Airline Passenger Satisfaction

Data Science Programming (MIS S381N)

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Agenda

01 **Problem Statement**
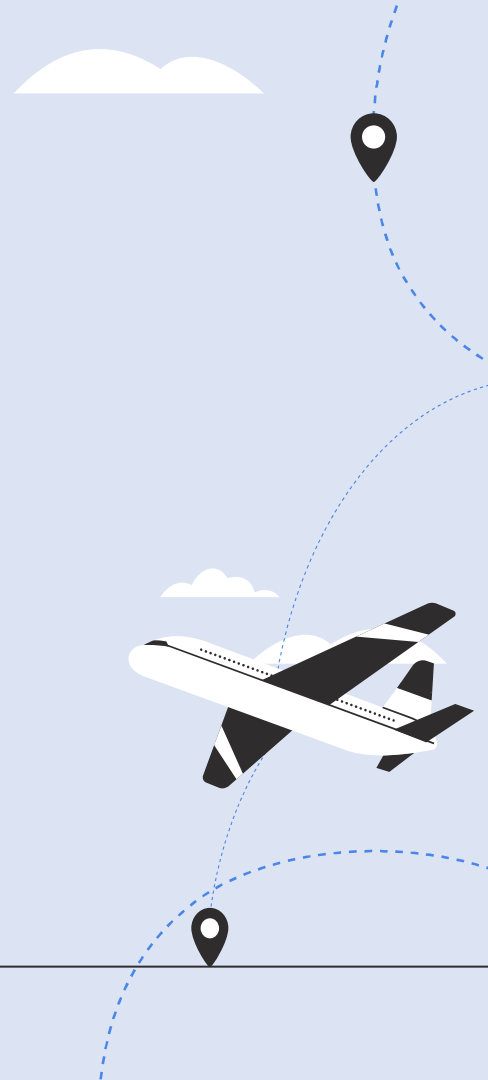
02 **Exploratory Data Analysis**

03 **Data Modeling**

04 **Conclusion**

05 **Future Scope**

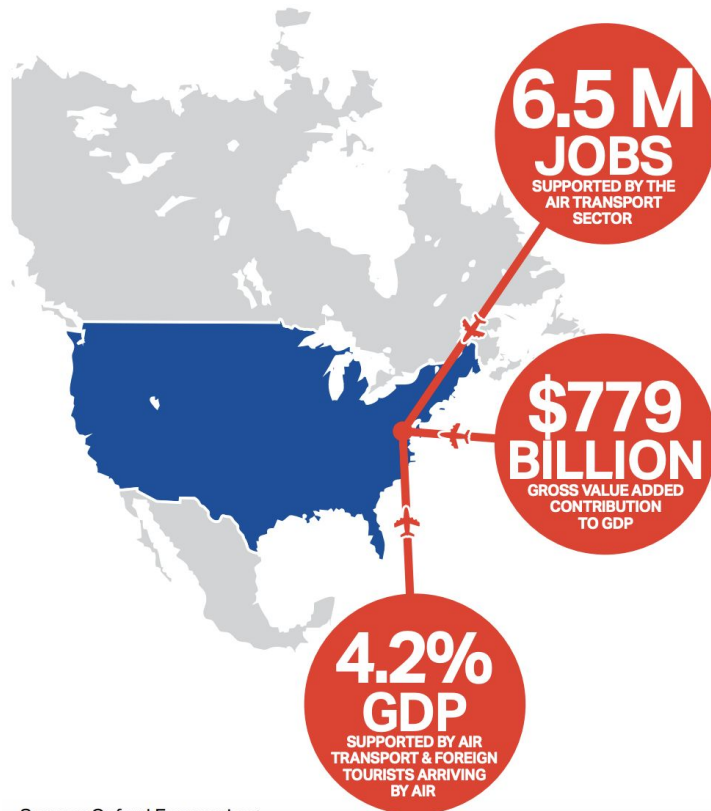# 01

Problem Statement
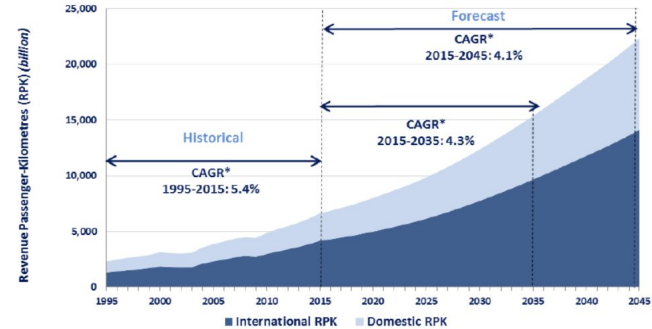
What are the factors that influence airline passenger satisfaction?
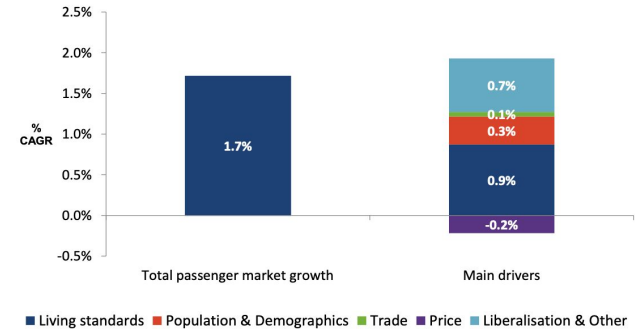
Aviation Sector is a major contributor to the US economy

6.5 M JOBS
SUPPORTED BY THE AIR TRANSPORT SECTOR

$779 BILLION
GROSS VALUE ADDED CONTRIBUTION TO GDP

4.2% GDP
SUPPORTED BY AIR TRANSPORT & FOREIGN TOURISTS ARRIVING BY AIR

Source: Oxford Economics [1]

The global airline industry is forecasted to grow at 4.1% CAGR for the next 20 years…

Revenue Passenger-Kilometres (RPK) *(billion)*

Forecast

CAGR*
2015-2045: 4.1%

Historical

CAGR*
1995-2015: 5.4%

CAGR*
2015-2035: 4.3%

■ International RPK   ■ Domestic RPK

..with growth in US forecasted at 1.7% CAGR driven by increased living standards

% CAGR

1.7%

0.7%
0.1%
0.3%
0.9%
-0.2%

Total passenger market growth   Main drivers

■ Living standards ■ Population & Demographics ■ Trade ■ Price ■ Liberalisation & Other

Why is customer satisfaction an important parameter for an airline?
- Customer satisfaction serves as an *__exit barrier__* and is strongly associated with repurchase intentions.
- It costs an airline *__~3x higher__* to acquire a new customer than retaining an existing one.

02

Exploratory Data Analysis

About the Dataset

US airline passenger satisfaction survey (pre-COVID)

Survey conducted on a sample of ~130k customers

Missing values for "Arrival Delay in Minutes" imputed with mean

Inputs:
- Age
- Gender
- Type of customer (Loyal/disloyal)
- Type of travel (Personal Travel, Business Travel)
- Class of travel (Business, Eco, Eco Plus)
- Flight distance

## Likert Scale (0 (N.A.) - 1 (low) - 5 (high):
- Inflight wifi service
- Departure/Arrival time convenient
- Ease of Online booking
- Gate location
- Food and drink
- Online boarding
- Seat comfort
- Inflight entertainment
- On-board service
- Leg room service
- Baggage handling
- Check-in service
- Inflight service
- Cleanliness
- Departure Delay in Minutes
- Arrival Delay in Minutes

Dependent Variable	Independent Variables

Airline satisfaction levels
1 - Dissatisfaction or Neutral
0 - Satisfaction

22 (w. 16 rating parameters)

Feature Engineering based on correlation analysis

Correlation : 0.96
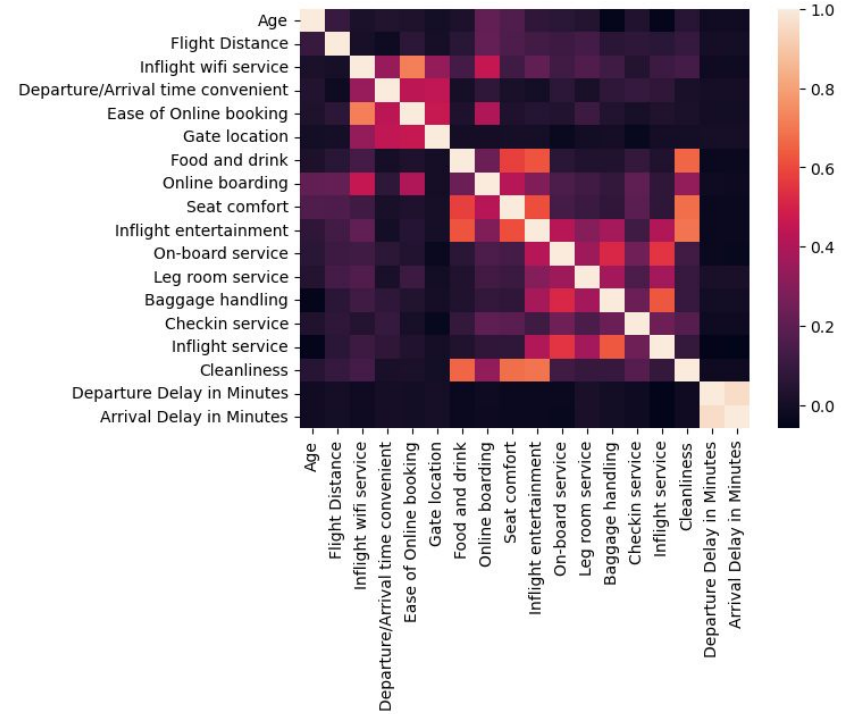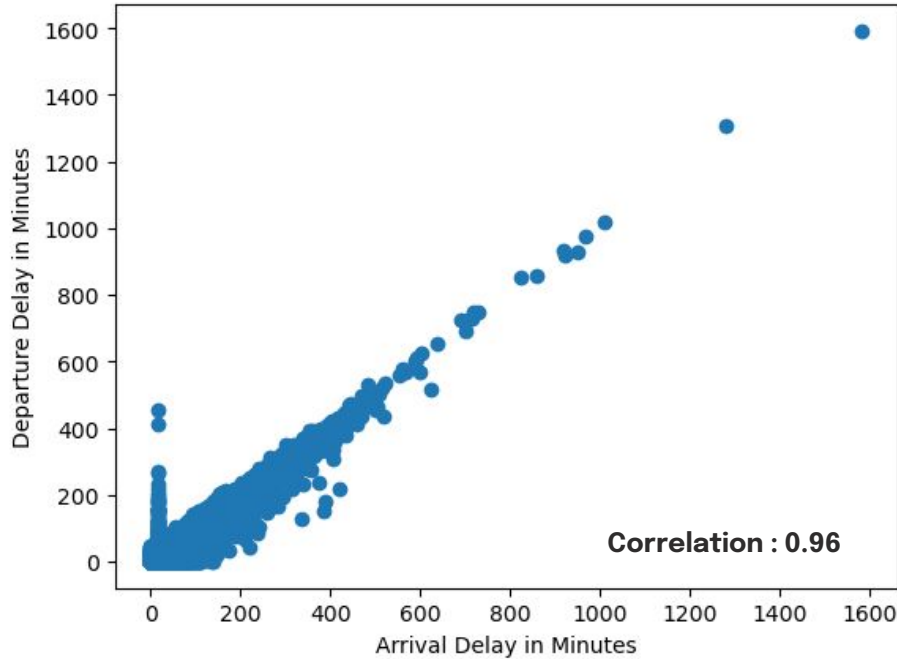
A new "Average Delay" feature created using mean of arrival and departure delay
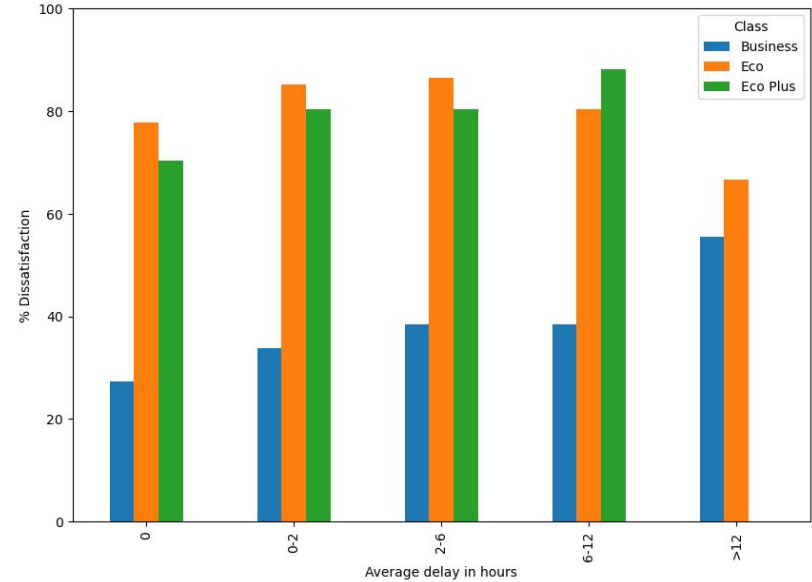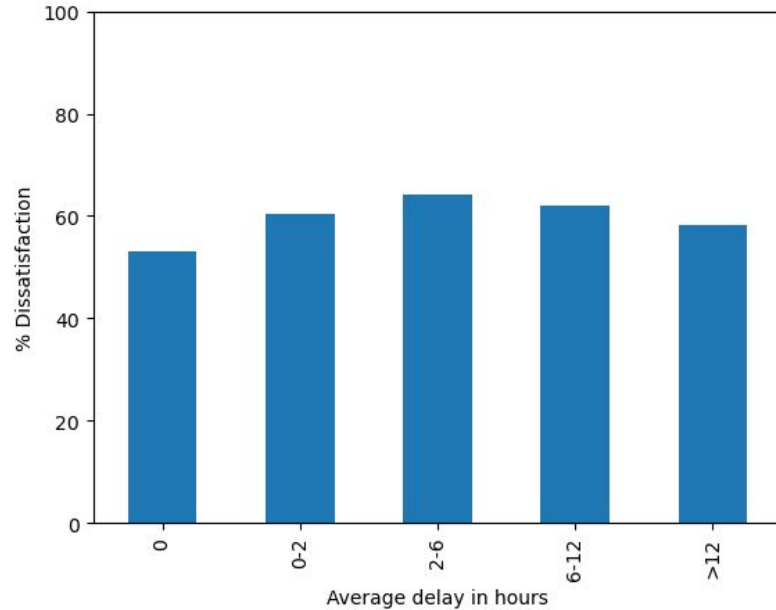
H1: All service ratings are important for predicting customer satisfaction
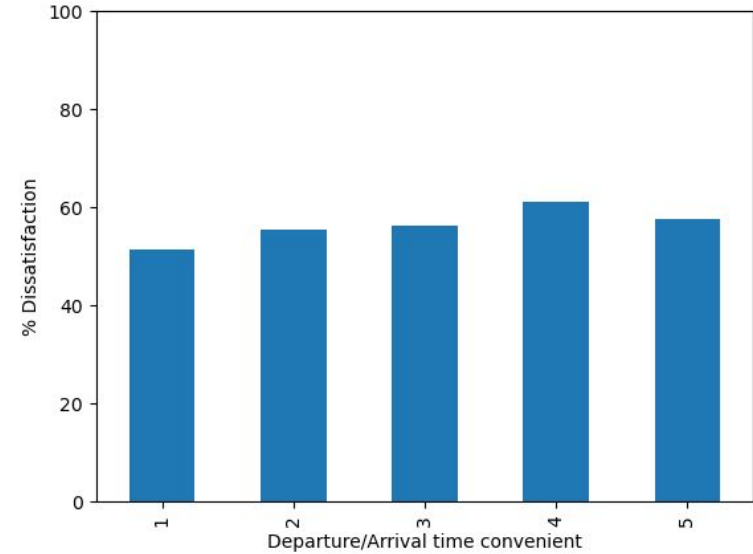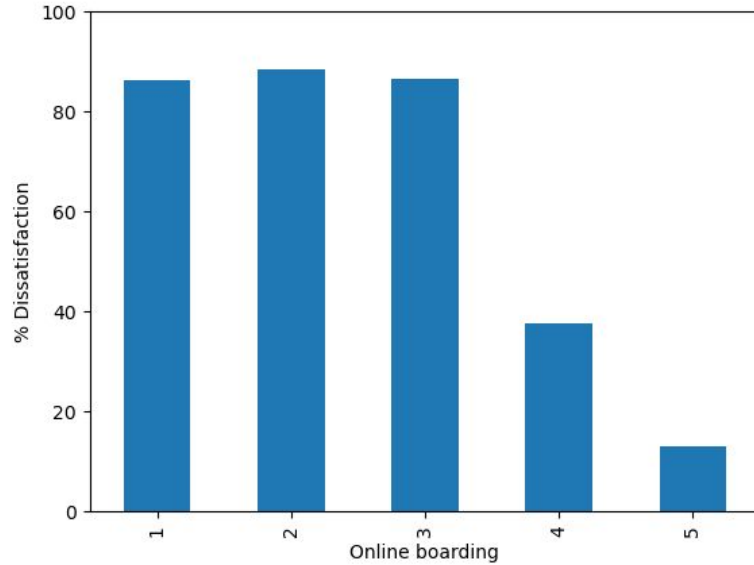
Conclusion – Some factors like "Online Booking", "In-Flight WiFi" & "Online Boarding" have a high impact on dissatisfaction
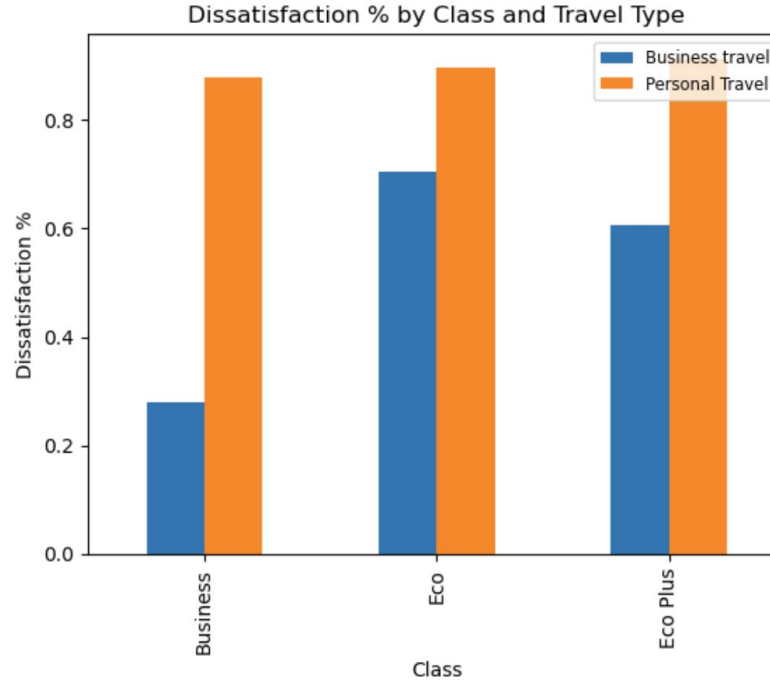
H2: Flight delays have a negative impact on passenger satisfaction

Conclusion – Dissatisfaction with flight delays is dependent on the class of travel

H3: Purpose of travel has no impact on satisfaction in the same travel class

Dissatisfaction % by Class and Travel Type

Conclusion – Personal travel has a higher overall dissatisfaction rate across all travel classes

H3: Purpose of travel has no impact on satisfaction in the same travel class
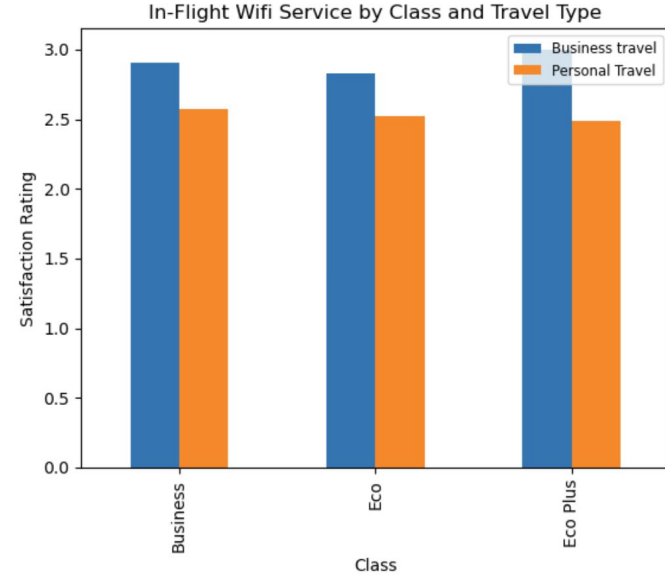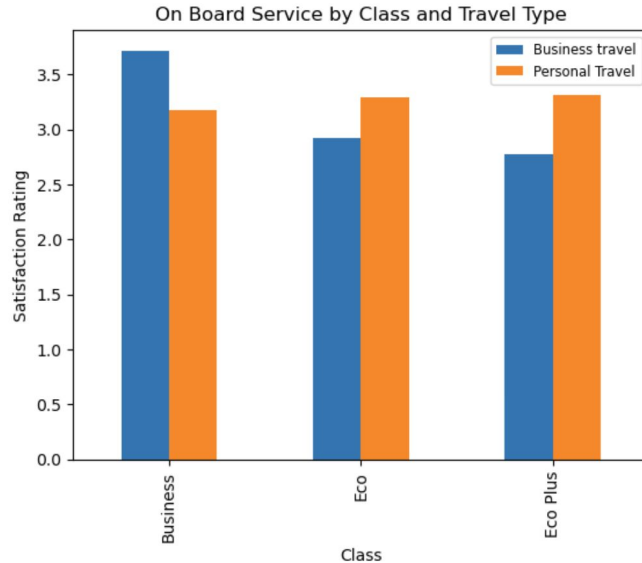
Conclusion – Perceived quality of an offering is impacted by the purpose of travel in the same class

H4: People are more likely to be dissatisfied on a longer flight

Customer Satisfaction by Flight Distance Category (Normalized)
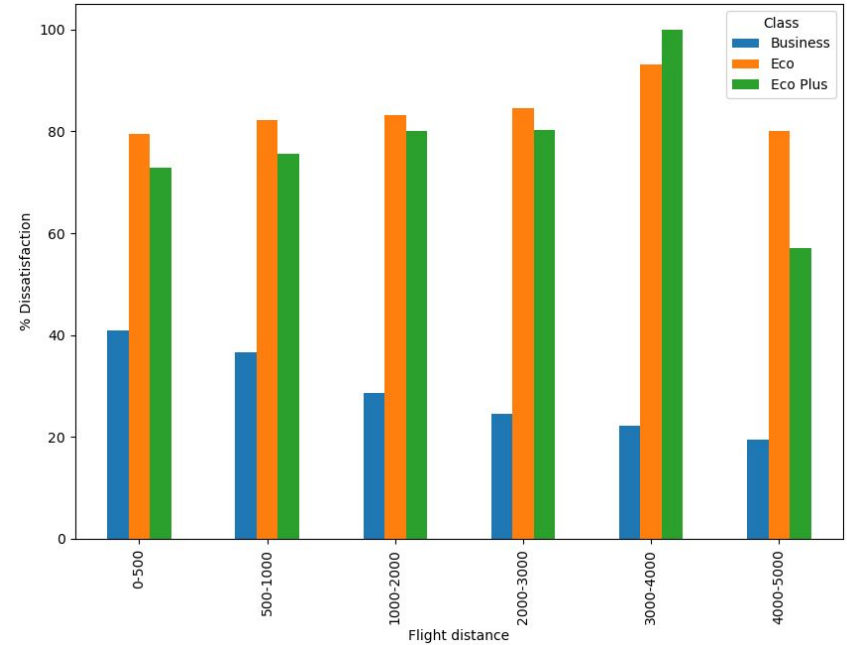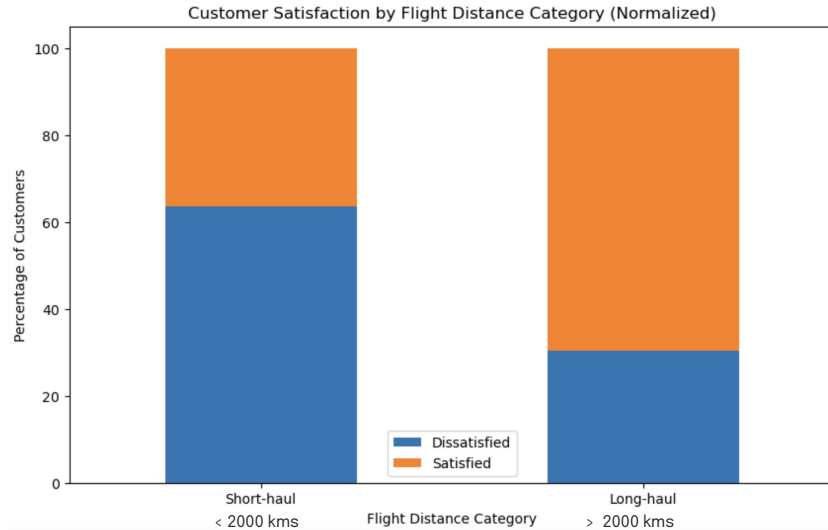
Conclusion – Class of travel impacted the satisfaction level across all distance ranges of a flight

H5: Loyalty to an airline is a strong indicator of customer satisfaction
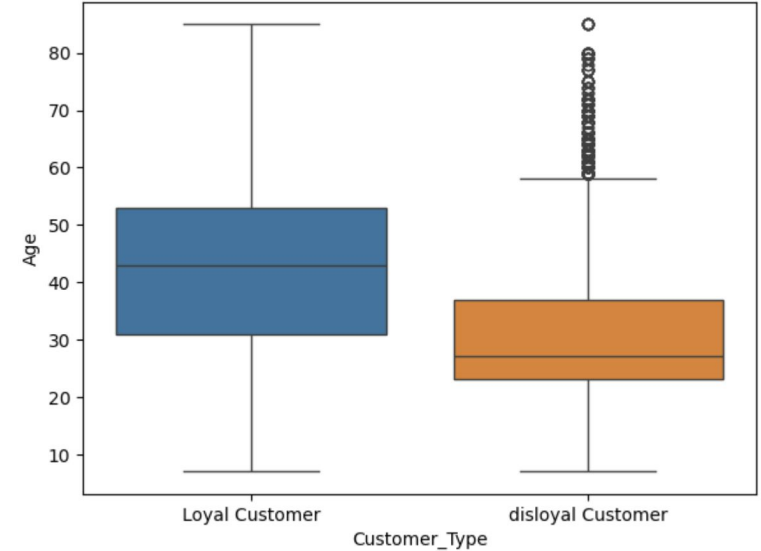
Conclusion – Loyal customers are more satisfied with the flight experience

03

Data Modeling

Naive Bayes

Feature Importance

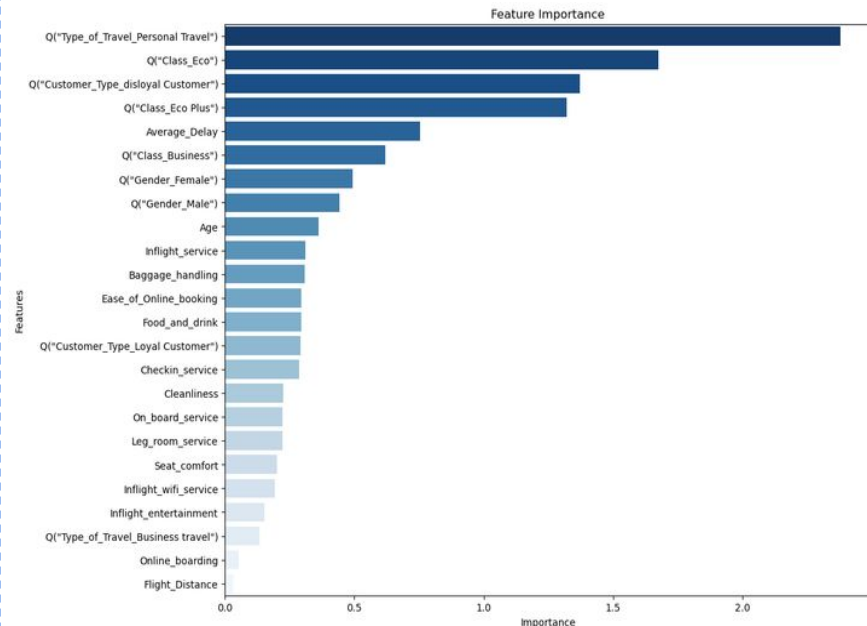| Features				
Q("Type_of_Travel_Personal Travel")				
Q("Class_Eco")				
Q("Customer_Type_disloyal Customer")				
Q("Class_Eco Plus")				
Average_Delay				
Q("Class_Business")				
Q("Gender_Female")				
Q("Gender_Male")				
Age				
Inflight_service				
Baggage_handling				
Ease_of_Online_booking				
Food_and_drink				
Q("Customer_Type_Loyal Customer")				
Checkin_service				
Cleanliness				
On_board_service				
Leg_room_service				
Seat_comfort				
Inflight_wifi_service				
Inflight_entertainment				
Q("Type_of_Travel_Business travel")				
Online_boarding				
Flight_Distance				

Importance

	Dissatisfaction Positive class	Satisfaction Negative class	Positive/Negative Ratio	Importance
Q("Type_of_Travel_Personal Travel")	0.000481	0.000045	10.787933	2.378428
Q("Class_Eco")	0.000632	0.000118	5.339826	1.675193
Q("Customer_Type_disloyal Customer")	0.000241	0.000061	3.938951	1.370914
Q("Class_Eco Plus")	0.000094	0.000025	3.740912	1.319330
Average_Delay	0.016442	0.007729	2.127285	0.754846
Q("Class_Business")	0.000252	0.000469	0.537913	0.620058
Q("Gender_Female")	0.000502	0.000306	1.636484	0.492550
Q("Gender_Male")	0.000476	0.000306	1.557778	0.443261
Age	0.036738	0.025564	1.437129	0.362647
Inflight_service	0.003314	0.002431	1.363551	0.310092
Baggage_handling	0.003302	0.002429	1.359441	0.307073
Ease_of_Online_booking	0.002491	0.001856	1.341804	0.294015
Food_and_drink	0.002893	0.002156	1.341702	0.293939
Q("Customer_Type_Loyal Customer")	0.000737	0.000551	1.337593	0.290872
Checkin_service	0.002976	0.002232	1.332996	0.287429
Cleanliness	0.002871	0.002293	1.252432	0.225087

Personal travel, economy class and disloyal customer are indicative of dissatisfaction (in-line with the EDA)

K-Nearest Neighbors
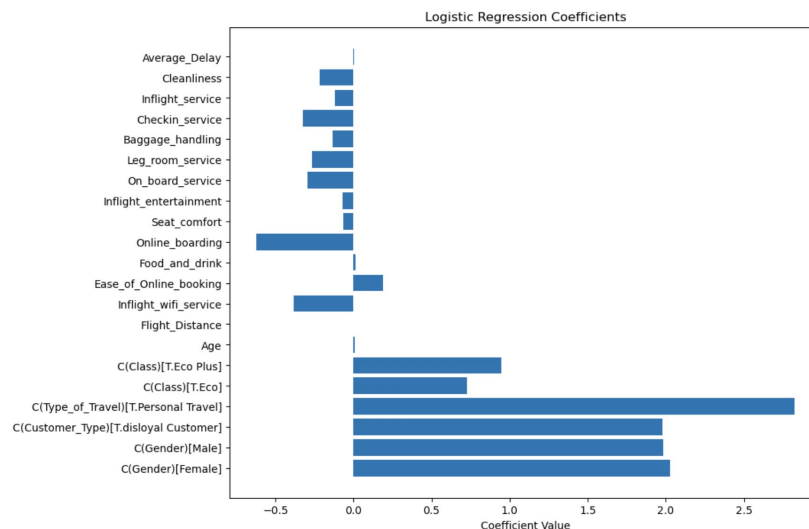
Accuracy: 92%
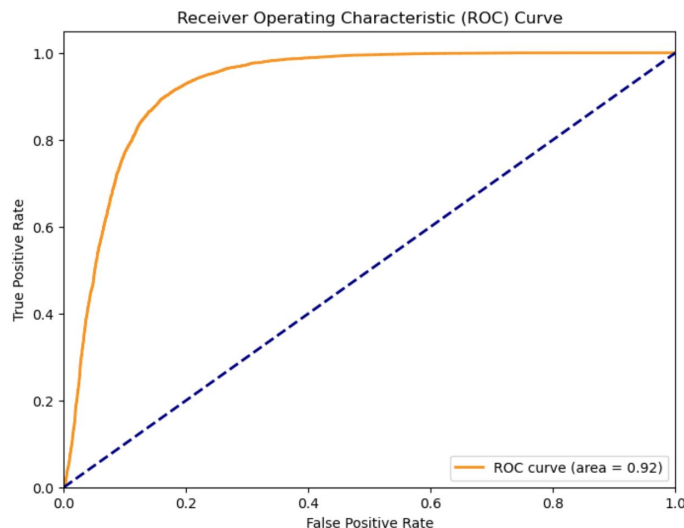**Improvement:** 48% (over baseline)
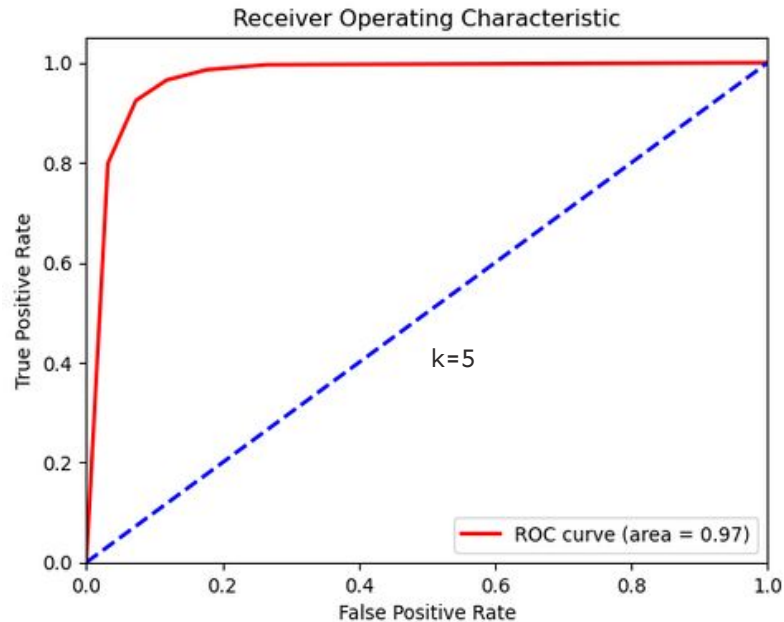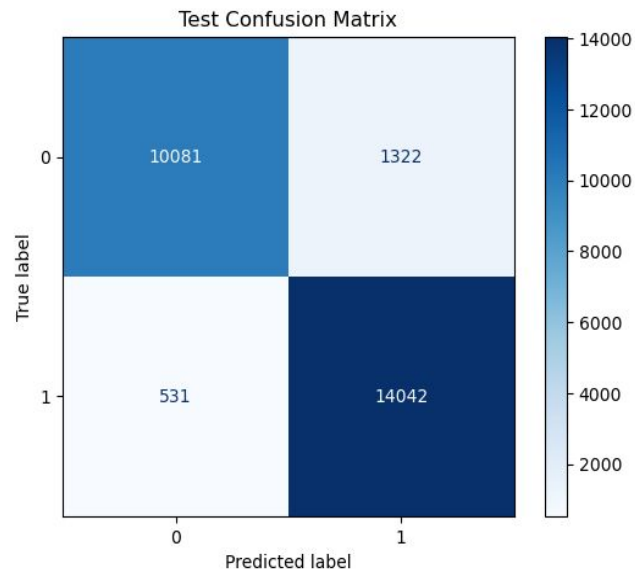
Logistic Regression

Accuracy: 87%
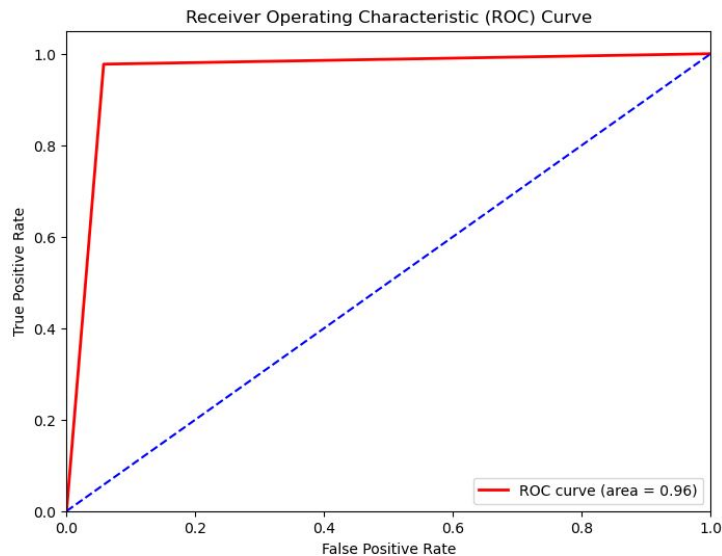**Improvement:** 43% (over baseline)

Personal travel is the highest indicator of dissatisfaction & online boarding is the highest indicator of satisfaction
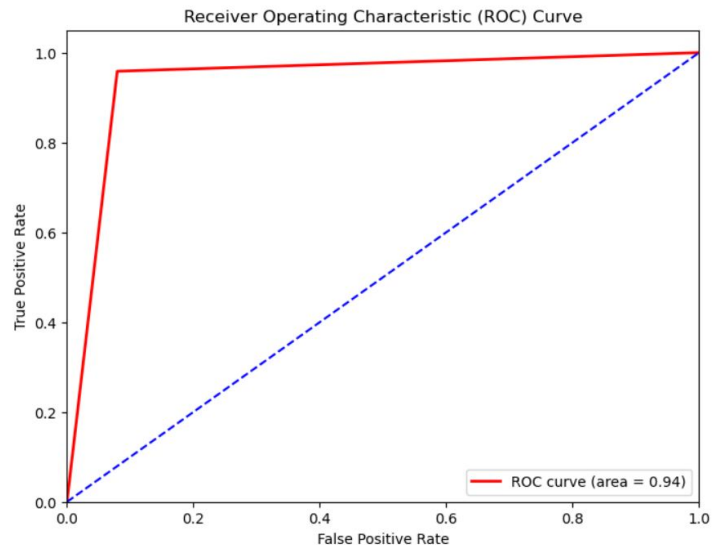
Ensemble Methods

Accuracy: 96%
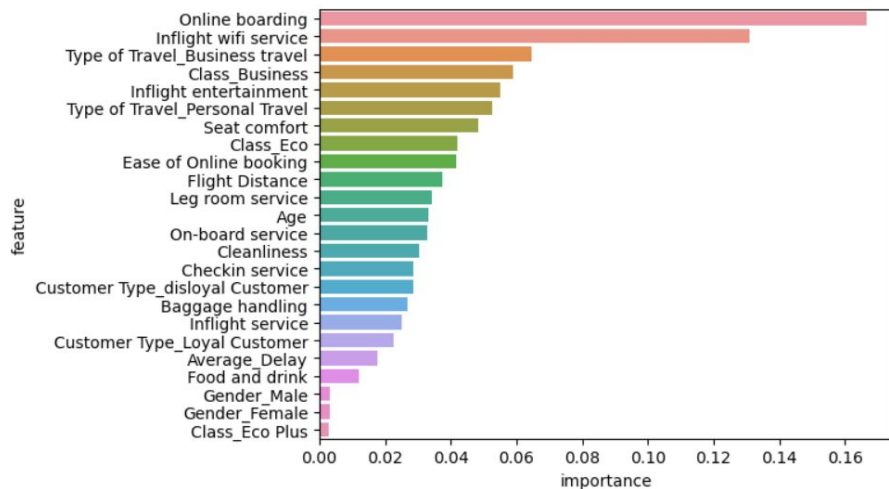**Improvement:** 52% (over baseline)

Random Forest

Boosting

Variable Importance

Random Forest
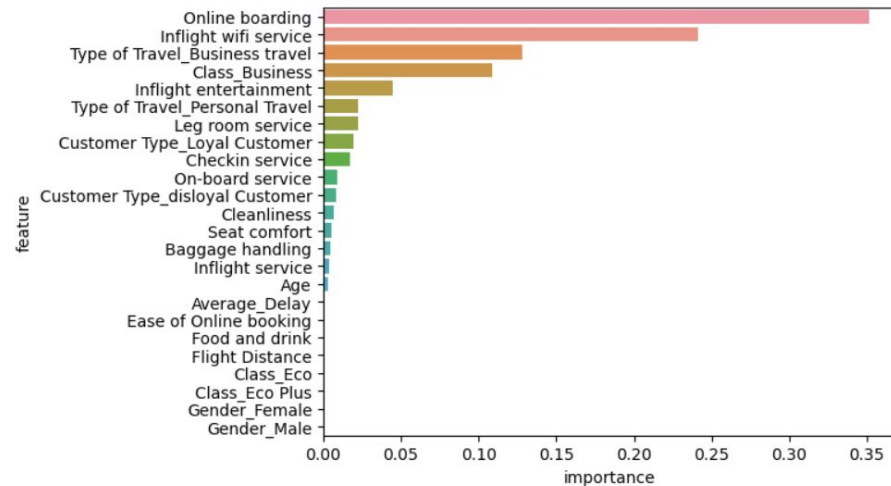
Boosting

Model Selection

Metrics	✔️ Gradient Boosting	✔️ Random Forest	❌ Logistic Regression	❌ KNN
ROC AUC	**0.94**	**0.96**	0.92	0.97
Accuracy	**0.94**	**0.96**	0.87	0.92
Sensitivity	**0.93**	**0.95**	0.87	0.91
Specificity	**0.92**	**0.94**	0.83	0.88
Precision	**0.95**	**0.97**	0.90	0.96

04 Conclusion

Recommendations

- **Focus on Digital Touchpoints** to enhance Customer Experience :
  - **Online Boarding**: Simplify the web check-in process and ensure user friendly website interface
  - **Inflight WiFi:** Introduce tiered pricing models for better connectivity, especially for business travelers.

- **Segmented Loyalty Programs** to incentivize switching to Business Class
  - **Economy Class Rewards**: Offer periodic upgrades and personalized rewards for frequent economy passengers.
  - **Tailored Incentives**: Develop personalized incentives based on travel history and preferences.

- **Addressing Non-Critical Factors** by maintaining standards across all services like "Cleanliness" and "Food & Drink" as a minimum standard is expected by customers when flying with an airline

In conclusion, we can see that by understanding and acting on these insights, the airline can create a better experience for every passenger because when passengers are happy, they're ***not just customers – they're your advocates!***

05 Future Scope

Limitations and Scope of Improvement

- The **impact of flight delay** to be investigated further
  - Study the impact for each class of travel separately
  - Gather insights re. compensation offered (e.g., vouchers, miles, or discounts on future flights)
- Gather more **socio-demographic data** to uncover accurate trends (e.g. income, education, & occupation).
- Include variables like price of flight to study the impact of **perceived price fairness** (Exhibit 1)
- Perform the analysis on **post-COVID customer data** to understand shifts in passenger priorities
  E.g. Increased importance of cleanliness, and add-on services like seat selection

Exhibit 1 – Customer satisfaction conceptual model in the air travel industry
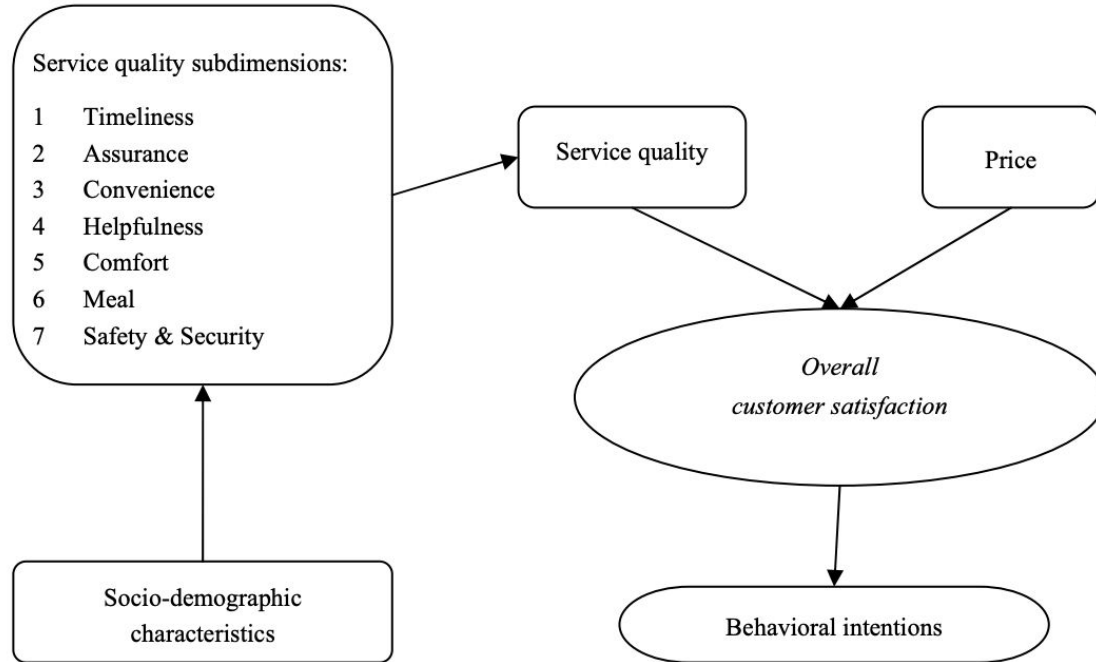
Citations

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