MACHINE LEARNING FOR AVIATION SAFETY

ACCIDENT TREND FORECASTING

GOAL

Objective: To analyze historical aviation accident data and forecast future trends in order to support aviation safety planning and decision-making.

WHY IT MATTERS

Timely and accurate forecasts enable aviation authorities, airlines, and emergency services to allocate resources effectively and implement proactive safety measures.

DATA UNDERSTANDING:

- **Data Source:** National Transportation Safety Board (NTSB)

- **Timeframe:** Data from 1962 to 2022, with a focus on 2000 to 2022 for this analysis.

- **Key Variables:**

Event Date, Injury Severity, Aircraft Damage, Purpose of Flight, Weather Condition

DATA PREPARATION

- Filtered dataset to include only years from 2000 to 2022.

- Handled missing and inconsistent data entries.

- Created new features such as:

    Total Injuries (fatal + serious + minor)

    Categorized injury severity
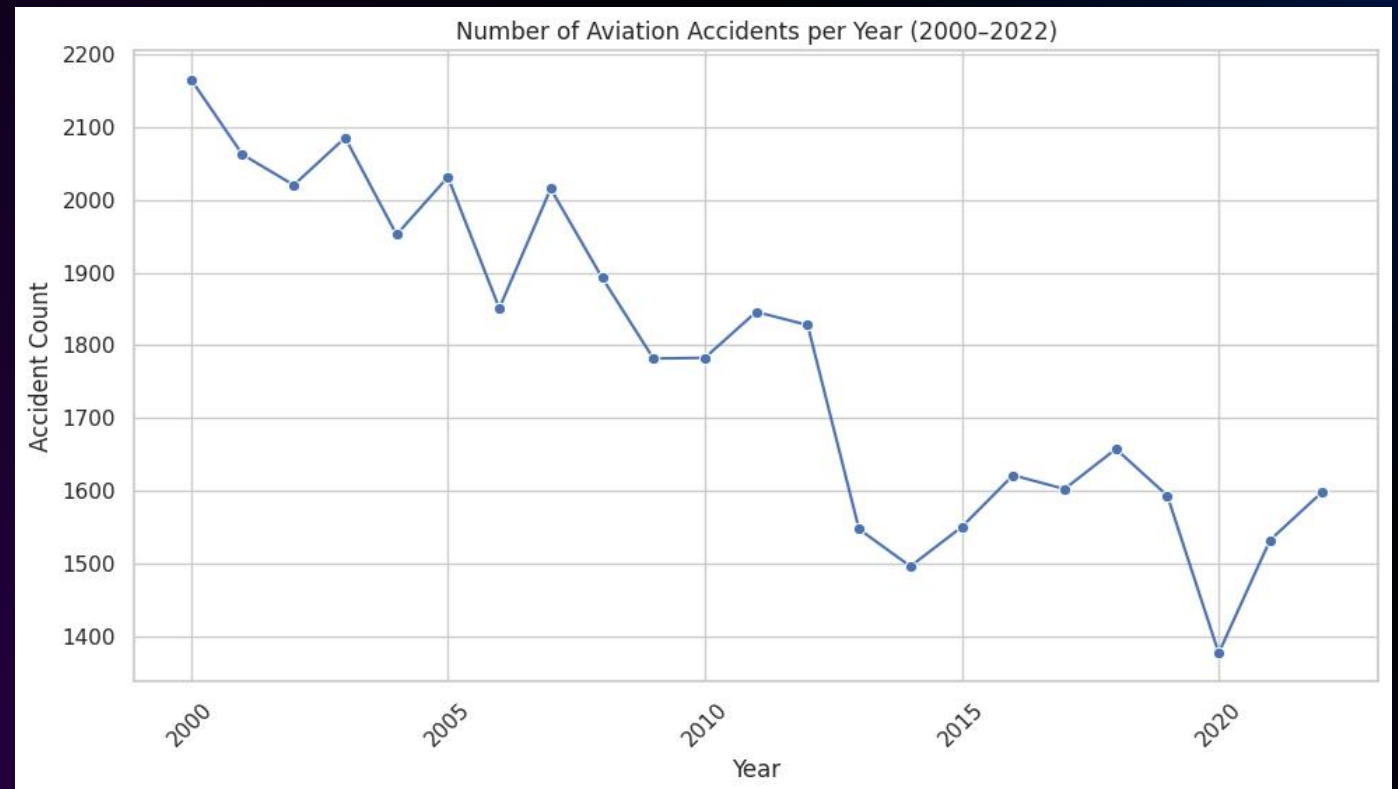
   Aggregated accident counts by year

ACCIDENT TRENDS

Observations:

•There has been a general downward trend in the number of aviation accidents per year from 2000 to 2022.

•There are some fluctuations year-to-year, but the overall pattern shows a decrease in accident frequency over this period.

Number of Aviation Accidents per Year (2000–2022)

PHASE OF FLIGHTS

Observations:

- The "Landing" phase has the highest number of total injuries, closely followed by "Takeoff" and "Approach".

- While the "Cruise" phase has fewer total accidents, accidents during this phase can still result in a notable number of total injuries.

Total Injuries by Phase of Flights
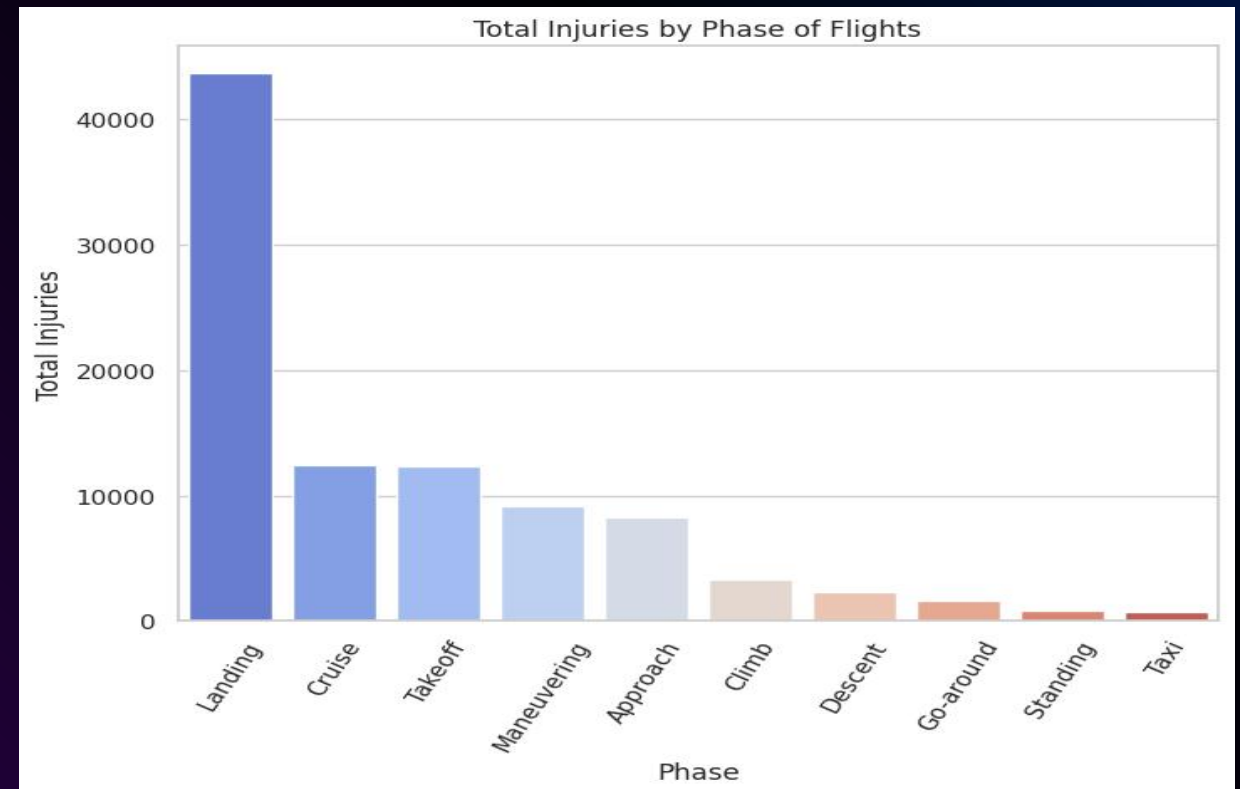
MAKES

Observations:

- "Destroyed" aircraft are overwhelmingly associated with "Fatal" injuries.

- "Substantial" damage is associated with all injury severity levels, but with a higher proportion of "Non-Fatal" and "Fatal".

Injury Severity by Top 5 Aircraft Makes
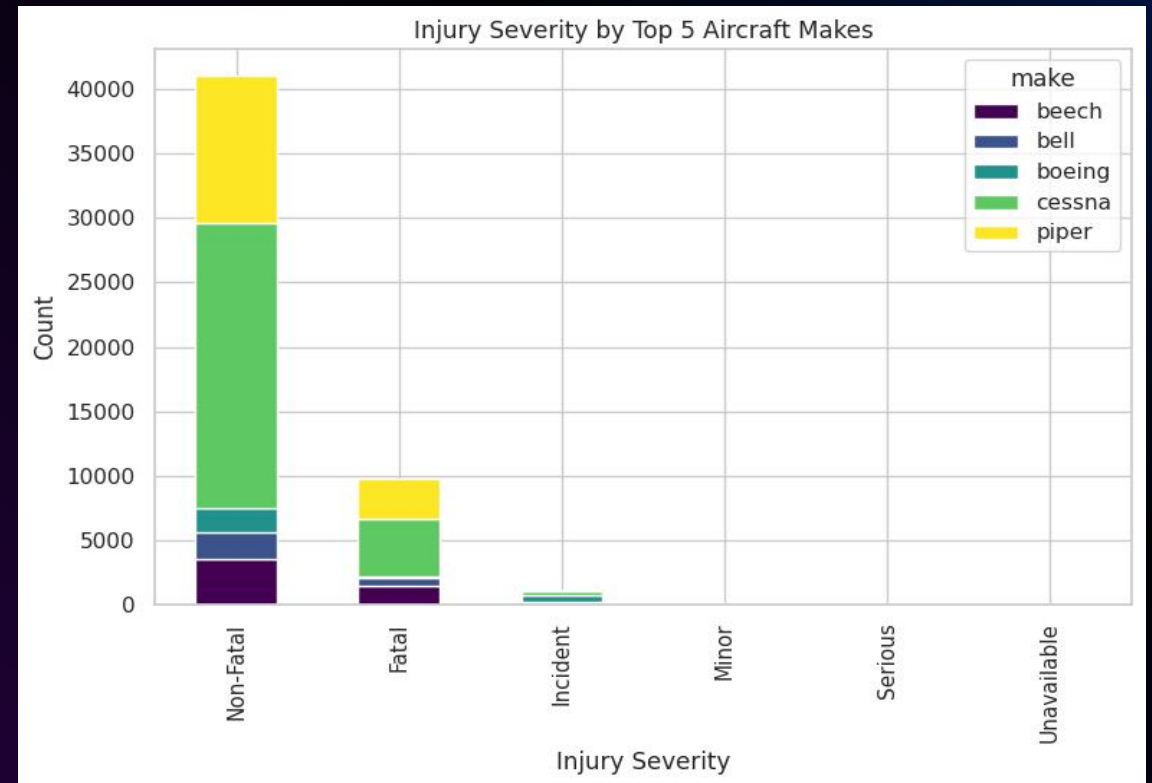
MODELING

- **Approach:** Built time series models to forecast accident counts from 2023 to 2027.

- **Models Used:**

  - ARIMA (Autoregressive Integrated Moving Average)

  - Prophet (developed by Facebook for time series forecasting)

EVALUATION

- **Performance:** Prophet slightly outperformed ARIMA in accuracy.

- **Forecast Result:** Continued stable or slightly declining trend in yearly accident counts.

- Cross-Validation (Prophet):

    Horizon: 1 to 4 years

    MAE range: 31.7 to 156.9

    RMSE range: 31.7 to 159.8

Model	MAE	RMSE
ARIMA	89.21	112.48
Prophet	79.96	100.41

CONCLUSIONS

•**Improved Planning:** Allows aviation authorities to plan safety campaigns and budget resources.

•**Risk Management:** Helps airlines and airports assess operational risks.

•**Policy Development:** Supports evidence-based safety regulations.

RECOMMENDATIONS

- Update forecasts annually with new data.

- Integrate external factors like weather, air traffic volume.

- Use findings to inform pilot training, emergency response drills, and airport safety reviews.

THANK YOU

Kenneth Nyangweso

kennethnyangweso99@gmail.com

https://github.com/kennethnyangweso/Project-Analysis-on-Aviation-Accidents