Aviation Risk Analysis & Recommendations

Phase 1 Project

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Project overview

- ❑ **Context:** The company is diversifying into commercial and private aviation and requires a deep understanding of operational risks to inform fleet acquisition.
- ❑ **Project Scope:** Evaluation of aviation accident data from 1962 to 2023 to determine safety records of various manufacturers and models.
- ❑ **Outcome:** Actionable recommendations for stakeholders to acquire a safe and reliable fleet.
- ❑ **Data Source:** NTSB Aviation Accident Dataset (1962-2023)

Business Understanding

▶ **The Problem:** The new aviation division has capital for investment but lacks historical data on operational risks. Purchasing without this insight poses significant safety and financial liability.

▶ **Key Objectives**:

  ▶ Identify the top 3 low-risk aircraft categories and manufacturers.

  ▶ Determine factors that increase accident severity (e.g., weather, phase of flight).

  ▶ Provide evidence-based investment recommendations.

▶ **Stakeholders:** Head of Aviation Division (Purchasing), Investment Committee (Financial Risk), Operations Team (Reliability).

Data Understanding

Dataset Overview

▶ 88,889 aviation accident records (1962-2023)

▶ 31 original features describing aircraft, events, and outcomes

▶ Focused on 1990-2023 for modern aviation relevance

Key Data Points Analyzed

▶ Aircraft make, model, and category

▶ Injury severity and counts (fatal, serious, minor)

▶ Weather conditions and flight phase

▶ Purpose of flight and damage extent

Data Quality: Addressed missing values, standardized categories, filtered for commercial relevance.

Data Analysis - Risk Factors

Data Preparation

▶ Standardized manufacturer and model names

▶ Focused on post-1990 data for modern relevance

▶ Created severity categories (Fatal, Non-Fatal Injury, etc.)

▶ Filtered to manufacturers with ≥50 accidents for statistical significance

Analytical Approach

▶ **Frequency Analysis:** Accident volume by manufacturer/model

▶ **Severity Analysis:** Fatality rates and injury outcomes

▶ **Contextual Analysis:** Weather, flight phase, and purpose impacts

▶ **Trend Analysis:** Safety improvements over time

Visualization 1 - Manufacturer Risk Profile

Key Findings:

Boeing, Cessna, Piper, Airbus, Bellanca show moderate fatality rates despite high accident volumes

Robinson & Bell helicopters exhibit highest fatality rates (50-70%)

Industry average fatality rate: ~40%

Business Insight: Some manufacturers combine high operational volume with manageable risk profiles.

Percentage of Fatal Accidents by Manufacturer (Top 10)
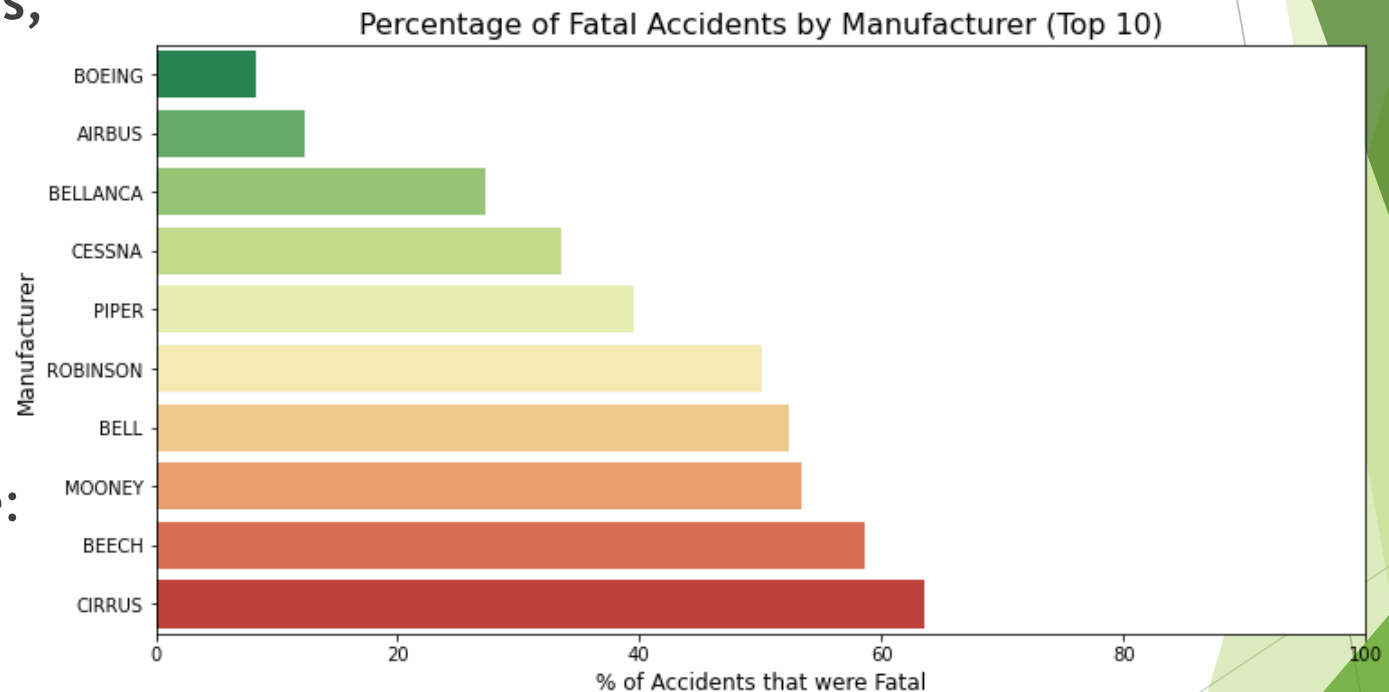
Aircraft Category Safety

Key Findings:

▶ **Airplanes** dominate accident volume but show varied severity

▶ **Helicopters** show disproportionate fatal outcomes

▶ **Gliders/Balloons** have lower fatal rates but limited commercial application

Fixed-wing aircraft offer better risk profiles for commercial operations than rotary-wing alternatives.
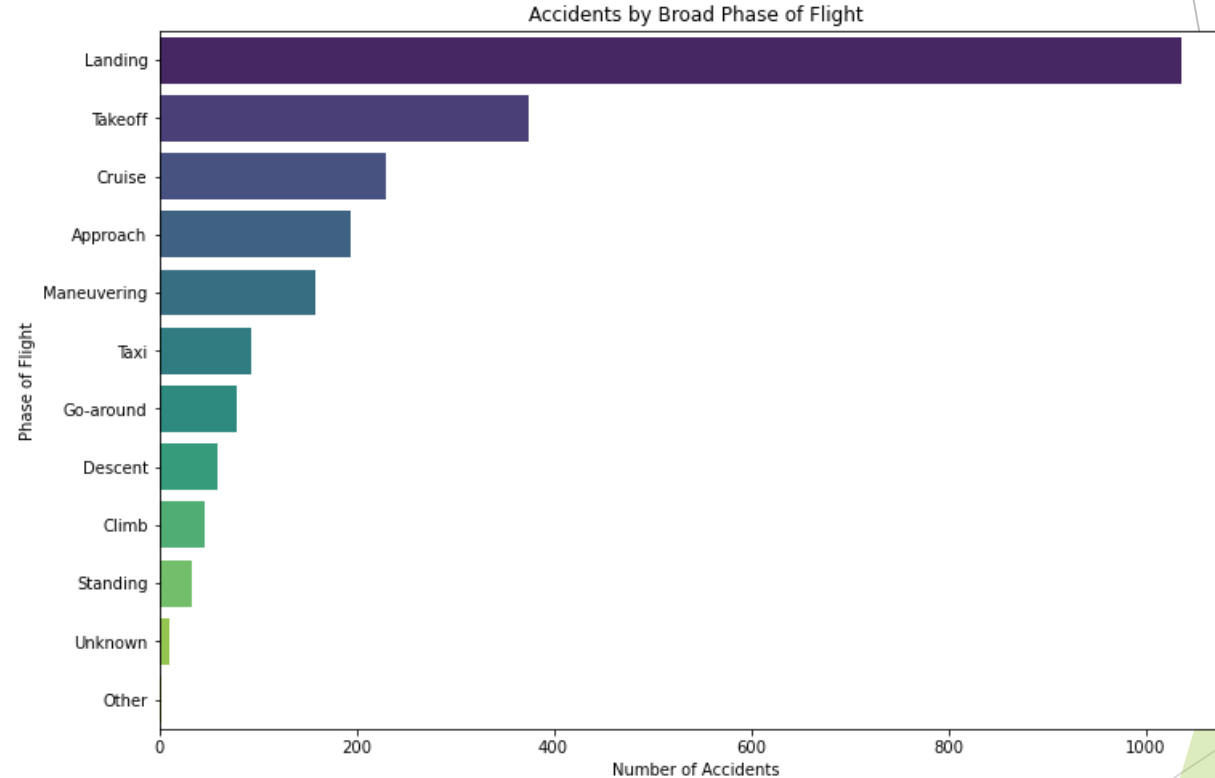

Severity Distribution by Top 5 Aircraft Categories
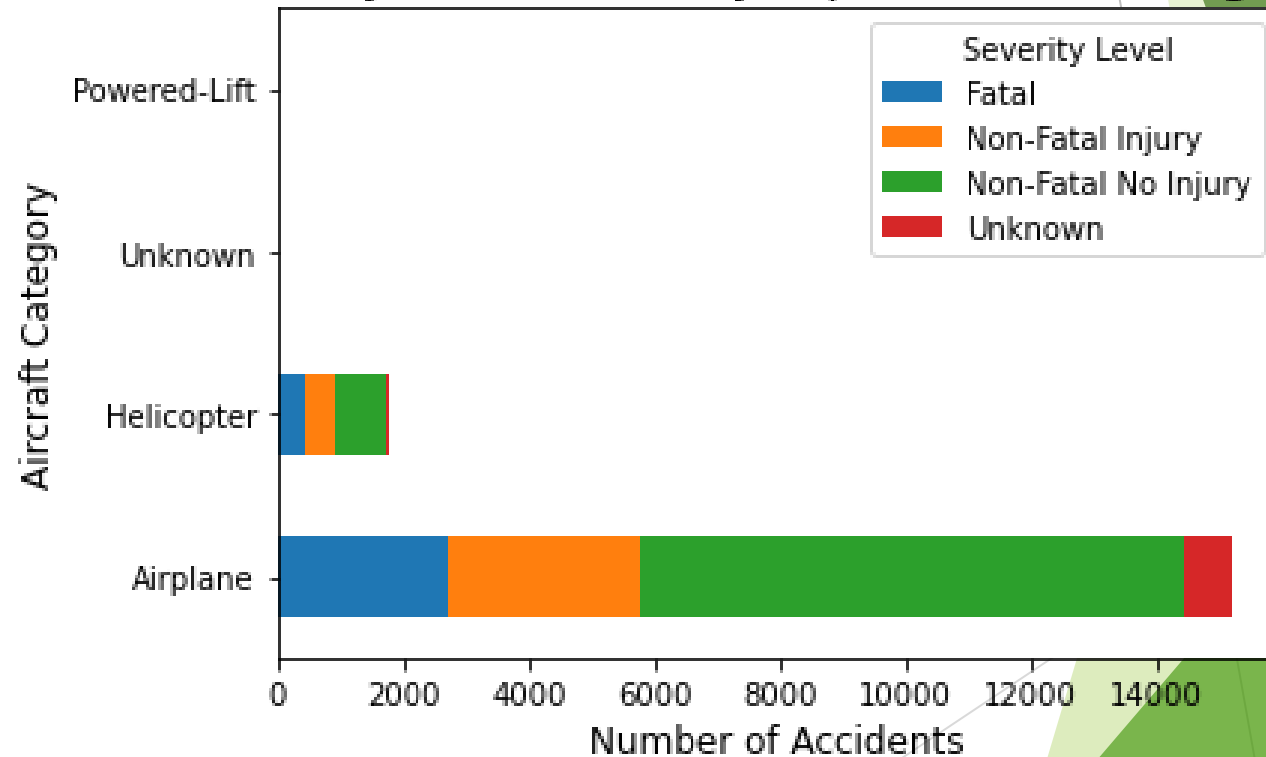
Accident severity by phase of flight

Key Findings:

High risk phases: most accidents occur during landing and takeoff.

Low risk phases: during cruising and taxi

Accidents by Broad Phase of Flight

Recommendations

Prioritize Boeing, CESSNA, PIPER, & Airbus

▶ Lower fatality rates (30-40%) compared to industry average

▶ High operational volume provides extensive safety data

▶ Established maintenance networks and training programs

Limit Robinson & bell helicopter acquisition.

▶ Highest fatality rates among top manufacturers (50-70%)

▶ Primarily used in higher-risk Personal/Instructional contexts

▶ Weather sensitivity and operational complexity increase risk

Implement phased operational strategy

▶ Personal/Instructional flights dominate accident data but build experience

▶ Commercial operations show better safety records per flight hour

▶ Gradual expansion allows safety culture development

Thank You

- Questions?