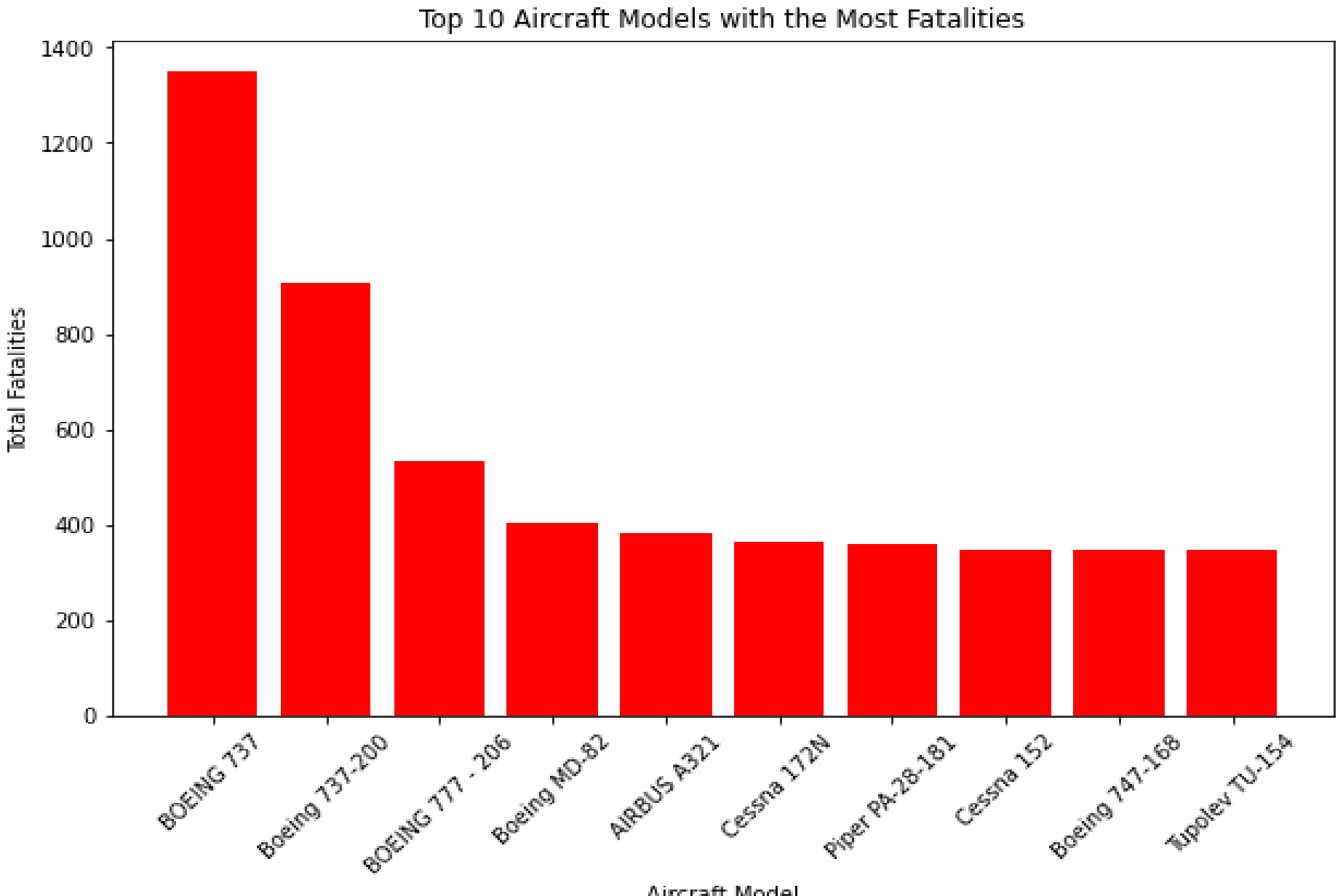



Top 10 Aircraft Models with the Lowest Accident Frequency
MD Helicopters Inc
MD HELICOPTERS, INC.
MD HELICOPTERS INC
MD HELICOPTERS
MD HELICOPTER INC
107.5 Flying Corporation
Aircraft Model
0.0
0.2
0.4
0.6
0.8
1.0
Number of Accidents

Important observations from the analysis include:
Specific models of planes where identified to be more dangerous than others were identified. Some of the most hazardous aircraft to acquire in the above analysis include; The Boeing 737 had one of the highest accident frequencies which denotes that it is risky to acquire. Likewise, the Cessna 172 and Boeing Stearman PT-17 were the most common planes to be associated with accidents, mainly in private flight use and operation. Caution has to be applied when it comes to existing potential deals with these aircraft types.

However, certain types of aircrafts had very low accident ratio and very few if no fatal accidents at all. The firms that demonstrated a high level of safety were MD Helicopters which recorded fewer accidents and very few fatalities. These aircraft types are therefore safer options to go for and should form the bulk of the company's expansion agenda.

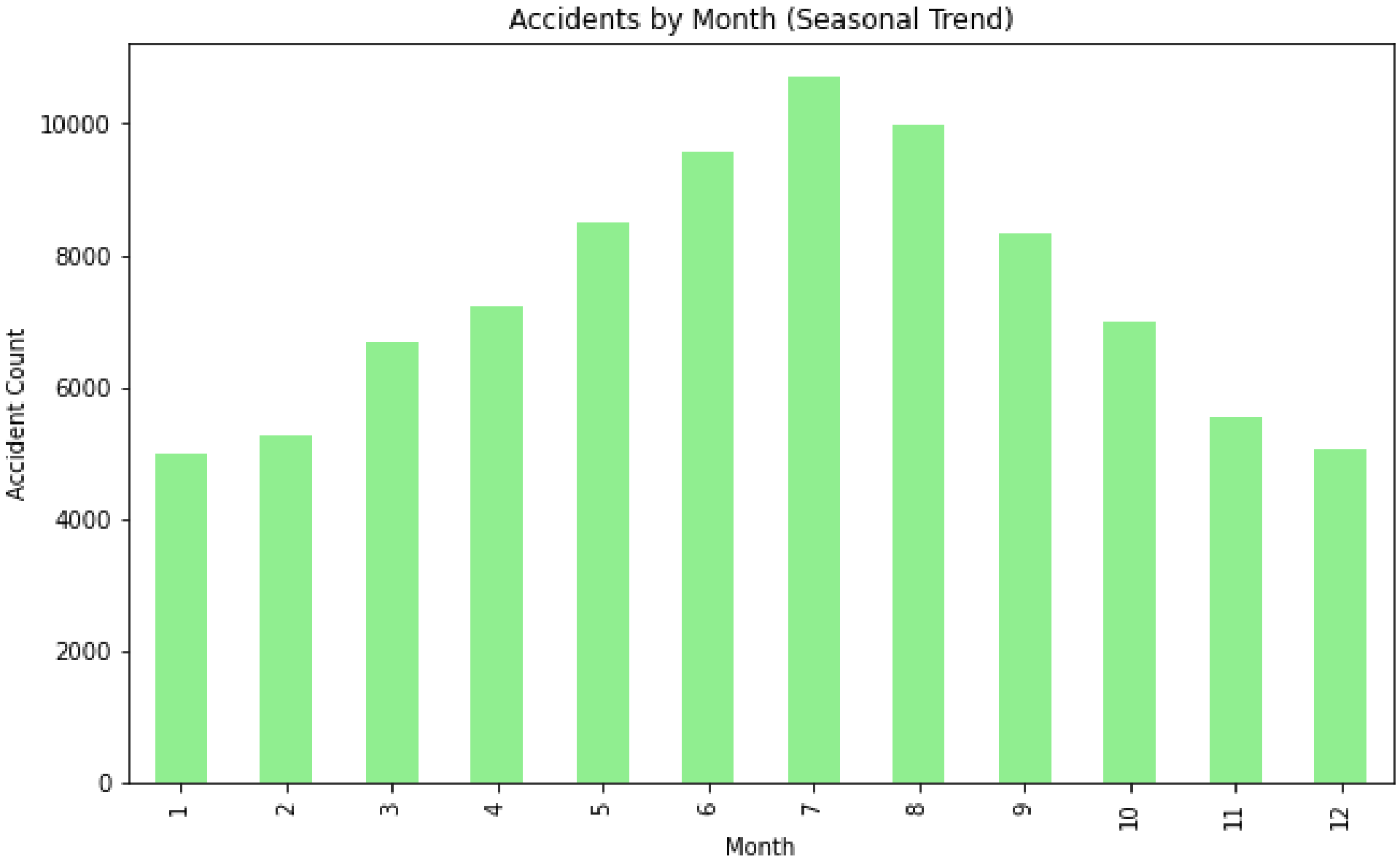
Fatalities per Aircraft Type



Observations from the above is that Aircraft such as the Boeing 737 and Boeing 777 have been found to exhibit significantly higher fatality counts in comparison to other models.

Given the inherent risks linked to the Boeing 737 and 777, it is recommended that the company **avoid purchasing these models** as part of its aviation expansion strategy. The safety record of these aircraft indicates that they pose a greater operational risk, which could result in higher insurance premiums, increased maintenance costs, and potential liabilities.

Seasonal Trends in Accidents



The analysis revealed a clear seasonal trend in accidents. Accidents peaked during the summer months, particularly in June, July, and August. This is likely due to the increased volume of flights during the summer travel season, as well as potential weather-related risks such as storms or extreme heat. These findings suggest that additional safety protocols and maintenance checks should be implemented during these high-risk months to mitigate the likelihood of accidents.

Recommendations

- The solution to the company's problem lies in carefully selecting aircraft based on their accident history and implementing proactive risk mitigation strategies. The following recommendations were derived from the data:

1. Avoid High-Risk Aircraft: Aircraft with a history of frequent accidents and fatalities, such as the Boeing 737 and Cessna 172, should be avoided. These aircraft present significant safety concerns that could increase operational hazards.
2. Prioritize Low-Risk Aircraft: Aircraft such as MD Helicopters have a strong safety record, with fewer accidents and minimal fatalities. These aircraft should be prioritized for acquisition as they present lower operational risks.
3. Mitigate Seasonal Risks: Implement heightened safety protocols during the summer months, particularly June, July, and August, when accident rates tend to spike. This could involve increasing the frequency of maintenance checks, conducting additional pilot training, or limiting flight operations during adverse weather conditions.

Evaluation of the Solution

The data-driven recommendations presented in this analysis provide the company with a clear path to minimizing risk in its new aviation division. By focusing on aircraft with a proven track record of safety and proactively addressing seasonal risks, the company can significantly reduce the likelihood of accidents and associated operational costs.

In comparison to a baseline scenario where aircraft are selected without consideration of historical accident data, the proposed solution offers a substantial improvement in risk management. Avoiding high-risk aircraft will reduce potential liabilities and insurance costs, while prioritizing low-risk aircraft will improve the company’s overall safety profile.

Limitations and Future Work

However, it should be noted that despite the fact that the analysis is carried out from the historical data, there are certain drawbacks. This implies that data for some of the occurrences might have been incomplete thus distorting some of the results. Also, the analysis was based on historical data, and new plane models or new technologies that appeared in the market and were not represented in the data base might lead to new risks.

As for expansion of this study, future studies may include more up to date data or examine new patterns in aircraft safety haven. It is going to be important for the company to monitor the new types of aircraft models and keep updating the risks assessments on a frequent basis in order to mitigate potential risks in the aviation business.

Conclusion

In conclusion, this data-driven analysis provides a comprehensive solution to the company's aviation expansion problem. By avoiding high-risk aircraft, prioritizing low-risk models, and implementing proactive safety measures during high-risk months, the company can significantly reduce operational hazards and position itself for long-term success in the aviation sector.

Future work should focus on continuous monitoring of accident trends to ensure that the company's safety strategies remain effective in the evolving aviation landscape.