Aviation Risk Analysis

Overview

- This project focuses on analyzing aviation accident data from the National Transportation Safety Board (NTSB), covering incidents between 1962 and 2023 across the United States and international waters. The primary goal is to gain actionable insights into aviation safety and identify patterns that can guide business decisions.

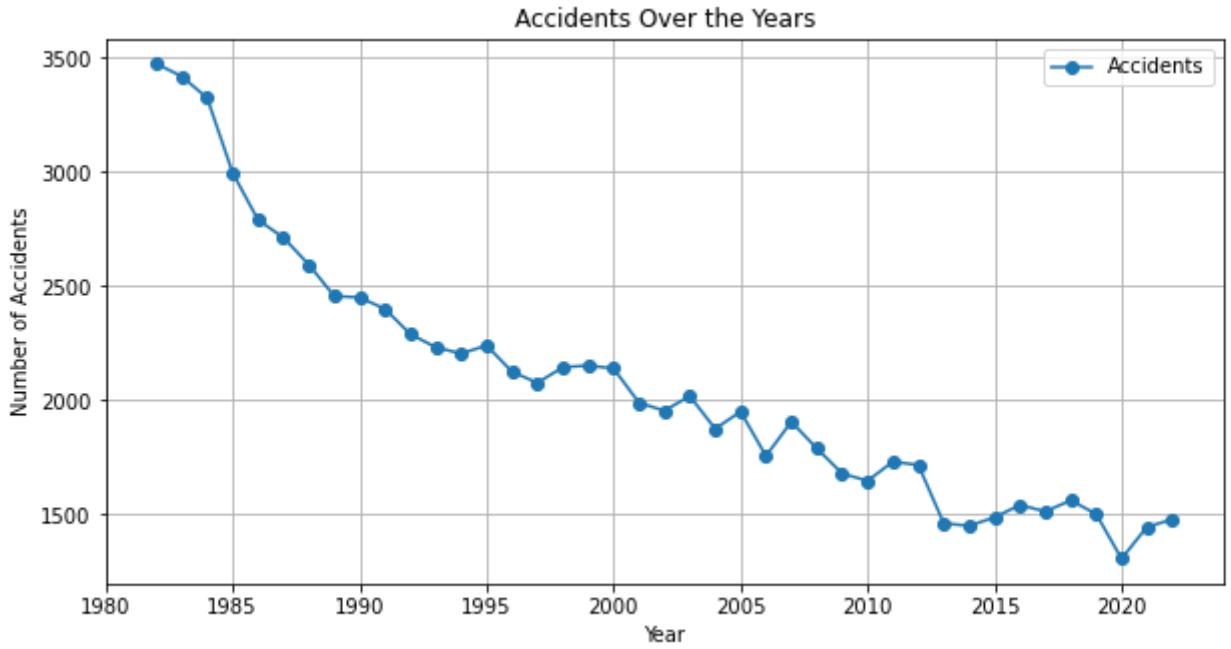
Business Understanding

- The company is entering the aviation industry without prior expertise hence we lack a systematic, data-driven approach in assessing aircraft safety and operational risks. Misjudging the risk means making uninformed investment decisions that could jeopardize the success of venturing to the aviation industry and could lead to significant financial loss, operational disruptions, or reputational damage .
- Approach: Clean and analyze data, compute trends, compare models & manufacturers, and produce business recommendations.
- Goal: is to gain insights into aviation safety and identify patterns that will enable the company to identify low-risk aircraft options and confidently move forward with its aviation investments.

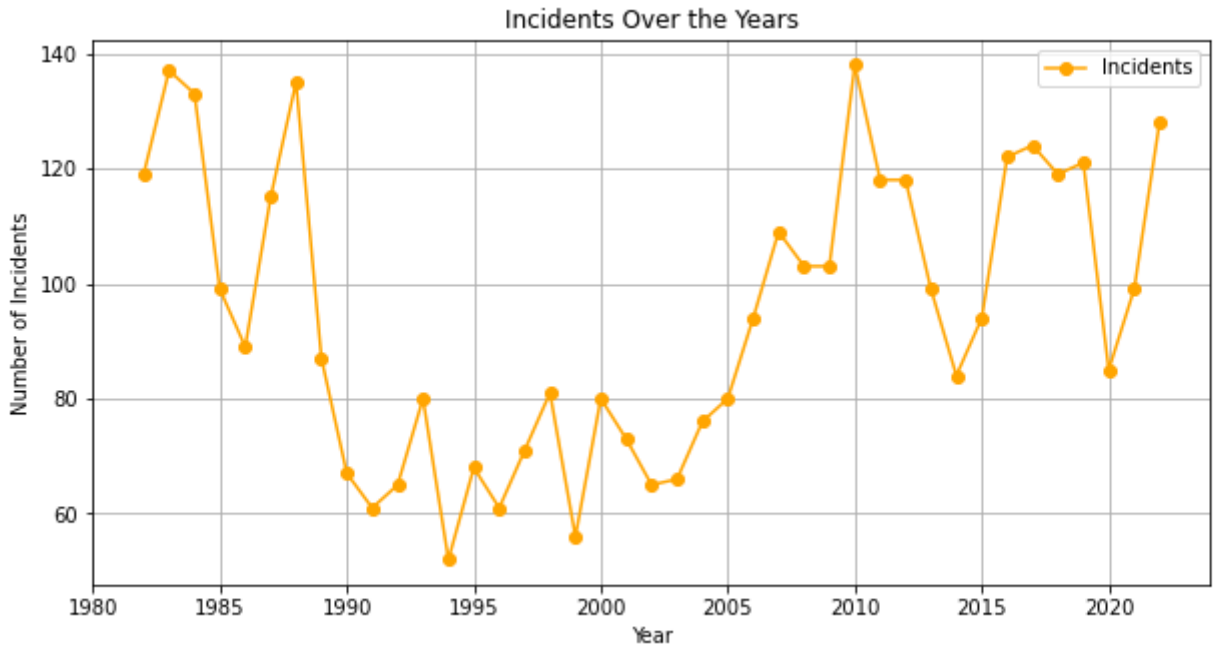
Data Understanding

- Aviation accident data from the National Transportation Safety Board (NTSB), covering incidents between 1962 and 2023 across the United States and international waters was used.
- It entails 90348 records of aircraft accident investigations.
- Each record contains data on:
  - When & where accident happened ie country, airport, date .
  - Aircraft details e.g make,model, number of engines,.
  - Damages & Injuries fatal or non fatal
  - External factors that could affect or cause accident e.g weather conditions

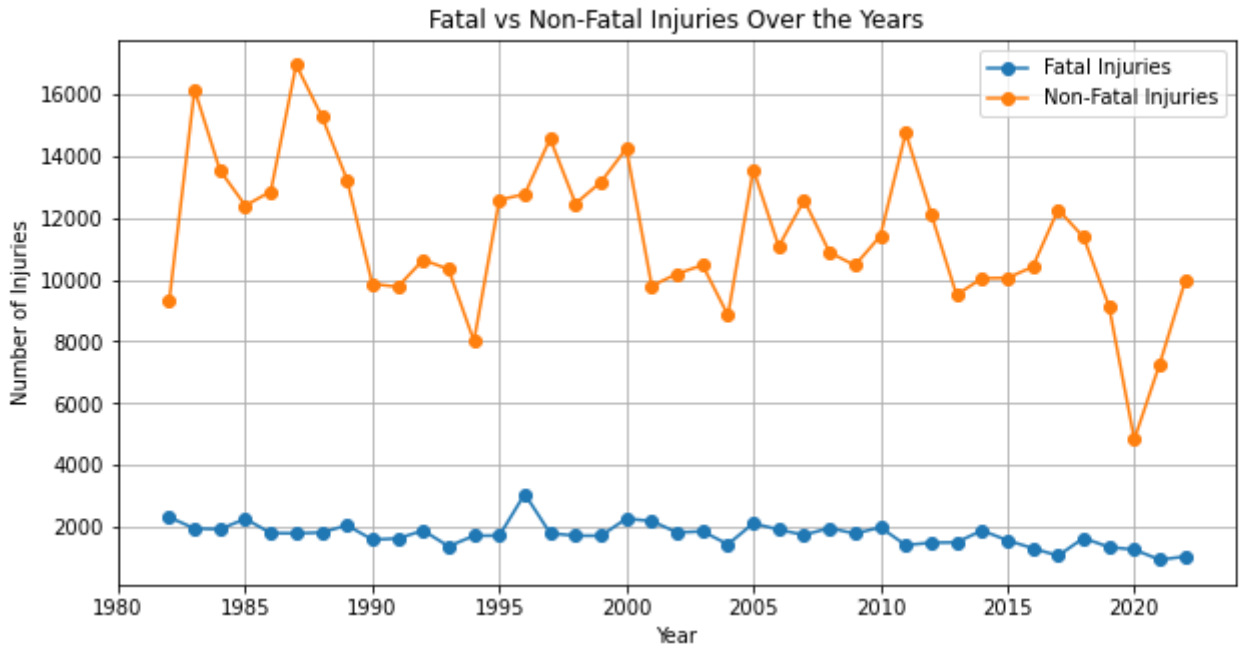
Trends Over The Years



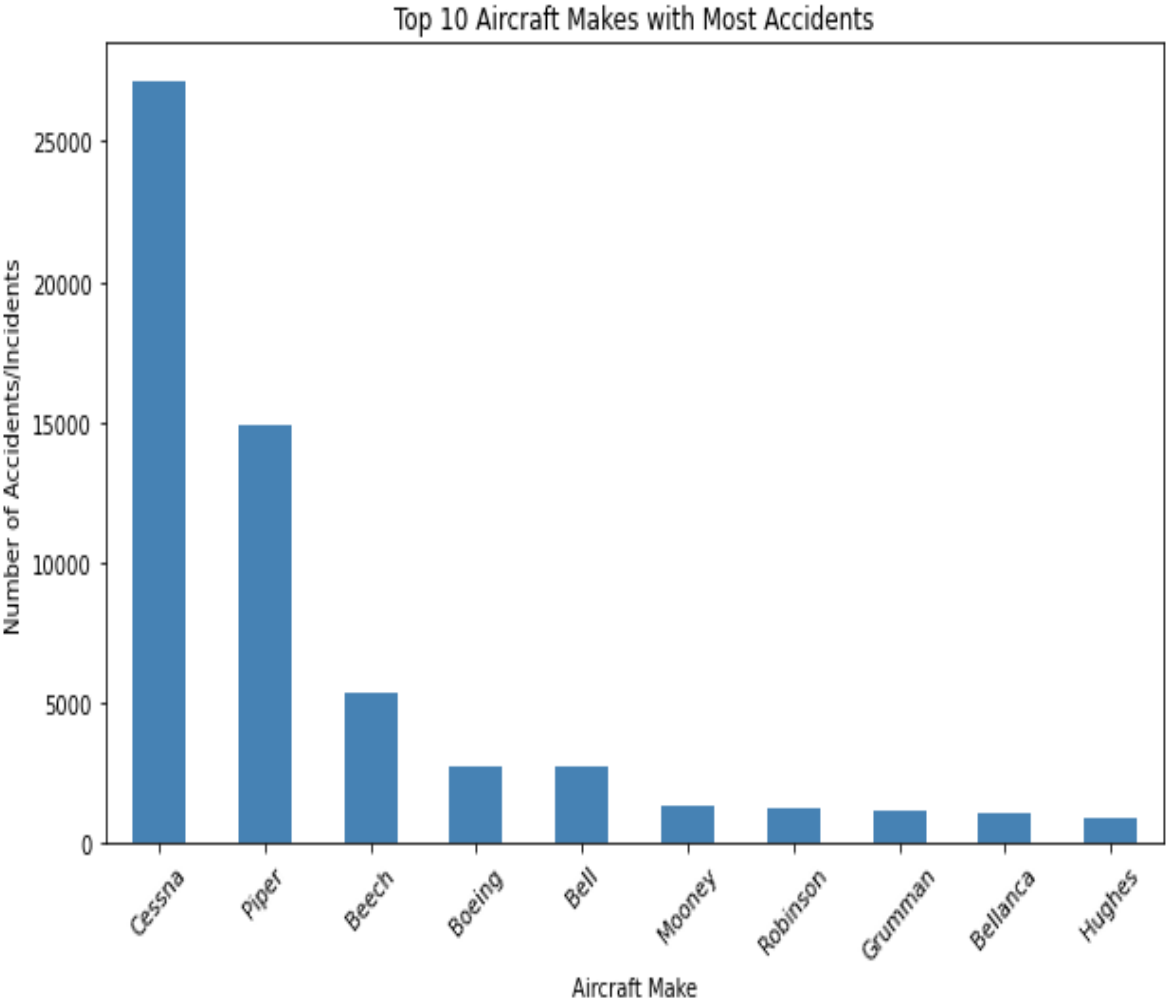
Incidents Over The Years

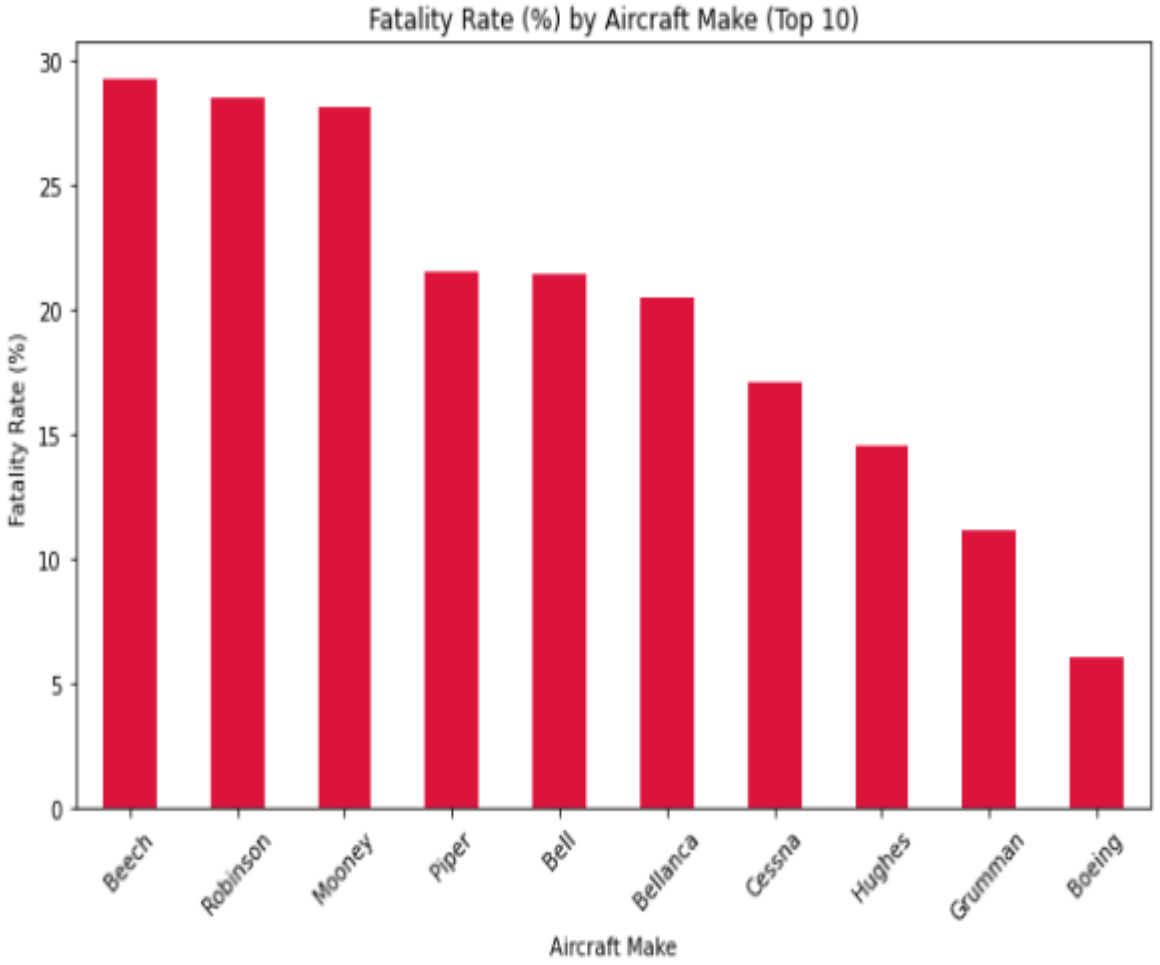


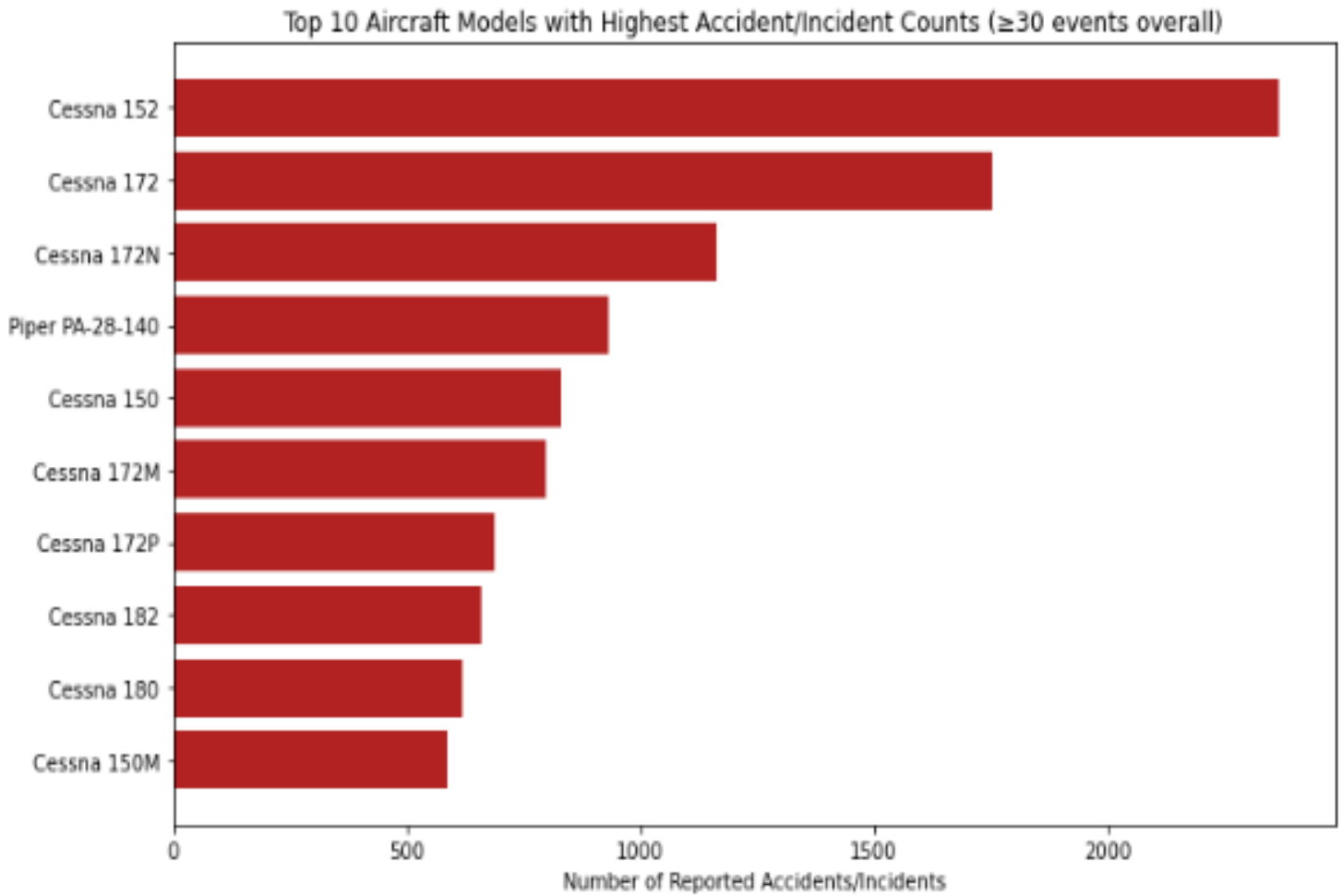
Injuries Over The Years

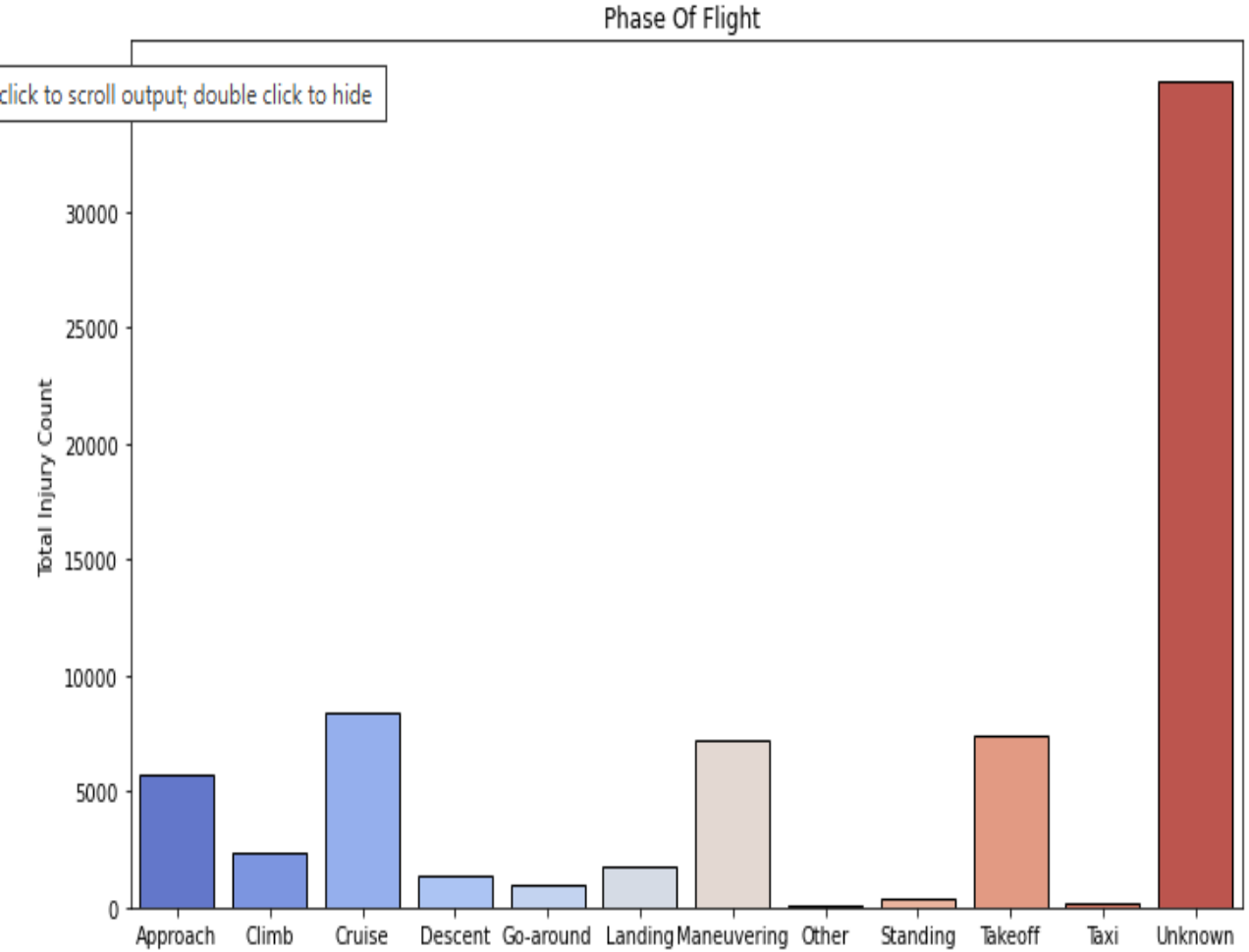


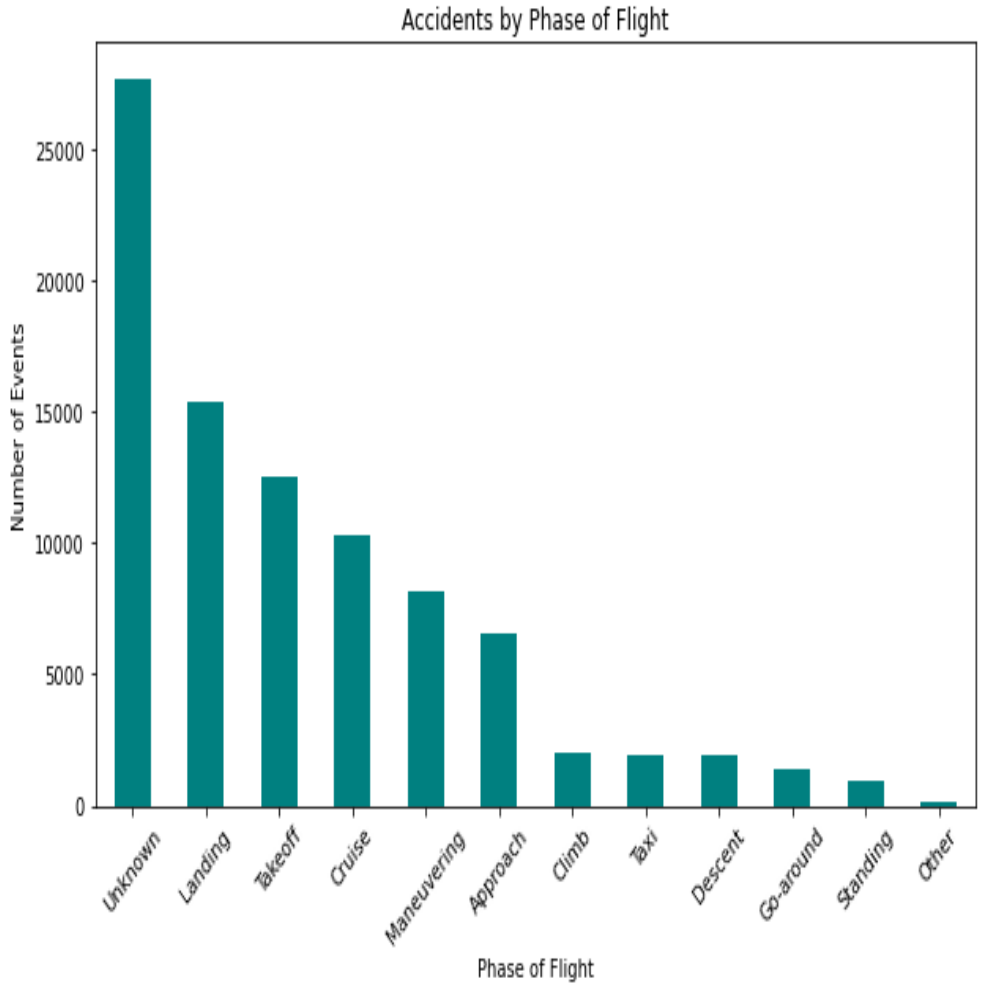
Aircraft Make &Model



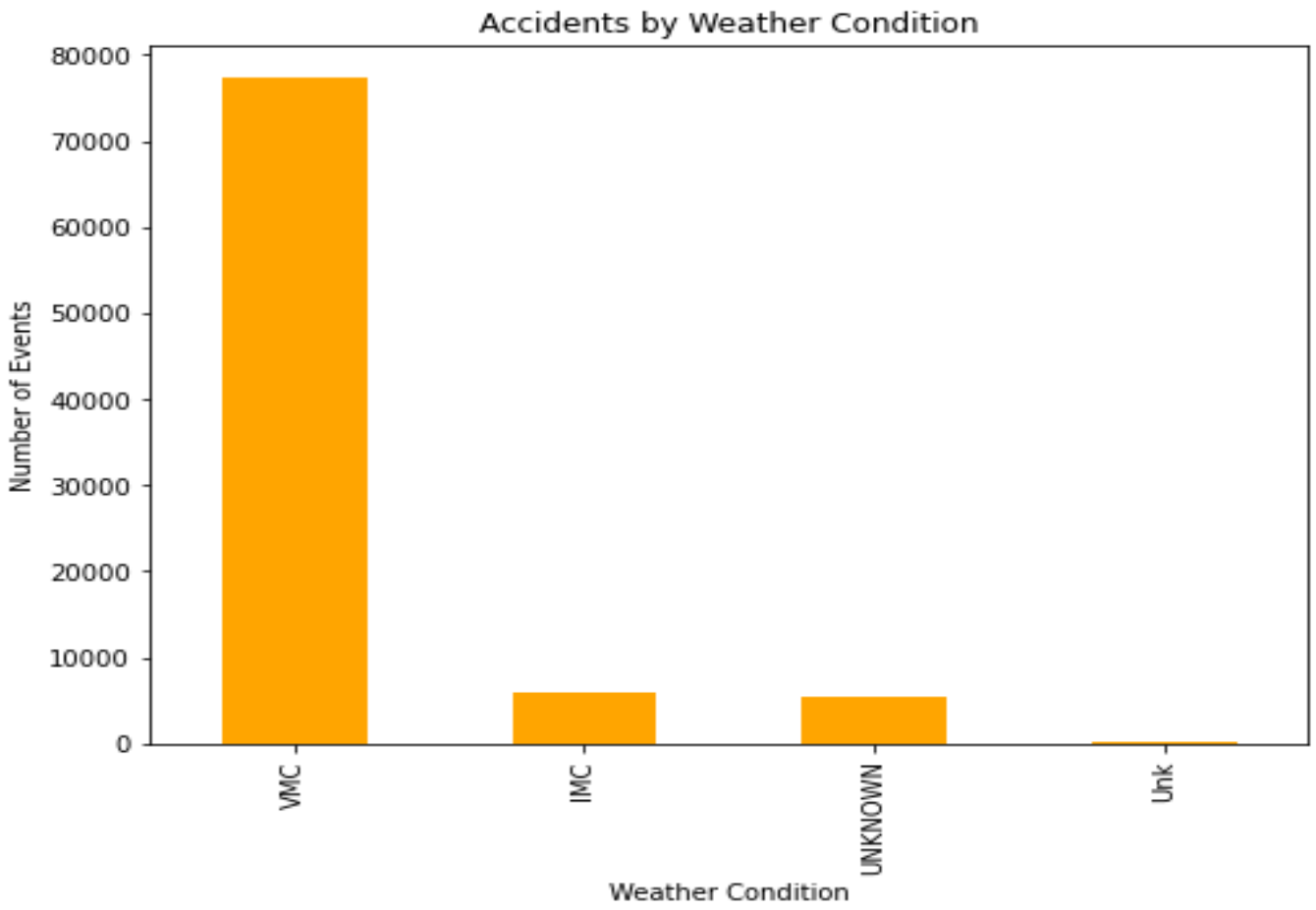



Top 10 Aircraft Models with Highest Accident/Incident Counts (≥30 events overall)
Cessna 152
Cessna 172
Cessna 172N
Piper PA-28-140
Cessna 150
Cessna 172M
Cessna 172P
Cessna 182
Cessna 180
Cessna 150M
0
500
1000
1500
2000
Number of Reported Accidents/Incidents

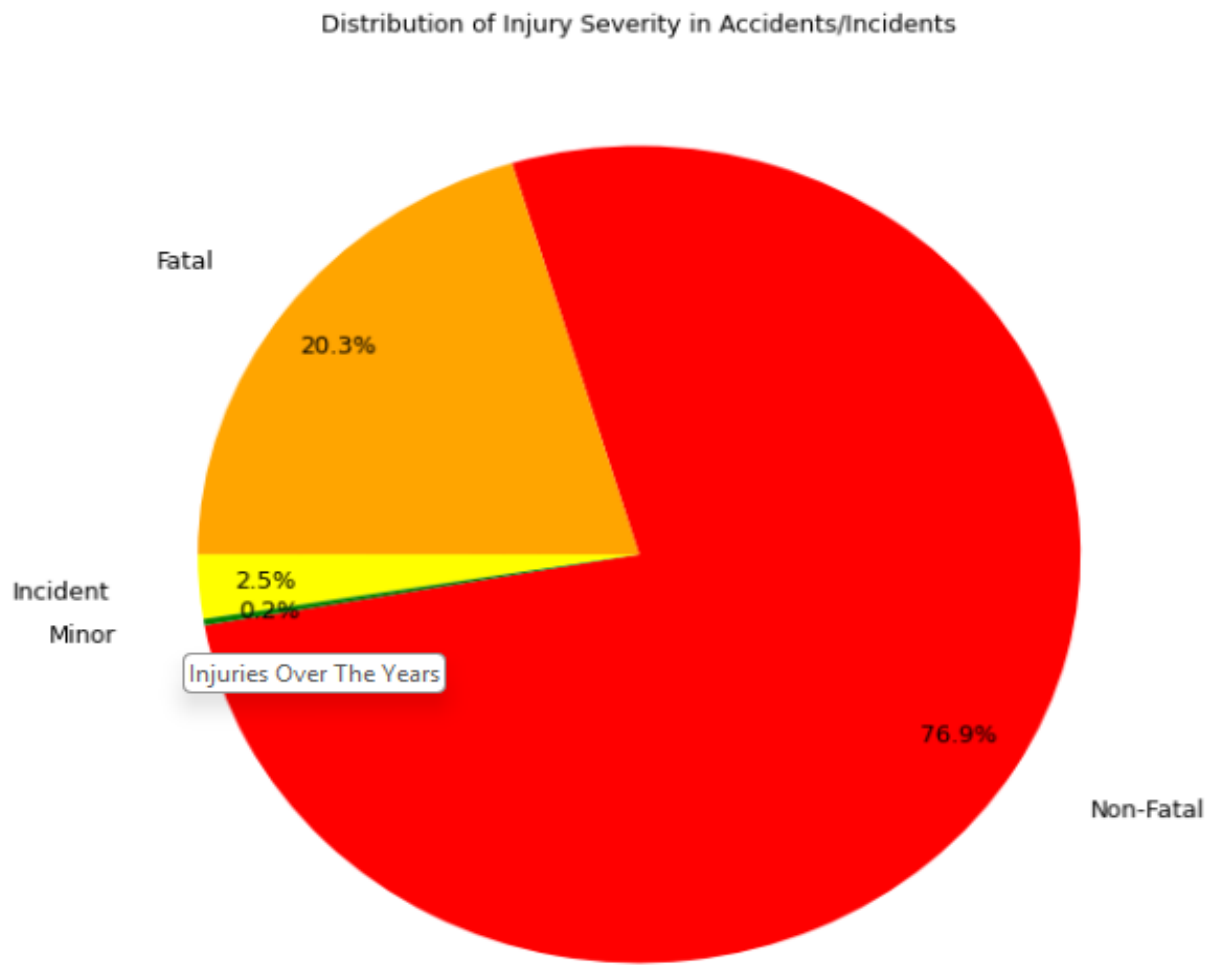

Phase Of Flight
click to scroll output; double click to hide
Total Injury Count
0
5000
10000
15000
20000
25000
30000
Approach
Climb
Cruise
Descent
Go-around
Landing
Maneuvering
Other
Standing
Takeoff
Taxi
Unknown


Accidents by Phase of Flight
Number of Events
0
5000
10000
15000
20000
25000
Unknown
Landing
Takeoff
Cruise
Maneuvering
Approach
Climb
Taxi
Descent
Go-around
Standing
Other
Phase of Flight

Weather Conditions



Injuries Severity



Insights

1. Accidents over the years

- Total aviation accidents/incidents peaked in earlier decades and have declined significantly since the 1980s.

- Fatal events follow the same downward trend, showing safety improvements over time.

2. Aircraft Make & Model Safety

- Some makes appear frequently in accidents, while others are rarely involved.

- Among the top makes, certain aircraft have much lower fatality rates compared to peers.

3. Phase of Flight Risk

- Most accidents occur during takeoff and landing phases, while cruise has far fewer incidents.Landing often has a higher share of fatal outcomes.

Insights cont…

4. Weather Conditions

- The majority of accidents occur in visual meteorological conditions (clear weather) simply because most flights occur in good weather.

- However, the fatality rate is higher in poor/Instrument Meteorological Conditions (IMC).

5. Injury Severity

- Many aviation accidents result in no injuries or minor injuries, but a notable share still leads to fatalities.

- Fatal accidents, while less frequent, are highly impactful.

6. Operator Type

- Private and general aviation operators account for a disproportionately higher number of accidents compared to commercial airlines.

- Commercial operators show lower accident and fatality rates due to stricter regulations and safety checks.

Conclusion

1. Modern aircraft (post-1990) are generally safer. The company should prioritize newer aircraft models instead of older ones with higher historical risks.

2. The company should invest in aircraft models with consistently low accident frequency and fatality rates.Avoid makes with disproportionately high fatal accidents.

3. Aircraft with advanced autopilot, landing assist, and navigation technologies should be prioritized.Training programs for pilots should emphasize takeoff and landing safety.

4. The company should purchase aircraft with enhanced weather resilience (radar, de-icing, navigation systems).Develop policies to limit risky flights in poor weather.

5. The company should invest in aircraft with strong safety records and crashworthiness.Proactive risk management strategies (maintenance, inspections) can keep fatality rates low.

6. The company should adopt a commercial-grade operational model, even if entering private charter markets.Safety culture and compliance with airline-level standards will minimize risk.

Business Recommendation

1.Choose newer Boeing (commercial jets) models or modern turbine aircraft for commercial operations from manufacturers with low accident and fatality rates in the dataset and are widely supported by safety programs and OEM maintenance networks

2. For private/small enterprise use, favor well-maintained, low-hours Cessna/Beechcraft models with documented maintenance history rather than older piston aircraft.

- Cessna & Piper may have many accidents events in the dataset, this mostly reflects fleet size; selection should focus on specific models with lower fatality rates.

3. Implement an operational risk program: require enhanced pilot training, strict maintenance audits, and data-driven safety monitoring like flight hours, incident reporting. This will reduce operational risk regardless of aircraft type.