**AI-Powered Flight Delay Predictor & Analyzer**

**1.Topic**

"AI-Powered Flight Delay Prediction and Causal Analysis using Historical Flight Data"

**2. Abstract**

This project focuses on predicting and explaining flight delays by analysing historical airline performance and delay datasets. Given inputs such as Carrier, Airport, and Month, the system computes the average delay per flight and provides a percentage breakdown of causal factors including Weather, Carrier, NAS (Air Traffic Control), and Late Aircraft. Beyond numerical outputs, the system generates human-friendly explanations to make the results interpretable for passengers, airlines, and regulators. This bridges the gap between predictive analytics and explainable AI, creating a tool that is both actionable and transparent.

**3. Industry / Application**

Aviation Industry (Airlines, Airports, FAA, IATA)

Travel & Tourism (Booking platforms, passenger info systems)

Logistics & Operations (Cargo flights, supply chain resilience)

**4. Research Context**

Flight delay prediction has been widely studied, but most works focus on prediction accuracy only. Limited research addresses explainability and breakdown of delay causes in a user-friendly manner.

**5. Need / Problem Statement**

Flight delays cost billions of dollars annually in fuel, crew rescheduling, and passenger compensation.

Passengers lack transparent insights into why delays occur.

Airlines need explainable forecasts for better decision-making, not just black-box predictions.

**6. What has NOT been done yet**

Existing models mostly stop at "Will the flight be delayed?"

Few tools give per-airline, per-airport, per-month causal breakdowns.

Lack of real-time explanation interfaces for passengers and operators.

Limited use of LLMs to transform raw data into human-readable narratives.

**7. What We Can Do**

Build a delay prediction + causal analysis engine.

Combine statistical models / ML with LLMs for explanation.

Provide interactive UI for passengers and analysts.

Enable data-driven decision support for airlines.

Future scope: Integrate weather forecasts + real-time air traffic data for dynamic predictions.

**8. Key Features of the Project**

Inputs: Carrier, Airport, Month/Year

Output: Avg. Delay (minutes/flight)

Causal Breakdown: % by Weather, Carrier, NAS, Late Aircraft

Explainable AI: Natural language interpretation

Extendable: Can integrate ML models for real-time forecasts

Scalable: Usable by both passengers & airline operators

**Data Sources:**

BTS ( Bureau of Transportation Statistics ) , US Dot on-time performance dataset, Weather + flight data combined

Expected Input and Output:

**I/p:**

Carrier: 9E (Endeavor Air Inc.)

Airport: ABE

Month: May 2025

**O/p:**

Avg Delay: 19.95 minutes per flight

Breakdown: Carrier (28%), Weather (30%), **Nation Airspace System** (15%), Late Aircraft (26%)

Explanation: "Flights from Endeavor Air at ABE in May 2025 are expected to be delayed on average by ~20 minutes.

The main contributors are projected to be adverse weather (30%) and airline operational issues (28%).

Late aircraft connections are also likely to play a significant role."