

Analysis of Aircraft Accident Data

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Introduction

➤ Overview

The company is keen on expanding into the aviation industry and is interested in:

- Diversification: The company wants to diversify and expand its existing portfolio and operate aircrafts for both commercial and private enterprises
- Risk Management: The company is keen on safety and wants to minimize the potential risks associated with operating aircrafts



Introduction

- Objectives of the analysis
 - Risk Assessment: Analyze aviation accident data to identify aircraft makes and models with High and Low Accident Injury Severity Rates
 - Decision support: Provide actionable insights based on findings that would guide on which aircraft to purchase

Data Description

■ Source of the data

Data analyzed is from the National Transportation Safety Board (NTSB) aviation accident data (1962-2023). The data provides civil aviation accidents and selected incidents in the United States and international waters. It covers various aviation activities (commercial, private, training flights, etc.)

■ Key features

This dataset typically includes detailed information about aviation accidents and incidents

■ Key Variables

■ Aircraft Information

- **Make:** The manufacturer of the aircraft involved in the event (e.g., Boeing, Cessna)
- **Model:** The specific model of the aircraft (e.g., 737, 152).

■ Event Details

- **Injury Severity:** The severity of injuries resulting from the event (e.g., Fatal, Serious, Minor, None)
- **Aircraft Damage:** The extent of damage to the aircraft (e.g., Substantial, Minor, Destroyed)

■ Injury Information

- **Total Fatal Injuries:** The total number of fatal injuries resulting from the event.
- **Total Serious Injuries:** The total number of serious injuries.
- **Total Minor Injuries:** The total number of minor injuries
- **Total Uninjured:** The total number of uninjured individuals.



Methodology

- Steps taken for data cleaning and preprocessing
 - Address missing values
 - Removed columns that had more than 60% of missing data.
 - Removed rows that had more than 60% data
 - Checked for outliers
 - Two models Cessna and Piper accounted for more than 45% of the data
 - This probably indicates that majority of the aircrafts used are Cessna and Piper
 - Though these seem as outliers, removing them from the data would not be ideal. However further analysis can be done with the exclusion of these two makes if the company opts not to buy any model from these two makes



Methodology

- Analytical methods used
 - Selected specific variables of interest that were then analyzed. These variables have been highlighted in the data description slide
- Calculated basic statistics like mean, median, and standard deviation to understand the distribution of Injury data set.
- Counted occurrences of different categories in the aircraft make and models
- Used heatmaps to visualize the distribution of injury severities across different aircraft makes
- Created bar charts to compare accident rates and injury severities among different aircraft models
- Created pivot tables to aggregate data by aircraft make and injury severity, providing a structured summary of the data.
- Focused on the top 20 aircraft makes and injury severity categories to conduct a more detailed and manageable analysis, allowing for targeted insights and recommendations



Key Findings

- Summary of major insights from the analysis
 - **High-Risk Aircraft Makes and Models**
 - CESSNA and Piper aircraft makes show a significantly high number of accidents, especially in the Cessna 152 model, which is associated with a high number of fatal and serious injuries.
 - Several makes show high counts of non-fatal injuries, suggesting that while accidents occur frequently, not all result in fatalities. This includes makes like Piper and Beechcraft
 - **High Incidence of Severe Damage:** The data indicates that many accidents lead to substantial damage to the aircraft. Models from Cessna and Piper frequently show significant aircraft damage
 - **Minor Damage and Incidents:** Some aircraft makes, such as Boeing and Airbus, show a higher proportion of incidents with minor damage, suggesting better overall safety performance



Detailed Observations

Examples of high-risk aircraft makes and models

► High-Risk Aircraft Makes

1. CESSNA

1. **Cessna 152:** has a high number of accidents, particularly those resulting in severe injuries and fatalities. This model is frequently used for flight training, which may contribute to its higher accident rate.
2. **Cessna 172:** Another model with a significant number of accidents, though often less severe than the 152. This model is widely used in general aviation.

2. Piper

1. **Piper PA-28:** This model shows a notable frequency of accidents. It is commonly used for flight training and personal aviation.
2. **Piper PA-32:** Known for having multiple incidents with both fatal and non-fatal injuries.

Detailed Observations

- Examples of low-risk aircraft makes and models

- **Boeing**

- **Boeing 737:** Known for its extensive use in commercial aviation with relatively low accident rates and injuries,
- **Boeing 747:** Another model with a strong safety record and fewer severe injuries compared to other large aircraft

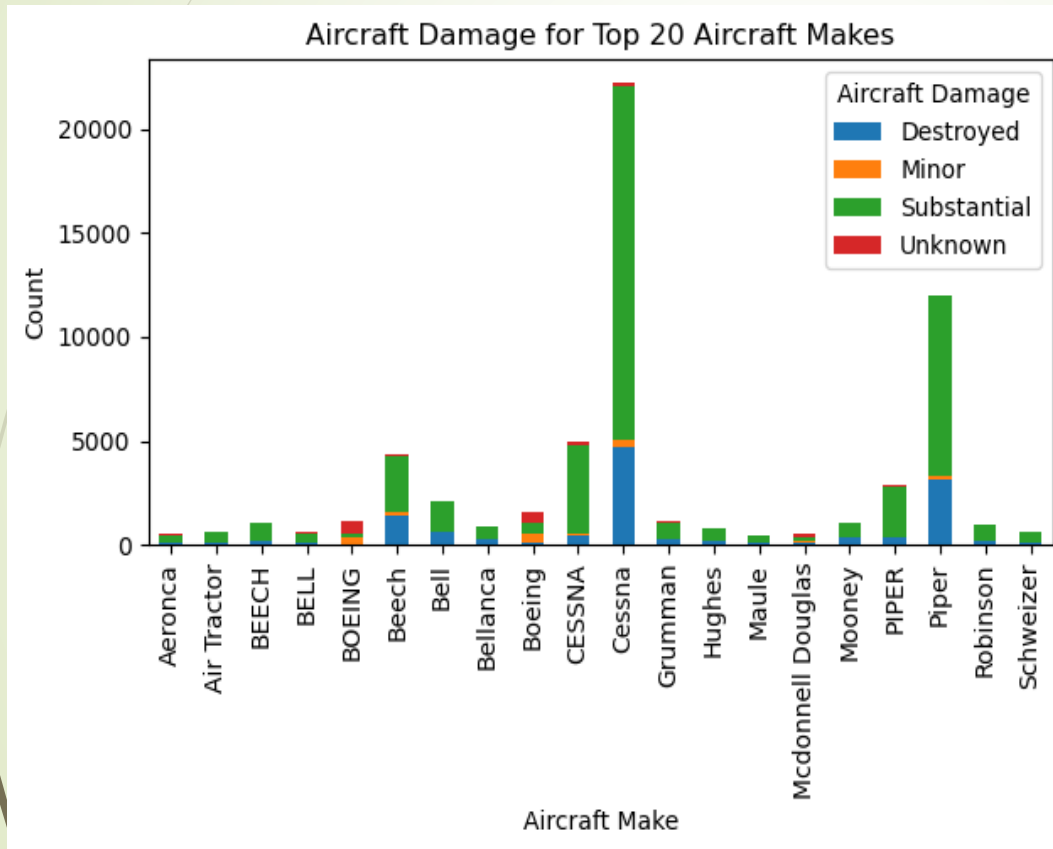
- **Airbus**

- **Airbus A320:** Widely used in commercial aviation with relatively low number of accidents and injuries.
- **Airbus A330:** Known for its strong safety performance in long-haul flights, with fewer incidents and injuries.

- **Embraer**

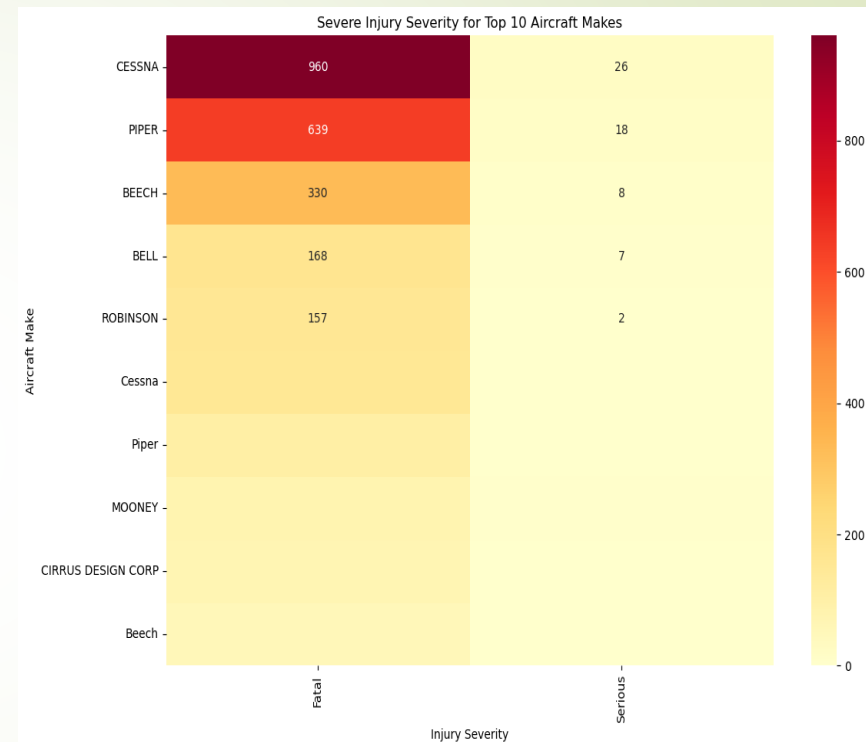
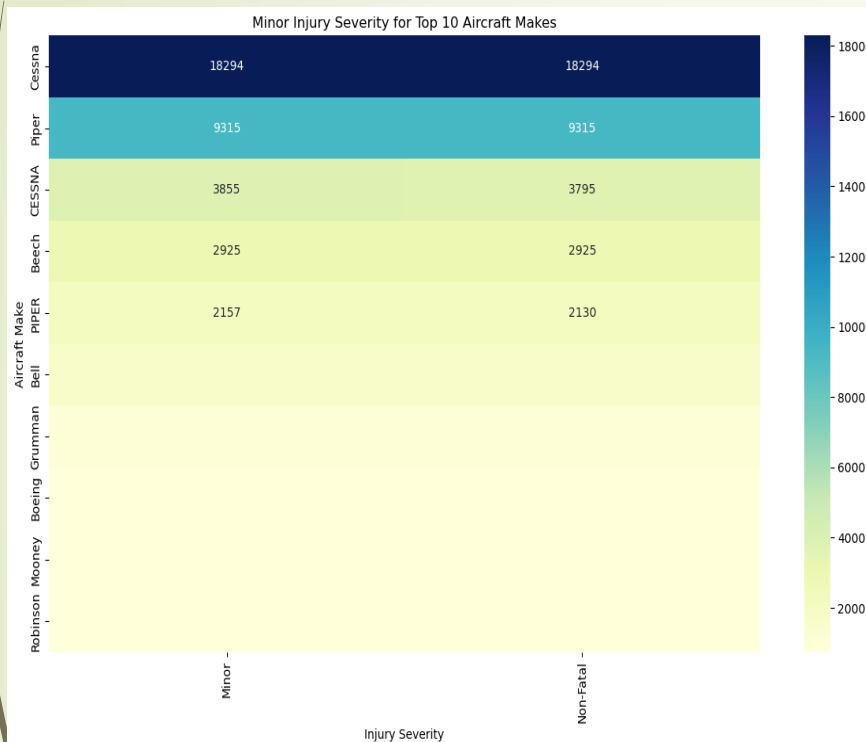
- **Embraer E190:** Used in regional flights showing fewer accidents and injuries.
- **Embraer E170:** Similar to the E190, this model is also known for its safety and reliability in regional operations

Aircraft accident and Damage Severity



Cessna and Piper have the highest number of accidents with significant damage to the aircraft

Injury Severity for top 10 aircrafts with high accident count



- Boeing appears to have minimal Severe Injury Severity.
- Cessna and Piper still top the list for both Severe and Minor though this is expected due to the two makes contributing to a high number of accidents



Recommendations

- Suggestions for further investigation
 - Conduct in-depth investigations into the specific factors contributing to the high accident rates and severe injuries associated with models like the Cessna 152, Cessna 172, Piper PA-28, and Piper PA-32.
 - Perform root cause analysis on accidents that resulted in fatalities and severe injuries. There could be other factors , such as weather conditions, pilot errors, mechanical failures, maintenance issues or other contributing factors
 - Review the maintenance practices and schedules for different aircraft makes and models. Identify any discrepancies or shortcomings that may contribute to accidents.
 - Compare the safety records of newer aircraft models with older ones. Assess whether newer models incorporate better safety features and technologies that reduce the risk of accident



Recommendations

- Actionable insights based on the analysis
 - Identify if Cessna and Piper are preferred aircrafts by further including data records on all aircraft make and flight hours.
 - If these makes are preferred then further identify the safer models to invest in
 - If these makes are not preferred, It may be good to further analyze the data excluding the Cessna and Piper models if
 - Further analysis needs to be made on Boeing, Airbus and Embraer if the company wishes to invest in aircrafts that ferry a high number of passengers or goods.
- Suggestions for further investigation



Conclusion

- The analysis of accident data is a good start but it is critical to incorporate other datasets highlighted above such as:-
 - Total Aircraft flight hours data
 - Pilot and Crew experience
 - Aircraft Maintenance Records
 - Published aircraft safety records such as the manufacturer safety record.

Questions



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