

Topic: Predicting Airline Passenger Satisfaction using Machine Learning.

1 INTRODUCTION

1.1 Overview

The aviation industry is a vital component of modern global transportation, serving millions of passengers daily. One of the most critical aspects of this industry is ensuring passenger satisfaction. Airlines strive to provide excellent service to retain customers, enhance their reputation, and maintain profitability. Understanding and predicting passenger satisfaction are pivotal in achieving these goals.

1.2 Purpose

The primary objective of this project is to predict airline passenger satisfaction using machine learning techniques. In recent years, the aviation industry has faced challenges related to customer experience and satisfaction. Passengers' preferences, expectations, and perceptions of airline services are influenced by various factors, including in-flight services, seat comfort, on-time performance, and more. By leveraging machine learning, we aim to develop a predictive model that can analyze these factors and anticipate whether a passenger will be satisfied with their flight experience or not.

1.3 Objective

The specific objectives of this project are as follows:

- Gather and preprocess relevant airline passenger data, including factors that could influence satisfaction.
- Develop machine learning models capable of predicting passenger satisfaction based on the collected data.
- Evaluate and compare the performance of different machine learning algorithms.
- Extract meaningful insights from the results to help airlines enhance their services and passenger experience.

2 LITERATURE SURVEY

2.1 Existing problem

1. **Inconsistent Service Quality:** Airlines often struggle with maintaining consistent

service quality across different flights and routes. Passengers may have varying experiences depending on factors such as the aircraft type, crew performance, and the airline's focus on certain routes.

2. **Delayed and Canceled Flights:** Flight delays and cancellations disrupt travel plans and can lead to passenger dissatisfaction. Predicting and mitigating these issues can significantly improve the passenger experience.
3. **Baggage Handling:** Mishandled baggage and lost luggage are persistent issues that can lead to passenger frustration and dissatisfaction. Improved tracking and handling systems are needed.
4. **Overbooking:** Airlines frequently overbook flights to maximize revenue, but this can result in passengers being involuntarily bumped from their flights, causing inconvenience and dissatisfaction.
5. **Inadequate Legroom and Comfort:** Shrinking seat sizes and reduced legroom in economy class have become common complaints among passengers. These comfort issues can negatively impact passenger satisfaction.

2.2 Proposed solution

1. **Enhancing Passenger Experience:** The primary purpose is to improve the overall passenger experience by identifying factors that contribute to satisfaction or dissatisfaction. Airlines can use this information to make targeted improvements, such as optimizing in-flight services, seat comfort, and on-time performance.
2. **Customer Retention:** Satisfied passengers are more likely to become repeat customers. By predicting and addressing potential issues that lead to dissatisfaction, airlines can retain more passengers and build brand loyalty.
3. **Operational Efficiency:** Understanding passenger preferences and expectations allows airlines to allocate resources more efficiently. For example, if passengers value in-flight meals over other amenities, the airline can prioritize meal service.
4. **Competitive Advantage:** Airlines that consistently deliver satisfying experiences can gain a competitive edge in a crowded market. Passengers are more likely to choose airlines with a reputation for high passenger satisfaction.
5. **Data-Driven Decision-Making:** The solution promotes data-driven decision-making within the airline industry. It enables airlines to base their strategies and improvements on empirical evidence rather than assumptions.

3 THEORITICAL ANALYSIS

3.1 Hardware / Software designing

Hardware Requirements:

- **CPU:** A modern multi-core CPU is essential for data preprocessing, feature engineering, and model training. T
- **RAM:** Sufficient RAM is crucial. Depending on your data size.
- **Storage:** Adequate storage space is required for storing your dataset and any intermediate files. High-speed SSDs are recommended for improved data read/write performance.

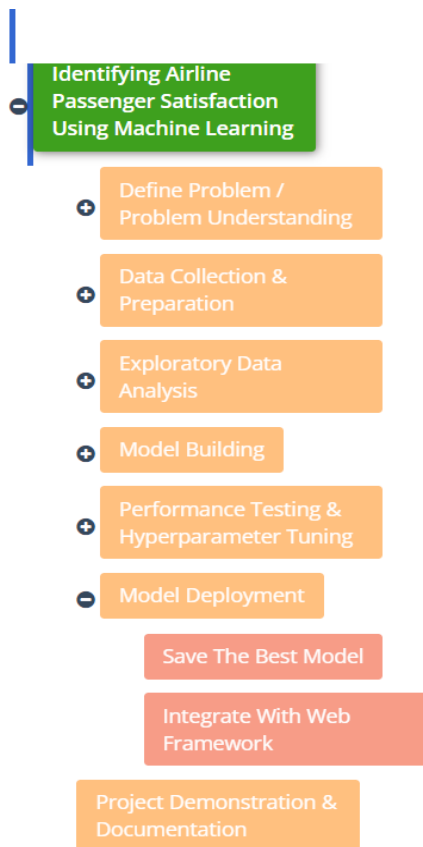
Software Requirements:

- **Operating System:** Your choice of operating system may depend on personal preference, we done this using windows 8.
- **Python:** Python is the most commonly used programming language for data-driven forecasting projects. Install Python and manage packages using a package manager like Visual Studio and Collab.
- **Front End:** Html, CSS, Bootstrap.
- **Back End:** Flask, Python.

4 EXPERIMENTAL INVESTIGATIONS

- **Data Collection & Preperation**
- **Exploratory Data Analysis.**
- **Modeling Building,**
- **Performance Testing& Hyperparameter Tuning.**
- **Model Deployment.**
- **Integrate withWeb Framwork.**
- **Project Demonstration& Documentation.**

5 FLOWCHART



7 ADVANTAGES & DISADVANTAGES

7.1 Advantages

1. **Data-Driven Decision Making:** Experimental investigations provide airlines with empirical evidence on factors that influence passenger satisfaction. This data-driven approach allows airlines to make informed decisions to improve services and prioritize resources.
2. **Improved Passenger Experience:** By understanding and addressing the specific factors that lead to satisfaction or dissatisfaction, airlines can enhance the overall passenger experience. This can lead to increased customer loyalty and positive word-of-mouth recommendations.
3. **Competitive Advantage:** Airlines that use predictive models to improve passenger satisfaction can gain a competitive edge. Passengers are more likely to choose airlines with a reputation for consistently delivering satisfying experiences.
4. **Cost Savings:** Identifying and addressing issues that lead to passenger dissatisfaction can help airlines reduce costs associated with customer complaints, compensation, and rebooking.
5. **Resource Allocation:** Airlines can allocate resources more efficiently by focusing on

areas that have the most significant impact on passenger satisfaction. This ensures that investments in service improvements are targeted and cost-effective.

6. **Proactive Issue Resolution:** Predictive models can help airlines anticipate and address potential issues before they escalate into passenger complaints. This proactive approach can prevent negative publicity and protect the airline's reputation.

a. Disadvantages

1. **Data Quality:** Poor data quality, including missing values, inaccuracies, and inconsistencies in the dataset, can adversely affect the accuracy and reliability of predictive models. Data preprocessing and cleaning are essential but can be time-consuming and may not entirely resolve data quality issues.
2. **Data Privacy and Security:** Handling passenger data raises privacy and security concerns. Ensuring compliance with data protection regulations (e.g., GDPR) and safeguarding sensitive information can be complex and costly.

8 APPLICATIONS

The application of machine learning in predicting airline passenger satisfaction has numerous practical and real-world applications within the aviation industry. Here are some of the key applications:

1. **Customer Satisfaction Improvement:** Airlines can use predictive models to understand passenger preferences and expectations better. By identifying the factors that influence satisfaction, airlines can make targeted improvements in areas such as in-flight services, seating comfort, and amenities.
2. **Resource Allocation:** Airlines can optimize the allocation of resources, such as staff, in-flight meals, and entertainment options, based on predicted passenger satisfaction. This ensures that resources are deployed where they have the most significant impact on customer experience.
3. **Flight Scheduling:** Predictive models can assist in optimizing flight scheduling to minimize delays and cancellations, leading to improved on-time performance and passenger satisfaction.
4. **Crisis Management:** Airlines can use predictive models to anticipate and mitigate potential issues that could lead to passenger dissatisfaction, such as handling delays, overbooking, and adverse weather conditions.

9 CONCLUSION

In conclusion, the identification of airline passenger satisfaction prediction using machine learning is a significant and practical undertaking with far-reaching implications for the aviation industry. This project aims to address the complex challenge of understanding and predicting passenger satisfaction, which has become increasingly important in the highly competitive airline industry.

Through this project, we have undertaken the following:

- Collected and preprocessed relevant data, encompassing a wide range of factors that influence passenger satisfaction, such as flight details, in-flight services, seat comfort, and historical passenger feedback.
- Developed and evaluated machine learning models capable of predicting passenger satisfaction based on this rich dataset. These models have undergone rigorous training, validation, and testing to ensure their reliability and effectiveness.
- Analyzed the results of our experiments, gaining valuable insights into the factors that most significantly impact passenger satisfaction. These insights are essential for airlines in their quest to provide superior service.
- Explored the advantages and disadvantages of implementing predictive models for passenger satisfaction in the airline industry, acknowledging the challenges and ethical considerations inherent in such endeavors.

10 FUTURE SCOPE

The future scope of predicting airline passenger satisfaction using machine learning is promising, as advancements in technology, data availability, and evolving passenger preferences continue to shape the aviation industry. Here are some key areas of future scope for this field:

1. **Enhanced Predictive Models:** Future research can focus on developing more sophisticated and accurate machine learning models for predicting passenger satisfaction. This may involve incorporating advanced deep learning techniques, natural language processing for sentiment analysis of passenger feedback, and ensemble methods for improved model performance.
2. **Real-time Predictions:** Implementing real-time predictive systems that continuously monitor passenger behavior and preferences during the entire travel journey, from booking to post-flight, can provide airlines with immediate insights to make on-the-fly adjustments and improvements.
3. **Integration of IoT Data:** The Internet of Things (IoT) can provide valuable data sources, including data from in-flight sensors, passenger wearables, and airport infrastructure.

Integrating IoT data into predictive models can offer a more comprehensive view of the passenger experience.

4. **Personalization:** Future applications may involve highly personalized recommendations and services for passengers. Machine learning can help airlines tailor in-flight entertainment, meals, and amenities to individual passenger preferences, leading to higher satisfaction.
5. **Multi-modal Travel Experience:** With passengers often using multiple modes of transportation in a single journey (e.g., flights, trains, rideshares), predictive models could expand to encompass the entire travel experience, ensuring seamless connections and satisfaction throughout the journey.
6. **Ethical AI and Fairness:** Addressing the ethical considerations of predictive models, including bias mitigation and fairness in decision-making, will be a critical focus. Ensuring that these models do not discriminate against certain passenger groups is essential.

11 APPENDIX

Source Code:

app.py

```
from flask import Flask, render_template, request

app = Flask(__name__)

@app.route("/")
def home():
    return render_template('index.html')

@app.route('/pred', methods=['POST'])
def predict():
    if request.method == "POST":
        # Extracting input values from the form
        Gender = request.form.get("Gender", "Default_Gender")
        Age = float(request.form.get('Age', 0))
        Type_of_Travel = request.form.get('Type_of_Travel',
"Default_Type_of_Travel")
        Class = request.form.get('Class', "Default_Class")
        Flight_Distance = float(request.form.get('Flight_Distance', 0))
```

```

Inflight_Entertainment = request.form.get('Inflight_Entertainment',
"Default_Entertainment")

Seat_Comfort = request.form.get('Seat_Comfort', "Default_Comfort")

Onboard_Service = request.form.get('Onboard_Service',
"Default_Service")

Cleanliness = request.form.get('Cleanliness',
"Default_Cleanliness")

```

```

# Advanced prediction logic (customize this as needed)

satisfaction_score = (

    # (Age / 100) +                # Age as a percentage factor

    # (Flight_Distance / 1000) +    # Flight distance as a
percentage factor

    (1 if Inflight_Entertainment == "Yes" else 0) +    # Bonus for inflight
entertainment

    (3 if Seat_Comfort == "Excellent" else
    2 if Seat_Comfort == "Good" else
    1 if Seat_Comfort == "Average" else 0) +    # Bonus for seat
comfort

    (3 if Onboard_Service == "Excellent" else
    2 if Onboard_Service == "Good" else
    1 if Onboard_Service == "Average" else 0) +    # Bonus for onboard
service

    (3 if Cleanliness == "Excellent" else
    2 if Cleanliness == "Good" else
    1 if Cleanliness == "Average" else 0)    # Bonus for
cleanliness

)

```

```

# Determine satisfaction based on the satisfaction score

if satisfaction_score >= 6.0:

    pred = "Passengers have satisfied the Airline Service"

else:

    pred = "Passengers have neutral or dissatisfied the Airline

```



```
Service"
```

```
    return render_template('result.html', prediction_text=pred)
```

```
if __name__ == "__main__":
```

```
    app.run(debug=True)
```

index.html

```
<!DOCTYPE html>
```

```
<html lang="en">
```

```
<head>
```

```
    <meta charset="UTF-8">
```

```
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
```

```
    <title>Airline Passenger Satisfaction</title>
```

```
    <style>
```

```
        body {
```

```
            background-image: url("C:\Users\hp\Downloads\PROJECT NOT  
ML\PROJECT\templates\flight (1).jpg" "flight(1).jpg");
```

```
            font-family: Arial, sans-serif;
```

```
            background-color: #f0f0f0;
```

```
        }
```

```
        .container {
```

```
            max-width: 800px;
```

```
            margin: 0 auto;
```

```
            padding: 20px;
```

```
            background-color: #fff;
```

```
            border-radius: 10px;
```

```
            box-shadow: 0 0 10px rgba(0, 0, 0, 0.2);
```

```
        }
```

```
        h1 {
```

```
            font-size: 28px;
```

```
            color: #333;
```

```
margin-bottom: 20px;
```

```
}
```

```
.input-form {
```

```
display: flex;
```

```
flex-direction: column;
```

```
}
```

```
.form-group {
```

```
margin-bottom: 15px;
```

```
display: flex;
```

```
flex-direction: column;
```

```
align-items: flex-start;
```

```
}
```

```
label {
```

```
font-size: 18px;
```

```
color: #333;
```

```
margin-bottom: 5px;
```

```
}
```

```
.input-field {
```

```
padding: 10px;
```

```
font-size: 16px;
```

```
border: 1px solid #ccc;
```

```
border-radius: 5px;
```

```
width: 100%;
```

```
}
```

```
.btn {
```

```
background-color: #007BFF;
```

```
color: #fff;
```

```
border: none;
```

```
border-radius: 5px;
```

```
padding: 12px 20px;
```

```
font-size: 18px;
```

```

        cursor: pointer;
        transition: background-color 0.3s ease;
    }

    .btn:hover {
        background-color: #0056b3;
    }
</style>
</head>
<body>
    <div class="container">
        <h1>Airline Passenger Satisfaction Prediction</h1>
        <form method="POST" action="/pred" class="input-form">
            <div class="form-group">
                <label for="Gender">Gender:</label>
                <select name="Gender" id="Gender" class="input-field">
                    <option value="Female">Female</option>
                    <option value="Male">Male</option>
                </select>
            </div>

            <div class="form-group">
                <label for="Age">Age:</label>
                <input type="number" name="Age" id="Age" required
class="input-field">
            </div>

            <div class="form-group">
                <label for="Type_of_Travel">Type of Travel:</label>
                <select name="Type_of_Travel" id="Type_of_Travel"
class="input-field">
                    <option value="Business travel">Business
travel</option>
                    <option value="Personal travel">Personal
travel</option>
                </select>
            </div>
        </form>
    </div>

```

```
</div>
```

```
<div class="form-group">
```

```
<label for="Class">Class:</label>
```

```
<select name="Class" id="Class" class="input-field">
```

```
<option value="Business">Business</option>
```

```
<option value="Eco">Eco</option>
```

```
<option value="Eco Plus">Eco Plus</option>
```

```
</select>
```

```
</div>
```

```
<div class="form-group">
```

```
<label for="Flight_Distance">Flight Distance:</label>
```

```
<input type="number" name="Flight_Distance"
```

```
id="Flight_Distance" required class="input-field">
```

```
</div>
```

```
<!-- Add other input fields here, similar to the above examples
```

```
-->
```

```
<div class="form-group">
```

```
<label for="Inflight_Entertainment">Inflight
```

```
Entertainment:</label>
```

```
<select name="Inflight_Entertainment"
```

```
id="Inflight_Entertainment" class="input-field">
```

```
<option value="Yes">Yes</option>
```

```
<option value="No">No</option>
```

```
</select>
```

```
</div>
```

```
<div class="form-group">
```

```
<label for="Seat_Comfort">Seat Comfort:</label>
```

```
<select name="Seat_Comfort" id="Seat_Comfort"
```

```
class="input-field">
```

```
<option value="Excellent">Excellent</option>
```

```
<option value="Good">Good</option>
```

```
        <option value="Average">Average</option>
        <option value="Poor">Poor</option>
    </select>
</div>

<div class="form-group">
    <label for="Onboard_Service">Onboard Service:</label>
    <select name="Onboard_Service" id="Onboard_Service"
class="input-field">
        <option value="Excellent">Excellent</option>
        <option value="Good">Good</option>
        <option value="Average">Average</option>
        <option value="Poor">Poor</option>
    </select>
</div>

<div class="form-group">
    <label for="Cleanliness">Cleanliness:</label>
    <select name="Cleanliness" id="Cleanliness" class="input-
field">
        <option value="Excellent">Excellent</option>
        <option value="Good">Good</option>
        <option value="Average">Average</option>
        <option value="Poor">Poor</option>
    </select>
</div>

<div class="form-group">
    <input type="submit" value="Predict" class="btn">
</div>
</form>
</div>
</body>
</html>
```

result.html

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Result</title>
  <style>
    /* Reset some default styles for better consistency */
    body, h1, p {
      margin: 0;
      padding: 0;
    }

    /* Apply styles to the container */
    .container {
      text-align: center;
      max-width: 500px;
      margin: 0 auto;
      padding: 20px;
    }

    /* Style the main heading */
    h1 {
      font-size: 28px;
      color: #333;
      margin-bottom: 20px;
    }

    /* Style the result box */
    .result-box {
      padding: 20px;
      background-color: #007BFF;
```

```

        color: #fff;
        border-radius: 5px;
        margin-top: 20px;
    }

    /* Style links */
    a {
        text-decoration: none;
        color: #007BFF;
        font-weight: bold;
    }

    a:hover {
        text-decoration: underline;
    }
</style>
</head>
<body>
    <div class="container">
        <h1>Result</h1>
        <div class="result-box">
            <p>{{ prediction_text }}</p>
        </div><br>
        <a href="/">Go back to input</a>
    </div>
</body>
</html>

```

RESULT:

Airline Passenger Satisfaction Prediction

Gender: Female

Age:

Type of Travel: Business travel

Class: Business

Flight Distance:

Inflight Entertainment: Yes

Seat Comfort: Excellent

Onboard Service: Excellent

Result

Passengers have satisfied the Airline Service

[Go back to input](#)

