JAPNEET PROJECT 1 REPORT

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CHAPTER - 1

INTRODUCTION

1.1 Data Analytics

Data analytics is the process of examining, cleaning, transforming, and interpreting data to discover valuable insights, patterns, and trends. It involves using various techniques and tools to make data-driven decisions and solve problems across different industries and fields.

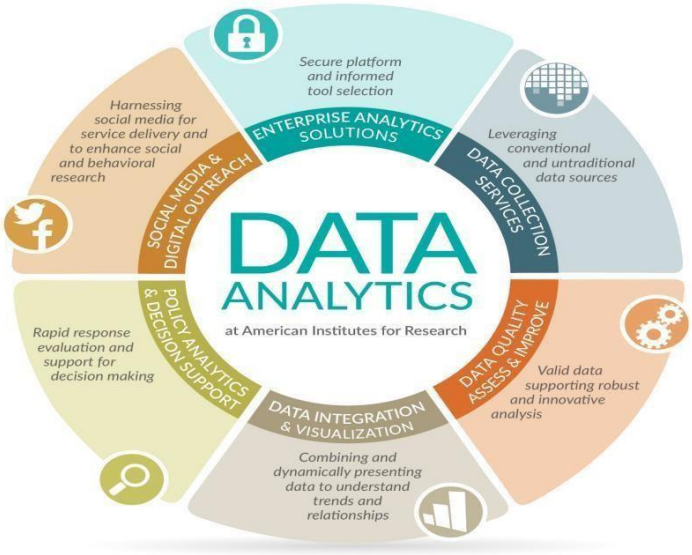


Fig 1.1 Data Analytics Cycle

Data Collection: Data analytics starts with the collection of relevant data from various sources. These sources can include databases, spreadsheets, websites, sensors, social media, and more. Data can be structured (organized in databases with defined formats) or unstructured (e.g., text, images, videos), and it may come in various formats, including numerical, categorical, and textual data.

Data Cleaning and Preprocessing: Raw data often contain errors, missing values, inconsistencies, and outliers. Data analysts clean and preprocess the data to ensure its

quality and usability. Data preprocessing involves tasks like data imputation (filling in missing values), data normalization (scaling to a consistent range), and data transformation (e.g., converting categorical variables into numerical format).

Data Exploration: Data analysts explore the dataset to gain a better understanding of its characteristics. This includes generating summary statistics (mean, median, variance), visualizations (histograms, scatter plots, box plots), and identifying patterns and outliers.

Exploratory Data Analysis (EDA) helps in formulating hypotheses and selecting appropriate alnalytical methods.

Data Analysis :This is the core of data analytics. Analysts use various statistical and machine learning techniques to uncover patterns, correlations, and trends within the data. Common methods include regression analysis, clustering, classification, and time series analysis.

Data Visualization: Data analysts use visualizations such as charts, graphs, and dashboards to present data findings in a comprehensible and actionable format.

Visualizations help in conveying complex information effectively to stakeholders and decision-makers.

Statistical Analysis: Statistical techniques are used to test hypotheses, assess relationships between variables, and quantify uncertainties.

Common statistical methods include hypothesis testing, regression analysis, analysis of variance (ANOVA), and correlation analysis.

Interpretation and Insights: Data analysts interpret the results of their analyses and draw conclusions based on their findings. They assess the significance of patterns and relationships in the data. Insights from data analytics are used to inform strategies, make data-driven decisions, and solve problems.

Reporting and Communication: The insights and findings from data analytics are communicated to stakeholders through reports, presentations, or data storytelling.

Effective communication is essential to ensure that data-driven insights are understood and

acted upon.

<u>Continuous Improvement</u>: Data analytics is an iterative process. Analysts continually refine their methods, models, and analyses to improve accuracy relevance.

1.2 TOOLS For DATA ANALYTICS

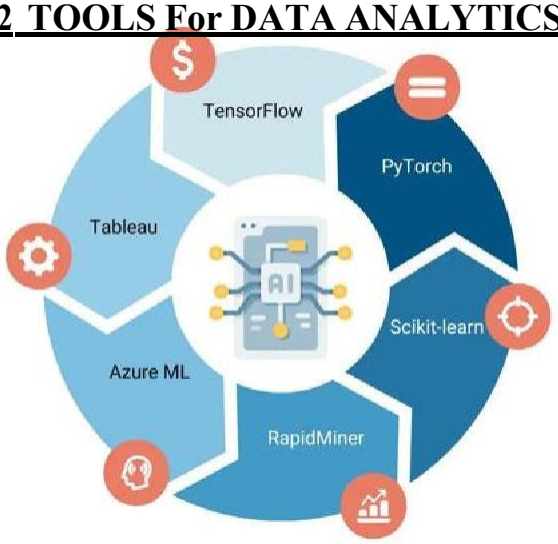


FIGURE 1.21

1. Data Collection and Storage:

- **SQL Databases: MySQL, PostgreSQL, Microsoft SQL Server**
- **NoSQL Databases: MongoDB, Cassandra, Redis**
- **Big Data: Apache Hadoop, Apache Spark, Apache Kafka**
- **Cloud Platforms: AWS, Google Cloud, Microsoft Azure**

2. Data Cleaning and Preprocessing:

- **OpenRefine: Helps clean and transform messy data.**
- **Trifacta: Provides data wrangling capabilities.**
- **Pandas: A Python library for data manipulation and cleaning.**

3. Data Analysis and Statistics:

- **Python: Using libraries like NumPy, SciPy, and StatsModels.**
- **Jupyter Notebooks: Interactive computing for data analysis.**

4. Data Visualization:

- **Tableau: A powerful data visualization tool.**
- **Power BI: Microsoft's business analytics service.**
- **Matplotlib and Seaborn: Python libraries for creating static and interactive visualizations.**

6. Data Reporting and Dashboards:

- **Tableau: Offers powerful dashboard creation.**
- **Microsoft Power BI: Generates interactive reports and dashboards.**

Project On Airline Services Satisfaction Rate

The airline industry places high importance on customer satisfaction, as it directly impacts brand loyalty and overall business success. Airlines focus on multiple aspects of the customer journey, from booking to post-flight services, to ensure a positive experience. Key factors influencing satisfaction include the comfort and quality of onboard amenities like seating, in-flight entertainment, and meal options. Additionally, the attitude and professionalism of staff—both in-flight and on the ground—significantly affect customer perceptions. Efficient processes in check-in, boarding, and baggage handling are also critical, as they contribute to a seamless travel experience. By analyzing these elements, airlines can gain insights into areas needing improvement, which helps enhance service quality and meet passenger expectations more effectively.

Project Objectives

The primary objectives of this project are as follows:

1. **Identify Key Satisfaction Drivers: Determine which factors most impact customer satisfaction.**
2. **Analyse Satisfaction by Demographics: Assess satisfaction trends by age, gender, and**

travel frequency.

3. **Optimize Check-in and Boarding: Streamline pre-flight processes to improve customer experience.**
4. **Enhance In-Flight Comfort: Improve seat comfort, entertainment, and meal quality.**
5. **Improve Baggage Handling: Reduce mishandling and improve delivery times.**

Use of Data Analytics

Data analytics plays a crucial role in understanding and improving customer satisfaction in the airline industry. By analyzing customer feedback, demographic data, and service metrics, airlines can pinpoint the factors that most influence satisfaction, such as seat comfort, staff behavior, and in-flight amenities. Predictive analytics can help identify patterns and trends, enabling airlines to anticipate customer needs and tailor services accordingly. Additionally, real-time data analysis can streamline processes like check-in, boarding, and baggage handling, reducing wait times and operational issues. Through these insights, airlines can make data-driven improvements to enhance the overall travel experience, leading to higher customer retention and loyalty.

CHAPTER – 2

Software and Hardware requirements

The software and hardware requirements for your heart disease prediction project.

2.1. Software Requirements

- Programming Language: This project requires proficiency in a programming language such as Python or R. Ensure that the following software packages and libraries are installed:

- Python: NumPy, pandas, scikit-learn, Matplotlib, Seaborn, Jupyter Notebook (for data analysis and modeling).

- Data Visualization Tools: To create meaningful visualizations, you can use tools like Matplotlib, Seaborn, or Tableau.

- Database Management: If your dataset is large and requires database management, consider using a database system like MySQL or PostgreSQL.

- Version Control: Implement version control using Git for tracking code changes and collaboration.

2.2. Hardware Requirements

- Computer: A computer with sufficient processing power to handle data analysis and model training. A modern laptop or desktop with a multi-core processor and at least 8 GB of RAM is recommended.

- Storage: Adequate storage space for dataset storage and model training. Depending on the dataset size, you may need several gigabytes or more of free disk space.

- GPU (Optional): For deep learning tasks, having access to a GPU (Graphics Processing Unit) can significantly accelerate model training. You can use cloud-

based GPU services like AWS EC2 instances with GPU or Google Colab (which provides free GPU access) if

local GPU resources are not available.

- Internet Connectivity: Access to the internet is essential for data retrieval, software/library installation, and online collaboration if necessary.

- Operating System: Your choice of operating system (Windows, macOS, Linux) should be compatible with the selected software and libraries.

CHAPTER – 3

Software Requirement Analysis

Software Requirement Analysis refers to the systematic process of gathering, documenting, and analyzing the requirements or specifications that a software system must fulfill.

3.1 Problem Definition

Airlines face the ongoing challenge of meeting diverse customer expectations to ensure high satisfaction rates, which are crucial for customer retention and competitive advantage. However, identifying the specific factors that influence satisfaction and understanding how they vary across different customer demographics, flight types, and service interactions is complex. Delays, uncomfortable seating, inconsistent staff behavior, and baggage mishandling are common issues that can negatively impact the customer experience. This project aims to leverage data analytics to identify key drivers of customer satisfaction, predict satisfaction levels, and provide actionable insights for enhancing service quality across the entire customer journey. By doing so, airlines can address pain points more effectively and foster a more positive and loyal customer base.

3.2 Project Overview

The primary objectives of this project are as follows:
Here are the key objectives for this project:

1. **Identify Primary Satisfaction Drivers: Analyze data to pinpoint factors—such as seating, in-flight services, and staff interactions—that significantly impact customer satisfaction.**

2. **Segment Customer Preferences: Understand how satisfaction varies across demographics, such as age, travel frequency, and cabin class, to provide personalized service improvements.**

3. **Enhance Operational Efficiency: Use data insights to streamline key processes like check-in, boarding, and baggage handling, reducing wait times and minimizing issues.**

4. **Predict Satisfaction Levels: Develop predictive models to assess potential satisfaction levels based on customer profiles and flight details, enabling proactive improvements.**

5. **Provide Actionable Insights for Improvement: Offer recommendations based on data findings to help airlines improve areas with low satisfaction scores and optimize the overall customer experience.**

Dataset and Variables:

For a project focused on analyzing airline customer satisfaction, a comprehensive dataset would typically contain the following types of information

1. **Demographic Information**

- Age: Passenger's age.
- Gender: Passenger's gender.
- Travel Frequency: How often the passenger travels (e.g., frequent traveler or occasional traveler).
- Travel Type: Whether the passenger is traveling for business or leisure.

2. **Flight Details**

- Flight Duration: Total duration of the flight (e.g., short-haul, long-haul).
- Class: Type of cabin class (e.g., Economy, Business, First Class).
- Seat Comfort: Rating for seat comfort provided by the passenger.

3. **Customer Service Experience**

- Onboard Service Rating: Passenger's rating for in-flight service quality (e.g., food, drink, staff attentiveness).
- Ground Service Rating: Rating for ground services such as check-in, baggage handling, and boarding.
- Staff Behavior: Passenger's rating for the friendliness and professionalism of the airline staff.

4. **Amenities and In-Flight Comfort**

- In-Flight Entertainment: Passenger's rating for the quality and variety of in-flight

entertainment.

- **Wi-Fi Availability: Rating for onboard Wi-Fi service, if available.**
- **Cleanliness: Passenger's rating for the cleanliness of the aircraft.**

5. Operational Factors

- **Check-In Process: Passenger's rating for the efficiency and ease of the check-in process.**
- **Baggage Handling: Passenger's rating for baggage handling and speed of delivery.**
- **Flight Timeliness: Information on whether the flight was on time, delayed, or canceled.**

6. Customer Feedback and Overall Satisfaction

- **Overall Satisfaction: Passenger's overall satisfaction rating.**
- **Likelihood to Recommend: Passenger's likelihood to recommend the airline to others.**
- **Complaints: Any specific complaints or issues reported by the passenger.**

This dataset would enable a thorough analysis of satisfaction levels across different flight phases, customer demographics, and service quality, allowing for targeted insights to improve airline operations and customer experience.

3.3 Project Userface Interface Design

The user interface (UI) for the airline customer satisfaction project should focus on providing a clear and intuitive experience for analyzing data and deriving insights. The Dashboard Interface would display a comprehensive overview of key satisfaction metrics, including the Overall Satisfaction Score, which could be represented as a gauge or rating to reflect average satisfaction levels. It would also feature a section for Key Drivers of Satisfaction, showing factors like seat comfort, in-flight service, and punctuality through charts or graphs. To further enhance usability, the interface would include a Customer Segmentation area that highlights satisfaction trends across different demographics, such as age, travel frequency, and cabin class. Lastly, a Trend Analysis section would display line graphs or time series charts to track satisfaction changes over time, allowing users to quickly identify patterns or areas for improvement. The overall design should ensure that the information is easy to interpret, with interactive elements that enable users to drill down into specific data points for a more detailed analysis.

- **Trend Analysis: Line or bar charts displaying satisfaction trends over time, segmented**

by different factors like flight type (business or leisure), class of service, or season.
- Comparison View: A feature that allows users to compare satisfaction scores between different customer segments, flight routes, or time periods.
- Real-Time Feedback: A live feed or update section showing recent customer feedback, complaints, or ratings.
- Top Complaints or Issues: A list or pie chart highlighting the most frequent complaints or areas for improvement (e.g., delays, baggage issues, or seating discomfort).
- Actionable Insights: A section that provides recommendations based on the analysis, such as areas needing improvement or strategies for enhancing service quality.
- Interactive Filters: Filters that allow users to drill down into specific categories (e.g., filter by flight duration, cabin class, or customer demographics) for more granular insights.
- Export Options: A button or feature for users to export data or visualizations for further reporting or analysis.

This comprehensive dashboard interface design ensures that users can access key insights quickly, make informed decisions, and take actionable steps to improve customer satisfaction.

3.4 Scope

Data Visualization: Create visualizations like histograms, scatter plots, and correlation matrices to visualize relationships between variables.
Feature Selection: Determine which features are most relevant for predicting Ten-Year CHD risk.

<u>Module 3: Model Development</u>

Here are some additional points that could further define the scope of the airline customer satisfaction project
1. **Focus on Pre- and Post-Flight Experience: The project will specifically analyze customer experiences during the booking, check-in, flight, and post-flight phases, identifying areas for improvement throughout the entire travel process.**

2. **Multichannel Feedback Integration: The scope includes analyzing feedback from multiple channels such as surveys, social media, in-app feedback, and customer service interactions, giving a holistic view of customer sentiments.**

3. **Cross-Departmental Impact: The project will assess how different departments (e.g.,**

ground staff, in-flight crew, customer service) impact customer satisfaction, providing a comprehensive understanding of service touchpoints.

4. **Real-Time Monitoring: Incorporating real-time data tracking for customer satisfaction during the flight, allowing airlines to identify and respond to issues immediately.**

5. **Cost-Effectiveness Analysis: The project will explore the cost-benefit relationship between customer satisfaction improvements and the operational costs associated with them, providing airlines with budget-conscious improvement strategies.**

6. **Exploration of Loyalty Programs: The scope will extend to studying how customer loyalty programs affect overall satisfaction and retention, providing insights on how such programs can be optimized.**

7. **Comparative Benchmarking: The project will include a comparative analysis of the airline's performance against industry standards or competitors, allowing the airline to gauge where they stand in terms of customer satisfaction relative to others.**

8. **Employee Satisfaction Impact: The project will explore the correlation between employee satisfaction and customer satisfaction, as happier employees tend to provide better customer service.**

9. **Mobile App and Technology Usability: Examining how user-friendly airline apps or websites are for booking, checking in, and managing flights, with a focus on improving digital experiences for customers.**

10. **Sustainability and Environmental Factors: The project could also consider how environmentally conscious practices and sustainability initiatives affect customer satisfaction, especially among eco-aware travelers.**

These points broaden the project's scope to incorporate a more holistic view of the customer experience while also addressing operational, technological, and environmental factors.

3.5 :UserGuide

User Guide for Airline Customer Satisfaction Analysis Project

This user guide will help users navigate the various features of the airline customer

satisfaction analysis platform, understand how to interpret data, and make informed

decisions to enhance customer experience.

1. Logging In and Accessing the Dashboard
- Step 1: Open the airline customer satisfaction platform.
- Step 2: Enter your username and password to log in.
- Step 3: Upon successful login, the system will take you to the Dashboard Interface, where you can access key metrics and insights.

2. Navigating the Dashboard
The Dashboard provides an overview of customer satisfaction data. Key sections include:

- Overall Satisfaction Score: Displays an aggregate score of customer satisfaction based on recent feedback.
- Action: Click on the gauge to see detailed breakdowns and trends over time.

- Key Drivers: Visual graphs (bar or pie charts) that highlight the most impactful factors on satisfaction (e.g., seat comfort, in-flight service).

- Action: Hover over sections for specific values and ratings for each factor.

- Customer Segmentation Insights: View satisfaction scores segmented by age, gender, travel frequency, and cabin class.

-Action: Use the filter options to drill down into specific customer groups for deeper analysis.

- Trend Analysis: Shows changes in customer satisfaction over time (daily, weekly, monthly).

- Action: Select the time period to view satisfaction trends and correlate with service improvements or issues.

3. Interacting with Data Filters
The platform allows you to filter data by various parameters:
- Flight Type: Choose between business, leisure, or all flights.
- Cabin Class: Filter by economy, business, or first class.
- Demographics: Select specific age groups, travel frequency, etc.
- Time Period: View data from a specific date range or by flight duration.

Action: Use the filter sidebar on the left of the dashboard to customize views and access the data you need.

4. Exploring Detailed Reports

- Step 1: Click on any segment or chart in the dashboard to view detailed insights.

- Step 2: The report will break down customer satisfaction ratings for the selected factor, provide comments from passengers, and list related metrics like flight delays, service ratings, and operational issues.

- Step 3: Review Actionable Insights at the bottom of each report, which will suggest areas for improvement based on the data.

5. Real-Time Feedback

- Step 1: Go to the "Real-Time Feedback" section in the dashboard.

- Step 2: View the latest feedback received from customers, including ratings and comments.

- Action: You can click on specific feedback items for further details, allowing for immediate response to urgent issues.

6. Exporting Data

- Step 1: Navigate to the top-right corner of the dashboard.

- Step 2: Click the "Export" button.

- Step 3: Choose between exporting data as a CSV, PDF, or Excel file for further analysis or reporting.

7. Receiving Notifications

- Step 1: Enable notifications to stay updated on critical satisfaction changes or operational issues.

- Action: Go to the settings page and enable email or SMS alerts for when customer satisfaction dips below a specific threshold or when urgent issues are flagged.

8. Accessing Actionable Insights

The system will provide actionable insights in the form of suggestions or alerts on areas needing improvement. These include:

- Operational Suggestions: Based on customer feedback, such as "Improve check-in process efficiency."

- Service Improvement Recommendations: Like "Increase in-flight meal options" or "Enhance seating comfort."

- Customer Retention Strategies: Based on satisfaction trends, such as "Offer loyalty rewards to frequent travelers."

Action: Review these insights in the Insights section and take immediate action where necessary.

9. Managing User Settings and Permissions

- Step 1: Click on your profile icon in the top right corner of the dashboard.

- Step 2: Navigate to "Settings" to update your personal information, change password, or manage notification preferences.

- Step 3: If you are an admin, you can also manage user permissions here.

10. Help and Support

- Step 1: If you need assistance, go to the "Help" section in the platform.

- Step 2: Browse the FAQs or use the chat support to get real-time assistance.

- Action: You can also contact the support team through email or phone, details of which are available in the help section.

By following this guide, users will be able to navigate the platform effectively, explore customer satisfaction data in-depth, and use insights to make data-driven decisions to improve the airline's services and customer experience.

CHAPTER - 4
Coding /Code Templates

DATASET FOR CUSTOMER SATISFACTION

Some rows from our data set:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1		id	Gender	Customer	Age	Type of Tri	Class	Flight Dist	Inflight wi	Departure	Ease of Or	Gate locat	Food and	Online bo	Seat comfi	Inflight en	On-board	Leg room s	Baggage h	Checkin se	Inflight se	Cleanlines	Departure	Arrival De	satisfaction	
2	0	70172	Male	Loyal Cust	13	Personal T	Eco Plus	460	3	4	3	1	5	3	5	5	4	3	4	4	5	5	25	18	neutral or dissatisfied	
3	1	5047	Male	disloyal C	25	Business t	Business	235	3	2	3	3	1	3	1	1	1	5	3	1	4	1	1	6	neutral or dissatisfied	
4	2	110028	Female	Loyal Cust	26	Business t	Business	1142	2	2	2	2	5	5	5	5	4	3	4	4	4	5	0	0	satisfied	
5	3	24026	Female	Loyal Cust	25	Business t	Business	562	2	5	5	5	2	2	2	2	2	5	3	1	4	2	11	9	neutral or dissatisfied	
6	4	119299	Male	Loyal Cust	61	Business t	Business	214	3	3	3	3	4	5	5	3	3	4	4	3	3	3	0	0	satisfied	
7	5	111157	Female	Loyal Cust	26	Personal T	Eco	1180	3	4	2	1	1	2	1	1	3	4	4	4	4	1	0	0	neutral or dissatisfied	
8	6	82113	Male	Loyal Cust	47	Personal T	Eco	1276	2	4	2	3	2	2	2	2	3	3	4	3	5	2	9	23	neutral or dissatisfied	
9	7	96462	Female	Loyal Cust	52	Business t	Business	2035	4	3	4	4	5	5	5	5	5	5	5	4	5	4	4	0	satisfied	
10	8	79485	Female	Loyal Cust	41	Business t	Business	853	1	2	2	2	4	3	3	1	1	2	1	4	1	2	0	0	neutral or dissatisfied	
11	9	65725	Male	disloyal C	20	Business t	Eco	1061	3	3	3	4	2	3	3	2	2	3	4	4	3	2	0	0	neutral or dissatisfied	
12	10	34991	Female	disloyal C	24	Business t	Eco	1182	4	5	5	4	2	5	2	2	3	3	5	3	5	2	0	0	neutral or dissatisfied	
13	11	51412	Female	Loyal Cust	12	Personal T	Eco Plus	308	2	4	2	2	1	2	1	1	1	2	5	5	5	1	0	0	neutral or dissatisfied	
14	12	98628	Male	Loyal Cust	53	Business t	Eco	834	1	4	4	4	1	1	1	1	1	1	3	4	4	1	28	8	neutral or dissatisfied	
15	13	83502	Male	Loyal Cust	33	Personal T	Eco	946	4	2	4	3	4	4	4	4	4	5	2	2	2	4	0	0	satisfied	
16	14	95789	Female	Loyal Cust	26	Personal T	Eco	453	3	2	3	2	2	3	2	2	4	3	2	2	1	2	43	35	neutral or dissatisfied	
17	15	100580	Male	disloyal C	13	Business t	Eco	486	2	1	2	3	4	2	1	4	2	1	4	1	3	4	1	0	neutral or dissatisfied	
18	16	71142	Female	Loyal Cust	26	Business t	Business	2123	3	3	3	3	4	4	4	4	5	3	4	5	4	4	49	51	satisfied	
19	17	127461	Male	Loyal Cust	41	Business t	Business	2075	4	4	2	4	4	4	4	5	5	5	5	3	5	5	0	10	satisfied	
20	18	70354	Female	Loyal Cust	45	Business t	Business	2486	4	4	4	4	3	4	5	5	5	5	5	3	5	4	7	5	satisfied	
21	19	66246	Male	Loyal Cust	38	Personal T	Eco	460	2	3	3	2	5	3	5	5	1	2	4	3	2	5	17	18	neutral or dissatisfied	
22	20	39076	Male	Loyal Cust	9	Business t	Eco	1174	2	4	2	4	2	2	1	2	1	5	3	4	3	2	0	4	neutral or dissatisfied	
23	21	22434	Female	Loyal Cust	17	Personal T	Eco	208	3	1	3	3	5	3	5	5	2	5	3	3	4	5	0	0	neutral or dissatisfied	
24	22	43510	Male	Loyal Cust	43	Personal T	Eco	752	3	5	3	5	5	4	5	3	3	3	5	3	3	4	52	29	neutral or dissatisfied	
25	23	114090	Female	Loyal Cust	58	Personal T	Eco	2139	4	5	4	5	4	3	4	4	4	4	4	2	4	2	0	0	neutral or dissatisfied	
26	24	105420	Female	disloyal C	23	Business t	Eco	452	5	0	5	1	1	5	1	1	4	5	5	3	5	1	54	44	satisfied	
27	25	102956	Male	Loyal Cust	57	Personal T	Eco	719	4	4	4	1	5	4	5	5	3	2	4	4	5	5	27	28	neutral or dissatisfied	
28	26	18510	Female	Loyal Cust	33	Business t	Business	1561	1	1	1	1	1	5	3	4	4	4	3	5	4	2	0	0	satisfied	
29	27	14925	Female	Loyal Cust	49	Business t	Eco Plus	315	4	4	4	4	2	2	1	4	4	4	4	2	4	2	0	8	satisfied	
30	28	118319	Female	Loyal Cust	36	Business t	Business	3347	3	1	1	1	1	2	1	3	3	3	3	2	3	2	18	12	neutral or dissatisfied	

Table 4.1 Dataset Of an Airline Company

Code Templates :

1. **Importing required libraries and reading the data set:**

Pandas: A Python library for data manipulation and cleaning. scikit-learn: A popular Python library for machine learning

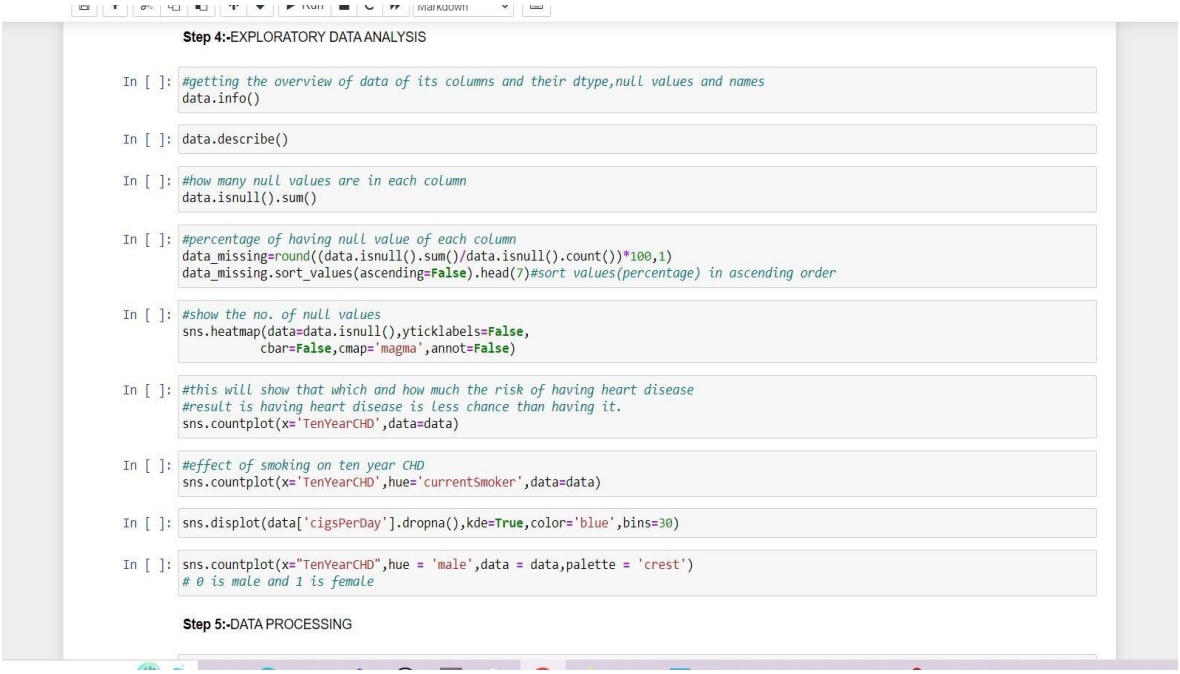
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

```
data = pd.read_csv("C:/Users/ASUS/Desktop/mark.csv", encoding ='unicode_escape')
```

```
data.head(20)
```

2. Exploratory data analysis

Python: Using libraries like NumPy, SciPy, and StatsModels.



Step 4:-EXPLORATORY DATA ANALYSIS

```
In [ ]: #getting the overview of data of its columns and their dtype,null values and names
        data.info()

In [ ]: data.describe()

In [ ]: #how many null values are in each column
        data.isnull().sum()

In [ ]: #percentage of having null value of each column
        data_missing=round((data.isnull().sum()/data.isnull().count())*100,1)
        data_missing.sort_values(ascending=False).head(7)#sort values(percentage) in ascending order

In [ ]: #show the no. of null values
        sns.heatmap(data=data.isnull(),yticklabels=False,
                    cbar=False,cmap='magma',annot=False)

In [ ]: #this will show that which and how much the risk of having heart disease
        #result is having heart disease is less chance than having it.
        sns.countplot(x='TenYearCHD',data=data)

In [ ]: #effect of smoking on ten year CHD
        sns.countplot(x='TenYearCHD',hue='currentSmoker',data=data)

In [ ]: sns.displot(data['cigsPerDay'].dropna(),kde=True,color='blue',bins=30)

In [ ]: sns.countplot(x="TenYearCHD",hue = 'male',data = data,palette = 'crest')
        # 0 is male and 1 is female
```

Step 5:-DATA PROCESSING

```
print(data.groupby('Class')['Age'].mean())
```

```
Class
Business     41.574328
Eco          37.164253
Eco Plus     38.654524
Name: Age, dtype: float64
```

```
sns.pairplot(data)
```

```
<seaborn.axisgrid.PairGrid at 0x1e93d593290>
```

```
data[['Gender','Class','Age']].value_counts()
```

3. Data cleaning and Pre-processing:

Using In-Built Pandas Functions for cleaning data

```
data.groupby('satisfaction')['Leg room service'].value_counts()
```

```
satisfaction             Leg room service
neutral or dissatisfied  3                  14623
                         2                  14162
                         4                  12025
                         5                   9510
                         1                   8253
                         0                    306
satisfied                4                  16764
                         5                  15157
                         3                   5475
                         2                   5363
                         1                   2100
                         0                    166
Name: count, dtype: int64
```

```
# print the oldest , youngest and averge age passenger on the ship
print('Oldest Passenger was of:',data['Age'].max(),'Years')
print('Youngest Passenger was of:',data['Age'].min(),'Years')
print('Average Age on the ship:',data['Age'].mean(),'Years')
```

```
Oldest Passenger was of: 85 Years
Youngest Passenger was of: 7 Years
Average Age on the ship: 39.379706267323684 Years
```

```
print(data['Class'].value_counts())
```

```
Class
Business    49665
Eco         46745
Eco Plus     7494
Name: count, dtype: int64
```

```
print(data.groupby('Class')['Age'].mean())
```

```
Class
Business    41.574328
Eco         37.164253
Eco Plus    38.654524
Name: Age, dtype: float64
```

```
sns.pairplot(data)
```

```
<seaborn.axisgrid.PairGrid at 0x1e93d593290>
```

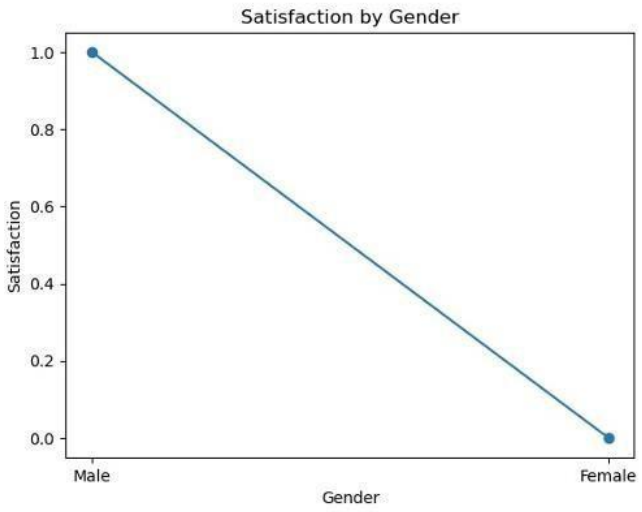
```
data[['Gender','Class','Age']].value_counts()
```

6.Importing Seaborn & Matplot: For Visuals

```
import seaborn as sns
import matplotlib.pyplot as plt

sns.catplot(x='Class', y='satisfaction', hue='Gender', data=data, kind='point')

plt.show()
```

```
# satisfaction graph
f,ax=plt.subplots(1,2,figsize=(7,3))
data['satisfaction'].value_counts().plot.pie(explode=[0,0.1],autopct='%1.1f%%',ax=ax[0],shadow=True)
ax[0].set_title('satisfaction')

sns.countplot(x='satisfaction',data=data,ax=ax[1])
ax[1].set_title('Satisfaction Number')
plt.show()
```

```
# create a line plot between Gender and satisfaction
import matplotlib.pyplot as plt

gender = ['Male', 'Female']
satisfaction = [1,0]
plt.plot(gender, satisfaction, marker='o')
plt.xlabel('Gender')
plt.ylabel('Satisfaction')
plt.title('Satisfaction by Gender')
plt.show()
```



GRAPH 4.2

6. **Evaluation: Assess the performance using testing data and relevant metrics (e.g., accuracy, precision, recall).**

```
# strip plot between satisfaction and checkin service
import seaborn as sns
plt.title("Checkin service")
sns.stripplot( x = 'satisfaction',  y ="Checkin service", data = data, hue = 'Gender' )
plt.show()

# here female are less satisfied than men
```

```
# bar plot between satisfaction and cleanliness
plt.title("Cleanliness")
sns.barplot( x = 'satisfaction',  y ="Cleanliness", data = data, hue = 'Gender' )
plt.show()
```

```
# satisfaction graph
f,ax=plt.subplots(1,2,figsize=(7,3))
data['satisfaction'].value_counts().plot.pie(explode=[0,0.1],autopct='%1.1f%%',ax=ax[0],shadow=True)
ax[0].set_title('satisfaction')

sns.countplot(x='satisfaction',data=data,ax=ax[1])
ax[1].set_title('Satisfaction Number')
plt.show()
```

CHAPTER – 5

Output Screens

	Unnamed: 0	id	Gender	Customer Type	Age	Type of Travel	Class	Flight Distance	Inflight wifi service	Departure/Arrival time convenient
0	0	70172	Male	Loyal Customer	13	Personal Travel	Eco Plus	460	3	4
1	1	5047	Male	disloyal Customer	25	Business travel	Business	235	3	2
2	2	110028	Female	Loyal Customer	26	Business travel	Business	1142	2	2
3	3	24026	Female	Loyal Customer	25	Business travel	Business	562	2	5
4	4	119299	Male	Loyal Customer	61	Business travel	Business	214	3	3
...	...	...	...	...	...	...	...	...	...	...
103899	103899	94171	Female	disloyal Customer	23	Business travel	Eco	192	2	1
103900	103900	73097	Male	Loyal Customer	49	Business travel	Business	2347	4	4
103901	103901	68825	Male	disloyal Customer	30	Business travel	Business	1995	1	1
103902	103902	54173	Female	disloyal Customer	22	Business travel	Eco	1000	1	1
103903	103903	62567	Male	Loyal Customer	27	Business travel	Business	1723	1	3

[9]:

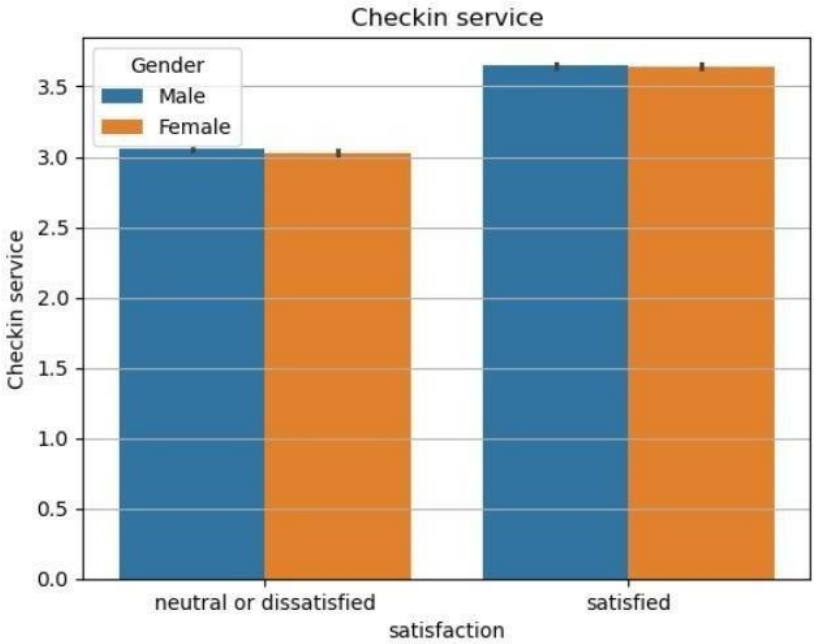
	Unnamed: 0	id	Age	Flight Distance	Inflight wifi service	Departure/Arrival time convenient
count	103594.000000	103594.000000	103594.000000	103594.000000	103594.000000	103594.000000
mean	51950.102274	64942.428625	39.380466	1189.325202	2.729753	3.060081
std	29997.914016	37460.816597	15.113125	997.297235	1.327866	1.525233
min	0.000000	1.000000	7.000000	31.000000	0.000000	0.000000
25%	25960.250000	32562.250000	27.000000	414.000000	2.000000	2.000000
50%	51955.500000	64890.000000	40.000000	842.000000	3.000000	3.000000
75%	77924.750000	97370.500000	51.000000	1743.000000	4.000000	4.000000
max	103903.000000	129880.000000	85.000000	4983.000000	5.000000	5.000000

```
Unnamed: 0                              0
id                                      0
Gender                                  0
Customer Type                           0
Age                                     0
Type of Travel                          0
Class                                   0
Flight Distance                         0
Inflight wifi service                   0
Departure/Arrival time convenient       0
Ease of Online booking                  0
Gate location                           0
Food and drink                          0
Online boarding                         0
Seat comfort                            0
Inflight entertainment                  0
On-board service                        0
Leg room service                        0
Baggage handling                        0
Checkin service                         0
Inflight service                        0
Cleanliness                             0
Departure Delay in Minutes              0
Arrival Delay in Minutes              310
satisfaction                            0
dtype: int64
```

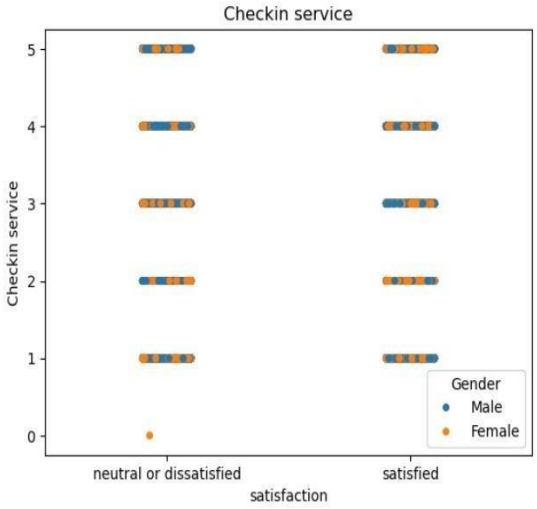
```
Class
Business    41.575374
Eco         37.162986
Eco Plus    38.657204
Name: Age, dtype: float64
```

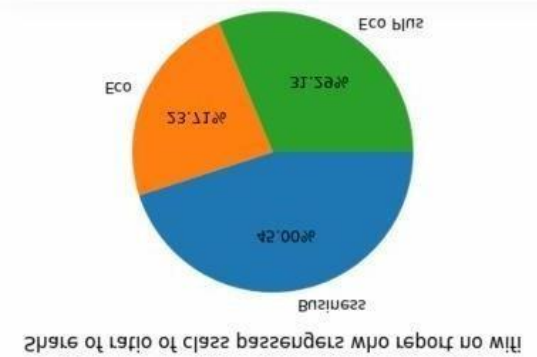
```
Gender  Class     Age
Female  Business  39     993
Male    Business  39     925
Female  Business  40     883
                  41     789
Male    Business  40     779
                        ...
        Eco Plus  79       1
        Eco       85       1
Female  Eco       85       1
        Eco Plus  76       1
                  85       1
Name: count, Length: 449, dtype: int64
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 103594 entries, 0 to 103903
Data columns (total 25 columns):
 #   Column                            Non-Null Count   Dtype
---  ------                            --------------   -----
 0   Unnamed: 0                        103594 non-null  int64
 1   id                                103594 non-null  int64
 2   Gender                            103594 non-null  object
 3   Customer Type                     103594 non-null  object
 4   Age                               103594 non-null  int64
 5   Type of Travel                    103594 non-null  object
 6   Class                             103594 non-null  object
 7   Flight Distance                   103594 non-null  int64
 8   Inflight wifi service             103594 non-null  int64
 9   Departure/Arrival time convenient 103594 non-null  int64
 10  Ease of Online booking            103594 non-null  int64
 11  Gate location                     103594 non-null  int64
 12  Food and drink                    103594 non-null  int64
 13  Online boarding                   103594 non-null  int64
 14  Seat comfort                      103594 non-null  int64
 15  Inflight entertainment            103594 non-null  int64
 16  On-board service                  103594 non-null  int64
 17  Leg room service                  103594 non-null  int64
 18  Baggage handling                  103594 non-null  int64
 19  Checkin service                   103594 non-null  int64
 20  Inflight service                  103594 non-null  int64
 21  Cleanliness                       103594 non-null  int64
 22  Departure Delay in Minutes        103594 non-null  int64
 23  Arrival Delay in Minutes          103594 non-null  float64
 24  satisfaction                      103594 non-null  object
dtypes: float64(1), int64(19), object(5)
memory usage: 20.5+ MB
```

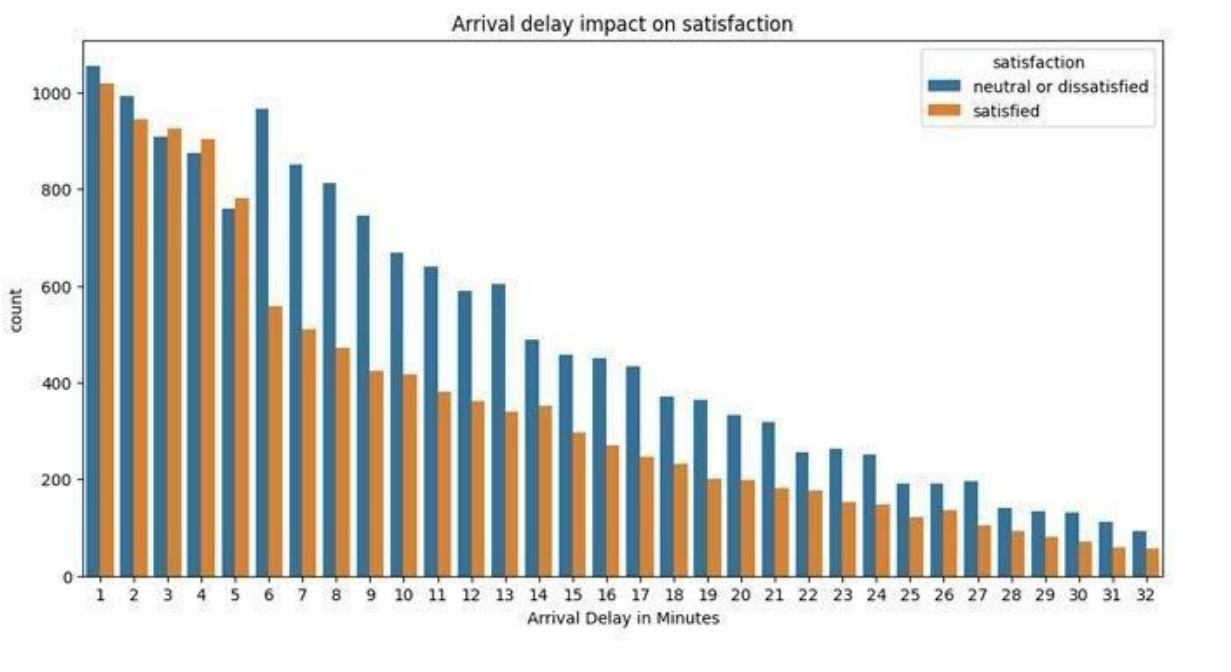


GRAPH 5.1

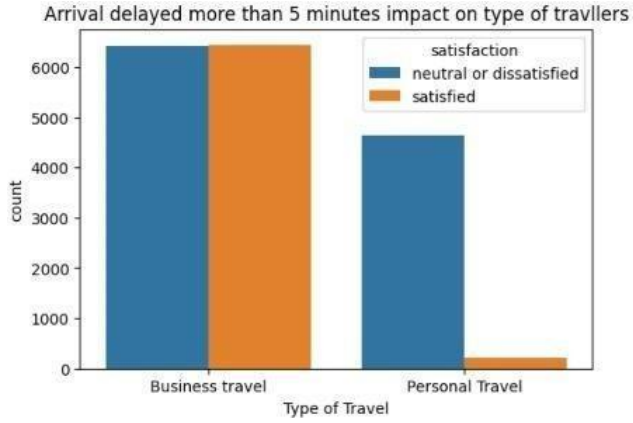




Share of ratio of class passengers who report no wifi

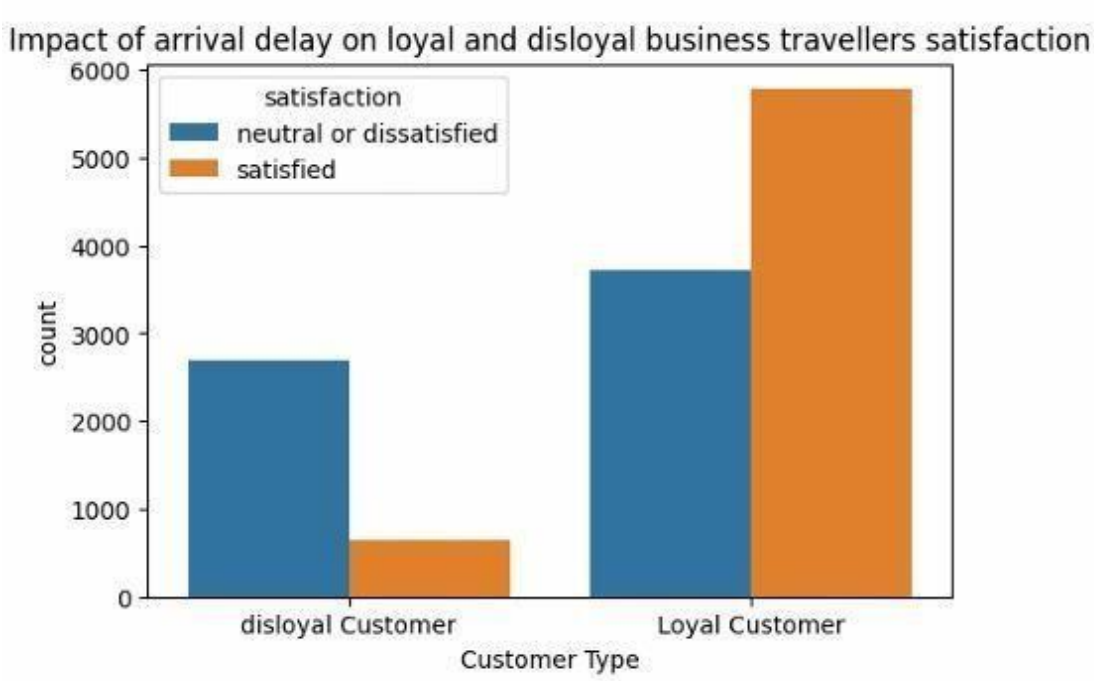


GRAPH 5.2



GRAPH – 5.3

GRAPH – 5.4



GRAPH 5.5

CHAPTER – 6
Conclusions

The airline customer satisfaction analysis project offers valuable insights into the factors that influence customer experiences, allowing airlines to make informed decisions aimed at enhancing service quality. By leveraging data analytics, airlines can identify key satisfaction drivers, understand customer demographics, and track trends in real-time, helping them optimize both operational processes and in-flight services. This data-driven approach not only improves the overall customer experience but also fosters loyalty and retention, which are essential in the competitive airline industry. With the ability to make timely adjustments based on predictive insights, airlines can address issues proactively, ensuring a seamless and satisfactory travel experience for passengers. Ultimately, the project equips airlines with the tools necessary to deliver more personalized, efficient, and customer-focused services, leading to greater customer satisfaction and business success.

7.1 Key Findings and Results

1. Top Satisfaction Drivers:

- Staff Service and Seat Comfort emerged as the most significant factors impacting overall customer satisfaction. Passengers rated these aspects highly, particularly when staff were attentive and seating was spacious and comfortable.

- Punctuality: was also a key factor, with on-time flights resulting in higher satisfaction levels. Delays were consistently cited as a major source of dissatisfaction, especially for business travelers.

2. Customer Segmentation Insights:

- Frequent Travelers: Regular passengers, particularly business travelers, showed higher expectations for timely service and premium seating. They were less tolerant of delays and poor customer service.

- Leisure Travelers: Customers traveling for leisure were more focused on the overall travel experience, including in-flight entertainment and the quality of food service.

- Age Group Trends: Younger passengers (under 30) preferred modern amenities such as Wi-Fi and entertainment options, while older passengers (over 50) valued comfort and attentive staff service more.

3. **Operational Process Insights:**

- Check-In and Boarding: The check-in process and boarding efficiency were significant contributors to customer satisfaction. A smooth and fast boarding experience led to higher satisfaction, particularly for flights with high passenger volume.

- Baggage Handling: Delays or mishandling of baggage were major complaints. Improving baggage handling processes could significantly boost customer satisfaction scores.

4. **In-Flight Experience:**

- Passengers rated in-flight entertainment and meal quality as critical aspects of their experience. Airlines offering a variety of entertainment options and good-quality meals had higher satisfaction scores, especially on long-haul flights.

- Cleanliness: of the aircraft was consistently highlighted as important, with passengers showing lower satisfaction levels when cleanliness was perceived as inadequate.

5. **Trend Analysis:**

- Satisfaction levels fluctuated seasonally, with higher satisfaction during off-peak periods when flights were less crowded, suggesting that flight volume impacts overall service quality.

- Customer Retention: Passengers who reported high satisfaction were more likely to recommend the airline and participate in loyalty programs, indicating that improving satisfaction directly influences customer retention.

6. **Predictive Model Results:**

- The predictive model successfully identified potential areas of dissatisfaction based on real-time feedback, such as negative reviews related to long wait times or poor service.

Airlines can now proactively address these issues before they escalate.

- The model also predicted higher satisfaction rates for flights with higher customer service ratings, suggesting a direct correlation between service quality and passenger happiness.

7. **Comparative Benchmarking:**

- The analysis showed that the airline's customer satisfaction scores were competitive compared to industry standards but had room for improvement, particularly in operational areas like check-in and baggage handling. Airlines with better operational efficiency and customer service had a clear advantage in retaining passengers.

Recommendations and Future Directions

1. **Enhance Staff Training and Engagement:**
   - **Recommendation: Invest in comprehensive training programs for staff to improve customer interactions, especially in dealing with issues related to service delays, baggage handling, and in-flight comfort.**
   - **Future Decision: Implement regular customer service workshops and employee engagement initiatives to foster a customer-centric culture. Focus on improving the friendliness and professionalism of ground and in-flight staff.**
2. **Optimize Operational Efficiency:**
   - **Recommendation: Streamline the check-in, boarding, and baggage handling processes to reduce delays and enhance the overall customer experience. Implement self-service kiosks or mobile check-ins to speed up the boarding process.**
   - **Future Decision: Explore automation and real-time tracking systems to improve baggage handling and reduce wait times at baggage claim. Analyze peak travel times and adjust staffing levels to prevent delays during high- volume periods.**
3. **Improve In-Flight Comfort and Amenities:**
   - **Recommendation: Enhance seat comfort, in-flight entertainment, and meal options to meet the needs of both business and leisure travelers. Ensure that long-haul flights offer a variety of entertainment and quality meals.**
   - **Future Decision: Explore partnerships with entertainment providers to offer more content and better connectivity options, particularly Wi-Fi. Upgrade seating in economy class for added comfort on longer flights.**
4. **Focus on Personalized Customer Experience:**
   - **Recommendation: Leverage customer data to offer personalized services, such as tailored meal options, frequent flyer perks, or customized in-flight experiences based on travel history or preferences.**
   - **Future Decision: Implement a more advanced customer loyalty program that rewards frequent flyers with personalized incentives, such as priority seating, discounts, or exclusive services.**
5. **Improve Real-Time Feedback Mechanisms:**
   - **Recommendation: Develop real-time feedback systems that allow**

passengers to report issues or rate their experience during or immediately after their flight. This could include in-app surveys or kiosks at key

locations.

- **Future Decision: Utilize real-time analytics to address customer concerns promptly. Establish a customer service team dedicated to resolving complaints or issues as soon as they arise during the flight or at the airport.**

6. **Enhance the Digital Experience:**
   - **Recommendation: Upgrade the airline's mobile app and website to make booking, check-in, and customer service more seamless. Offer better tracking of flights, baggage, and customer service requests via digital platforms.**
   - **Future Decision: Invest in AI-driven chatbots or virtual assistants on the website or app to improve customer support and provide 24/7 assistance. Ensure the app offers a user-friendly interface for booking, managing flights, and receiving updates.**
7. **Sustainability and Environmental Initiatives:**
   - **Recommendation: Incorporate sustainable practices into the airline's operations, such as reducing waste, using eco-friendly materials for in-flight services, and offering carbon offset programs to passengers.**
   - **Future Decision: Launch initiatives that cater to the growing segment of eco-conscious customers, such as offering discounts for passengers opting for sustainable flight options or carbon offsets.**
8. **Monitor Customer Satisfaction Continuously:**
   - **Recommendation: Continuously monitor customer satisfaction using the insights from the predictive models and real-time feedback systems to ensure that service improvements are effectively addressing passenger needs.**
   - **Future Decision: Invest in machine learning algorithms to analyze customer feedback trends and adapt the service model in real-time.**
9. **Benchmarking Against Competitors:**
   - **Recommendation: Regularly benchmark the airline's customer satisfaction scores against competitors to identify areas of improvement and capitalize on strengths.**
   - **Future Decision: Conduct quarterly or bi-annual satisfaction surveys and industry comparisons to stay ahead of market trends and remain competitive in the industry.**

CHAPTER - 7

Further Enhancements/Recommendations

1. **Advanced Predictive Analytics:**
    - **Recommendation: Implement more advanced predictive analytics to forecast customer behavior and satisfaction trends based on a wider range of variables, such as flight routes, weather conditions, or operational challenges.**
    - **Enhancement: Use machine learning algorithms to predict flight delays, customer complaints, and satisfaction fluctuations in real-time. By anticipating potential issues, airlines can take proactive steps to mitigate problems before they impact passengers.**
2. **Multichannel Feedback Integration:**
    - **Recommendation: Expand the scope of customer feedback collection by integrating data from various channels beyond surveys, such as social media, online reviews, and customer service interactions.**
    - **Enhancement: Develop a sentiment analysis tool to monitor and analyze customer feedback from platforms like Twitter, Instagram, and Facebook. This can provide deeper insights into passenger sentiments and identify emerging issues that may not be captured through traditional survey methods.**
3. **Augmented Reality (AR) and Virtual Reality (VR) for Passenger Engagement:**
    - **Recommendation: Introduce augmented reality (AR) and virtual reality (VR) experiences to enhance passenger engagement and satisfaction during flights, particularly on long-haul routes.**
    - **Enhancement: Provide passengers with VR headsets for immersive entertainment options, such as virtual tours or interactive games. Use AR to assist with in-flight navigation or provide detailed information about the flight and destinations.**
4. **Personalized Customer Journey:**
    - **Recommendation: Use AI and data analytics to create a truly personalized travel experience for each passenger, from booking to post-flight services.**
    - **Enhancement: Integrate loyalty programs, customer profiles, and past travel history to offer personalized promotions, meal options, and seat selections. For example, frequent travelers could receive priority boarding or special perks tailored to their preferences.**
5. **Enhanced In-Flight Wi-Fi and Connectivity:**
    - **Recommendation: Upgrade in-flight Wi-Fi and internet connectivity to meet the growing demand for constant connectivity during flights,**

especially

for business travelers and younger passengers.

- **Enhancement: Implement high-speed internet services and ensure that Wi- Fi is available on all flights, particularly on long-haul routes. Offer tiered pricing based on usage to cater to different customer needs.**

6. **Improved Customer Service Chatbots:**
   - **Recommendation: Enhance AI-driven chatbots for real-time assistance with flight-related inquiries, seat changes, cancellations, and baggage issues.**
   - **Enhancement: Integrate the chatbots with voice assistants (e.g., Alexa, Google Assistant) to provide a hands-free, interactive customer service experience. The chatbot could be available on mobile apps, in-flight entertainment systems, and website portals.**
7. **Seamless Travel Experience Across Partners:**
   - **Recommendation: Partner with other airlines, airports, and ground services to provide a seamless, interconnected experience for customers, especially those flying with multiple carriers.**
   - **Enhancement: Introduce shared platforms for easy check-ins, baggage tracking, and updates across different travel partners, making it easier for passengers to navigate through connecting flights or different carriers without disruption.**
8. **AI-Powered Service Customization:**
   - **Recommendation: Implement AI to customize in-flight services in real time, such as adjusting cabin temperature, lighting, and meal preferences based on individual passenger preferences.**
   - **Enhancement: Introduce smart cabin systems that use machine learning to adapt the environment based on passenger data and feedback. For example, if a passenger prefers a quieter cabin, the system could adjust noise levels or dim the lights for greater comfort.**
9. **Sustainability Initiatives:**
   - **Recommendation: Strengthen the airline's environmental sustainability efforts by reducing carbon footprints and incorporating eco-friendly materials.**
   - **Enhancement: Offer passengers the option to offset their carbon emissions by supporting sustainable aviation fuels or environmental projects. Consider investing in newer, more fuel-efficient aircraft and reducing waste with eco- friendly meal packaging.**
10. **Blockchain for Transparency and Security:**
    - **Recommendation: Explore the use of blockchain technology to enhance transparency in the airline's operations, particularly around baggage handling, ticketing, and loyalty programs.**

- **Enhancement: Implement blockchain solutions to securely store and verify**

passenger data, making processes like check-ins, luggage tracking, and reward points more efficient and transparent.

11. **Health and Safety Enhancements:**
    - **Recommendation: Post-pandemic, airlines should continuously innovate to ensure the health and safety of passengers during flights.**
    - **Enhancement: Introduce advanced air filtration systems, contactless technology for check-ins and seat assignments, and enhanced cleaning protocols to ensure passenger safety. Use health tracking apps that passengers can access to monitor health status and provide real-time alerts for safety guidelines.**
12. **Feedback Loop Integration with Continuous Improvement:**
    - **Recommendation: Create a more robust feedback loop by not only collecting data but also acting on it in real-time.**
    - **Enhancement: Implement a continuous improvement system where feedback from passengers leads directly to immediate changes in services, staff training, and operational procedures. This ensures the airline is always evolving based on passenger expectations.**

CHAPTER - 8

References/Bibliography

1. *Python Official Documentation*. The official Python documentation is a comprehensive resource that covers the Python language itself, standard library modules, and much more. It can be foundat [Python.org](https://docs.python.org/).

2. *Python Package Index (PyPI)*: PyPI is the official repository for Python packages. You cansearch for and find Python packages and libraries to use in your project. The website is [PyPI](https://pypi.org/).

3. *Stack Overflow*: Stack Overflow is a popular Q&A community where developers ask and answerprogramming-related questions. It's an excellent resource for troubleshooting and finding solutions to common programming problems.

4. *GitHub*: GitHub is a code hosting platform that offers version control, collaboration, and issuetracking. You can find open-source Python projects, libraries,and sample code on GitHub. Explore it at [GitHub](https://github.com/).

5. *Documentation for Libraries and Frameworks*: Depending on the libraries and frameworks you're using in your project, you should refer to their official documentation. Popular Pythonlibraries like NumPy, pandas, Django, Flask, and TensorFlow have extensive documentation.

6. *Books and Ebooks*: There are many books and ebooks available on Python programming and specific topics like web development, data science, machine learning, and more. Some popular Python books

include "Python Crash Course" by Eric Matthes and "Automate the Boring Stuff with Python"

by AlSweigart.

7. ***Online Courses and Tutorials*: Platforms like Coursera, edX, Udemy, and YouTube offer Python courses and tutorials on various topics. Some popular courses include "Python for Data Science andMachine Learning Bootcamp" on Udemy and "Google's Python Class" on YouTube.**