**Executive Summary – Dynamic Airline Pricing Optimization**

**Business Objective**

The goal of this project is to enhance airline revenue management by developing a data-driven system for predicting flight ticket prices and simulating dynamic pricing strategies. The aim is to balance profitability with competitiveness by adapting prices based on demand, booking timing, seat availability, and external conditions.

**Approach & Methodology**

* A **linear regression model** was built using historical flight data, incorporating both numerical and categorical features (e.g., route, time, seat class).
* The dataset was cleaned, preprocessed, and encoded using one-hot encoding to prepare it for training.
* A set of **rule-based pricing simulations** was implemented to mimic real-world airline strategies (e.g., early bird discounts, late booking surcharges).
* Comparative analysis was performed between **predicted base prices**, **rule-adjusted prices**, and **actual market prices**.
* **Weather condition data** was one-hot encoded and correlated with key features to assess its impact on pricing and demand.

**Key Insights**

* The model achieved strong performance with an **R² score of 0.913**, indicating high reliability in predicting base ticket prices.
* Flights booked close to departure or with low seat availability tend to have significantly higher prices.
* Weather factors like **rain and cloudy conditions** show moderate correlations with changes in price and availability, suggesting operational and risk-driven pricing.
* Business class, specific routes, and evening arrivals were consistently associated with higher fares.

**Top Predictive Features**

1. **Class (Economy vs Business)**
2. **Stops (Non-stop vs layovers)**
3. **Airline type (e.g., Vistara, Indigo)**
4. **Departure and arrival timing**
5. **Source and destination cities**
6. **Days left until departure**
7. **Remaining seats & inventory pressure**

**Recommendations**

* **Implement rule-based pricing layers** on top of ML predictions to reflect business logic and market dynamics.
* **Monitor weather conditions** as part of demand forecasting and pricing adjustments, especially for operationally sensitive routes.
* **Personalize pricing** by incorporating customer segmentation and booking behavior patterns into future models.
* **A/B test** dynamic pricing rules on select routes before full deployment.

**Ethical Considerations**

* Ensure **transparency and fairness** in dynamic pricing, especially during peak demand or emergencies.
* Avoid pricing discrimination based on non-operational factors such as location or browser history.
* Comply with **consumer protection laws** and disclose price fluctuations clearly to customers.
* Use demand prediction and pricing algorithms responsibly to avoid reinforcing social or economic inequalities.