AIRLINE DATA ANALYSIS USING SQL AND PYTHON

Abstract

The "Airline Data Analysis" project involves leveraging data analytics techniques to enhance the operational efficiency, customer satisfaction, and financial performance of a commercial airline. Through the examination of flight schedules, passenger bookings, and other relevant data sets, the project aims to optimize scheduling, improve the passenger experience, and make strategic decisions for revenue growth and cost reduction. Utilizing SQL, Python, and machine learning, this analysis provides actionable insights for stakeholders, contributing to data-driven decision-making in the dynamic aviation industry.

Business Problem¶

Our company has been providing high-quality air transportation service to our clients for several years, ensuring a safe, comfortable, and convenient journey for our passengers. We operate a diverse fleet of aircraft, ranging from small business jets to medium-sized machines. However, we

currently face challenges due to various factors such as stricter environmental regulations, higher flight taxes, increased interest rates, rising fuel prices, and a tight labor market leading to higher labor costs. These challenges are putting pressure on the company's profitability, and we are actively seeking solutions to address this issue. In order to tackle this challenge, the company is planning to analyze their database and identify opportunities to increase the occupancy rate, thereby boosting the average profit earned per seat.

Challenges

1. **Stricter environmental regulations:** The airlines industry is facing increasing pressure to reduce its carbon footprint, leading to the implementation of more stringent environmental laws. These regulations not only raise operating costs but also restrict the potential for expansion.
2. **Higher flight taxes:** Governments worldwide are imposing heavier taxes on aircraft as a means to address environmental concerns and generate revenue. This increase in flight taxes has raised the overall cost of flying, subsequently reducing demand.
3. **Tight labor market resulting in increased labor costs:** The aviation sector is experiencing a scarcity of skilled workers, leading to higher labor costs and an increase in turnover rates.

Objectives

1. Increase occupancy rate: By increasing the occupancy rate, we can boost the average profit earned per seat and mitigate the impact of the challenges we're facing.

2. Improve pricing strategy: We need to develop a pricing strategy that considers the changing market conditions and customer preferences to attract and retain customers.

3. Enhance customer experience: We need to focus on providing a seamless and convenient experience for our customers, from booking to arrival, to differentiate ourselves in a highly competitive industry and increase customer loyalty.

The end goal of this task would be to identify opportunities to increase the occupancy rate on low-performing flights, which can ultimately lead to increased revenue for the company.

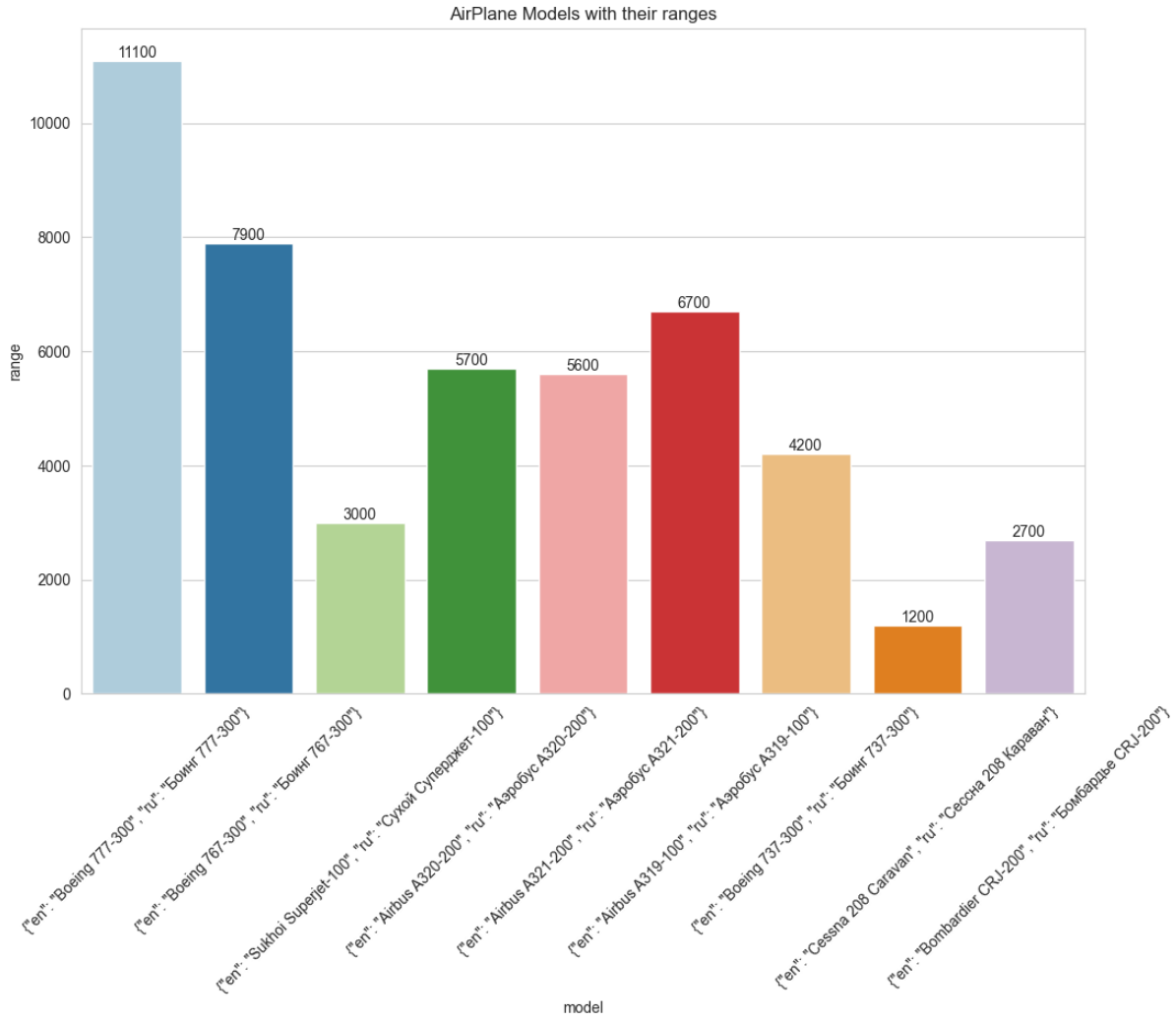
Basic Analysis

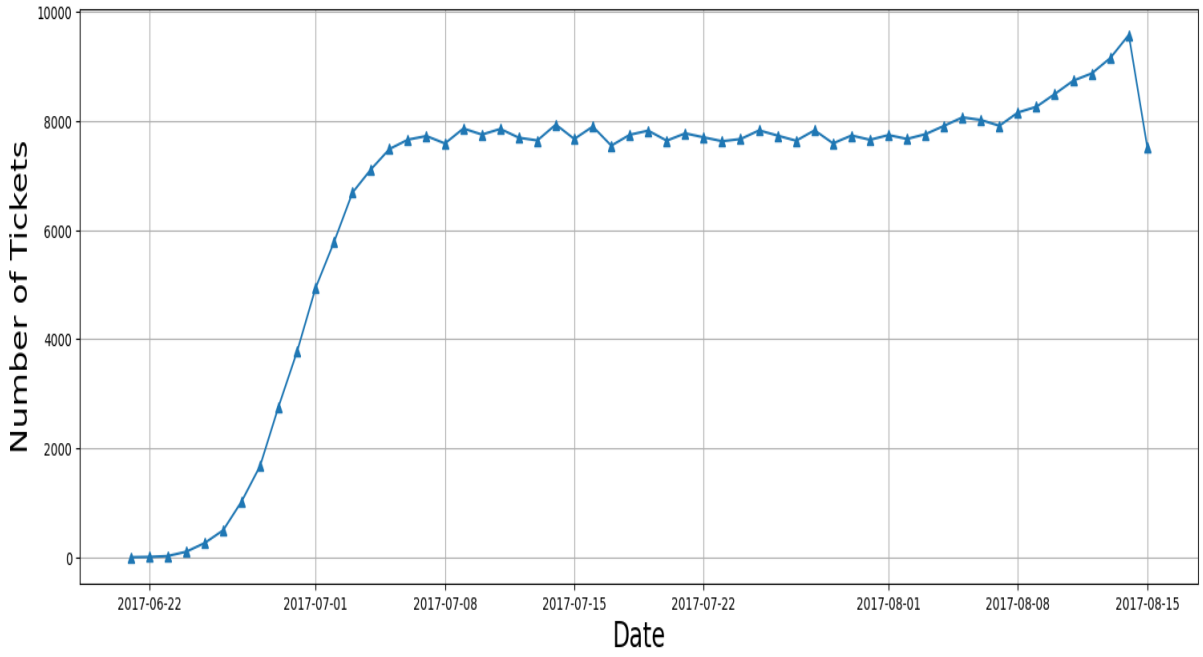
The basic analysis of data provides insights into the number of planes with more than 100 seats, how the number of tickets booked, and total amount earned changed over time, and the average fare for each aircraft with different fare conditions. These findings will be useful in developing strategies to increase occupancy rates and optimize pricing for each aircraft.

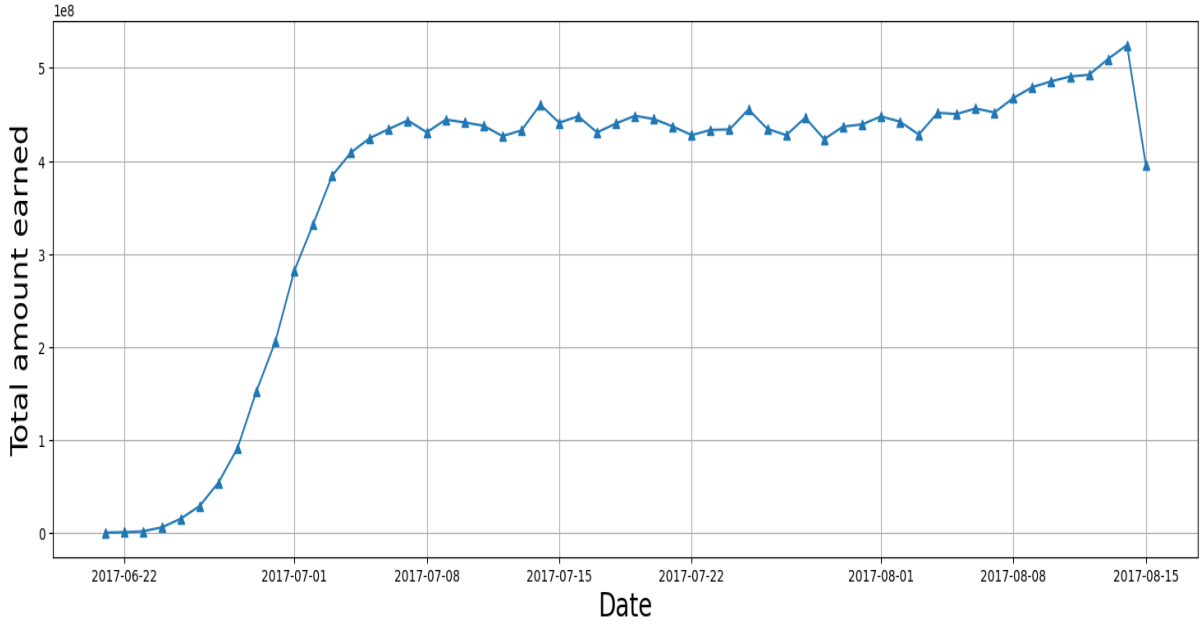
Table 1 shows the aircraft with more than 100 seats and the actual count of the seats.

	aircraft_code	num_seats
0	319	116
1	320	140
2	321	170
3	733	130
4	763	222
5	773	402
6	CN1	12
7	CR2	50
8	SU9	97

Table 1

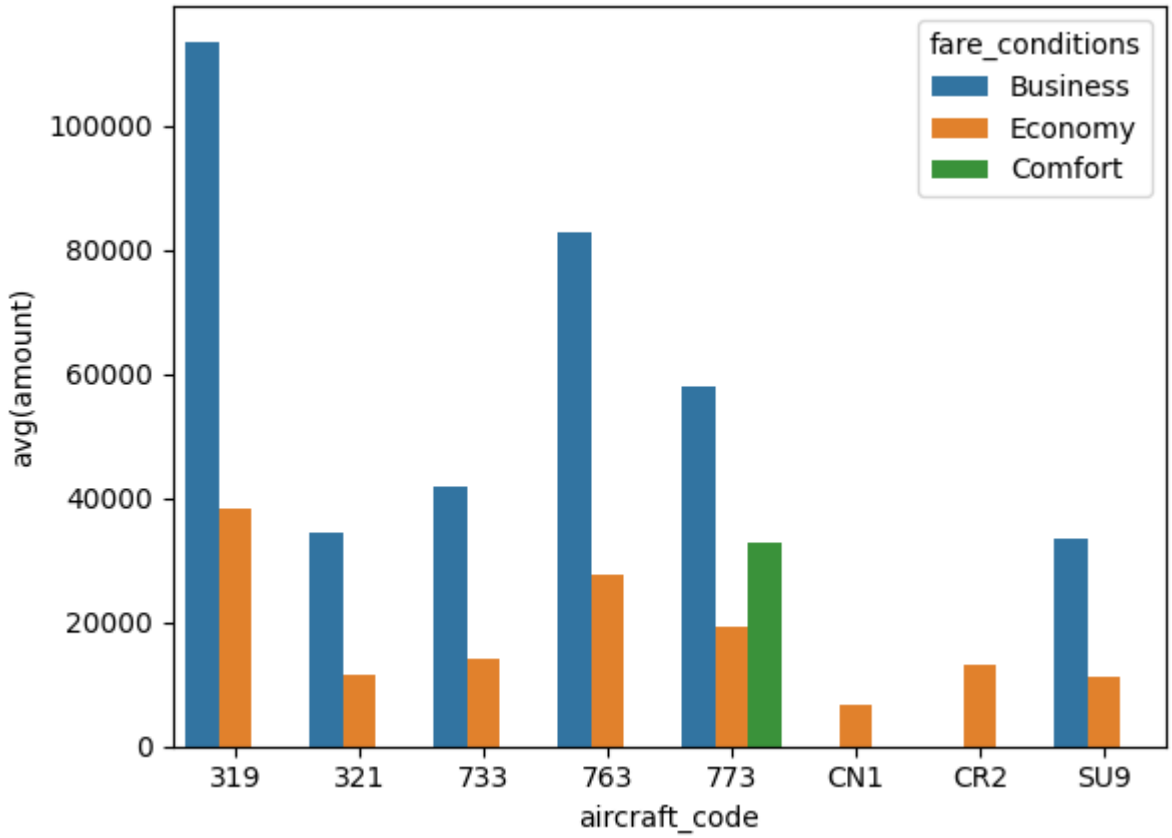






- Utilized a line chart visualization to analyze the trend of ticket bookings and revenue earned.
- The number of tickets booked showed a gradual increase from June 22nd to July 7th.
- From July 8th until August, ticket bookings remained relatively stable with a noticeable peak in bookings on a single day.
- The revenue earned by the company is closely correlated with the number of tickets booked.
- The total revenue earned followed a similar trend throughout the analyzed time period.
- Further exploration of the factors contributing to the peak in ticket bookings could help increase overall revenue and optimize operational strategies.

Revenue Analysis



- Here we successfully derived the names of airplanes using their codes
- So it seems like " Airbus A319-100 " is having maximum average number of Business class seats.
- Also " Airbus A319-100 " is having maximum average number of Economy seats.
- And " Boeing 777-300 " is having maximum number of Comfort seats.
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Average occupancy per aircraft

	aircraft_code	booked_seats	num_seats	occupancy_rate
0	319	53.583181	116	0.461924
1	321	88.809231	170	0.522407
2	733	80.255462	130	0.617350
3	763	113.937294	222	0.513231
4	773	264.925806	402	0.659019
5	CN1	6.004431	12	0.500369
6	CR2	21.482847	50	0.429657
7	SU9	56.812113	97	0.585692

	aircraft_code	booked_seats	num_seats	occupancy_rate	Ic occupancy rate	Ic Total Annual Turnover
0	319	53.58318098720292	116	0.46192397402761143	0.5081163714303726	2976779410.0
1	321	88.80923076923077	170	0.5224072398190045	0.574647963800905	1801980510.0
2	733	80.25546218487395	130	0.617349709114415	0.6790846800258565	1569207310.0000002
3	763	113.93729372937294	222	0.5132310528350132	0.5645541581185146	4808404810.0
4	773	264.9258064516129	402	0.659019419033863	0.7249213609372492	3774326050.0
5	CN1	6.004431314623338	12	0.5003692762186115	0.5504062038404727	106011180.00000001
6	CR2	21.48284690220174	50	0.42965693804403476	0.4726226318484382	2181036550.0
7	SU9	56.81211267605634	97	0.5856918832583128	0.644261071584144	5625933169.999999

Occupancy Analysis

To maximize profitability, airlines must analyze revenue streams, including overall income, average revenue per ticket, and occupancy rates. This information helps identify profitable aircraft types, itineraries, and pricing optimization opportunities. The highest total revenue is generated by the SU9 aircraft, likely due to its lower ticket prices. The CN1 aircraft has the lowest total revenue, possibly due to its limited economy class offering. Monitoring average occupancy rates helps airlines fill seats efficiently, increase revenue, and reduce expenses. Improving occupancy rates can be financially beneficial and achieved through pricing strategies and operational considerations. Airlines should focus on optimizing pricing strategies for gradual revenue growth.

Occupancy Rate Analysis:

	flight_id	avg_occupancy
0	1	16.11392405063291
1	2	17.89108910891089
2	3	17.432989690721648
3	4	NaN
4	5	NaN

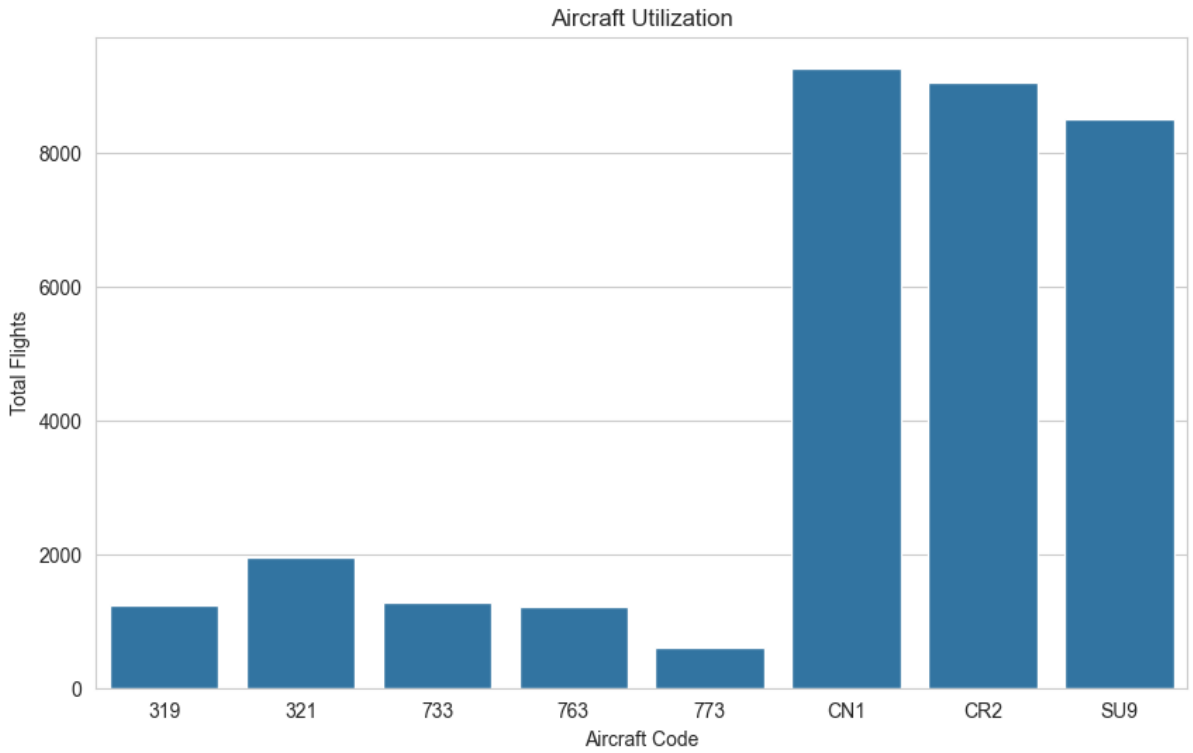
Flight Performance Metrics

	flight_id	scheduled_arrival	actual_arrival	delay_seconds
0	1185	2017-09-10 14:55:00+03	\N	None
1	3979	2017-08-25 17:35:00+03	\N	None
2	4739	2017-09-05 14:15:00+03	\N	None
3	5502	2017-09-12 11:20:00+03	\N	None
4	6938	2017-09-04 13:20:00+03	\N	None

As we can see the delay time is none, so it shows the better performance of the airline. When it shows some delay then it affects the performance of the airplane.

Aircraft Utilization

	aircraft_code	total_flights
0	319	1239
1	321	1952
2	733	1274
3	763	1221
4	773	610



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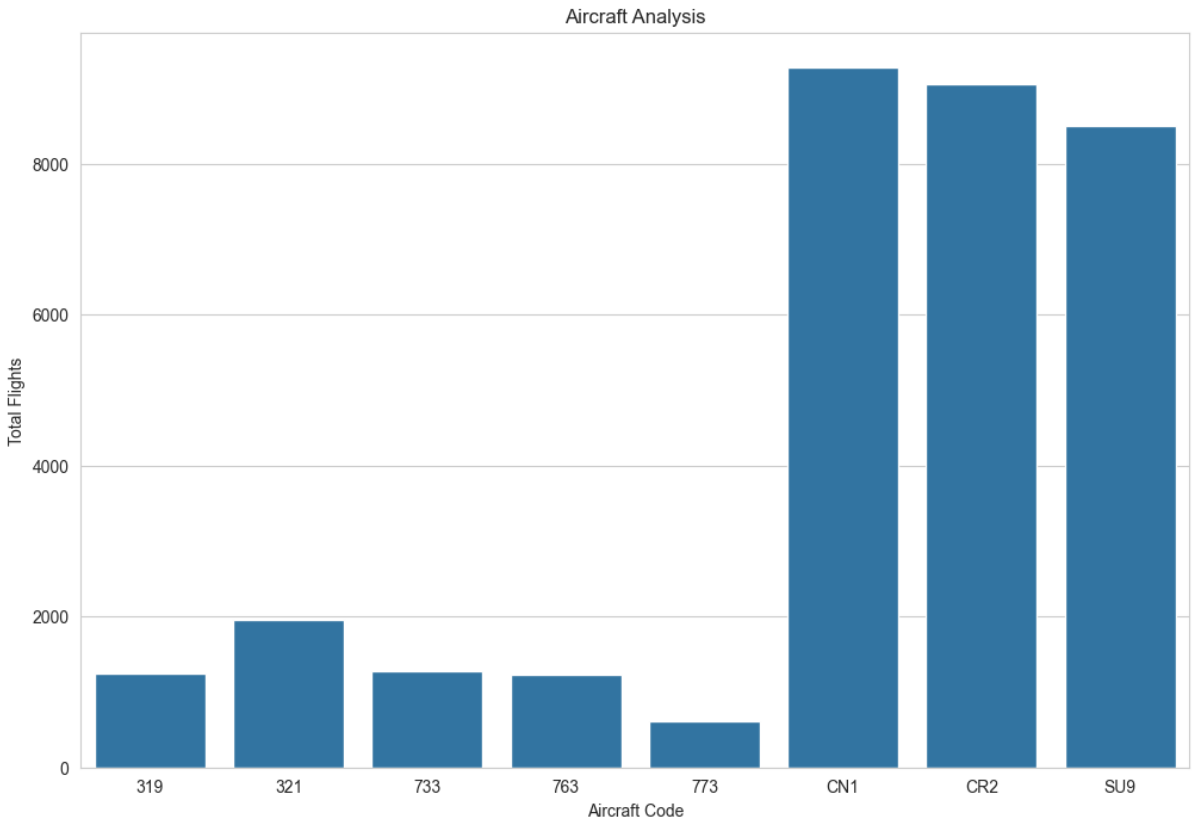
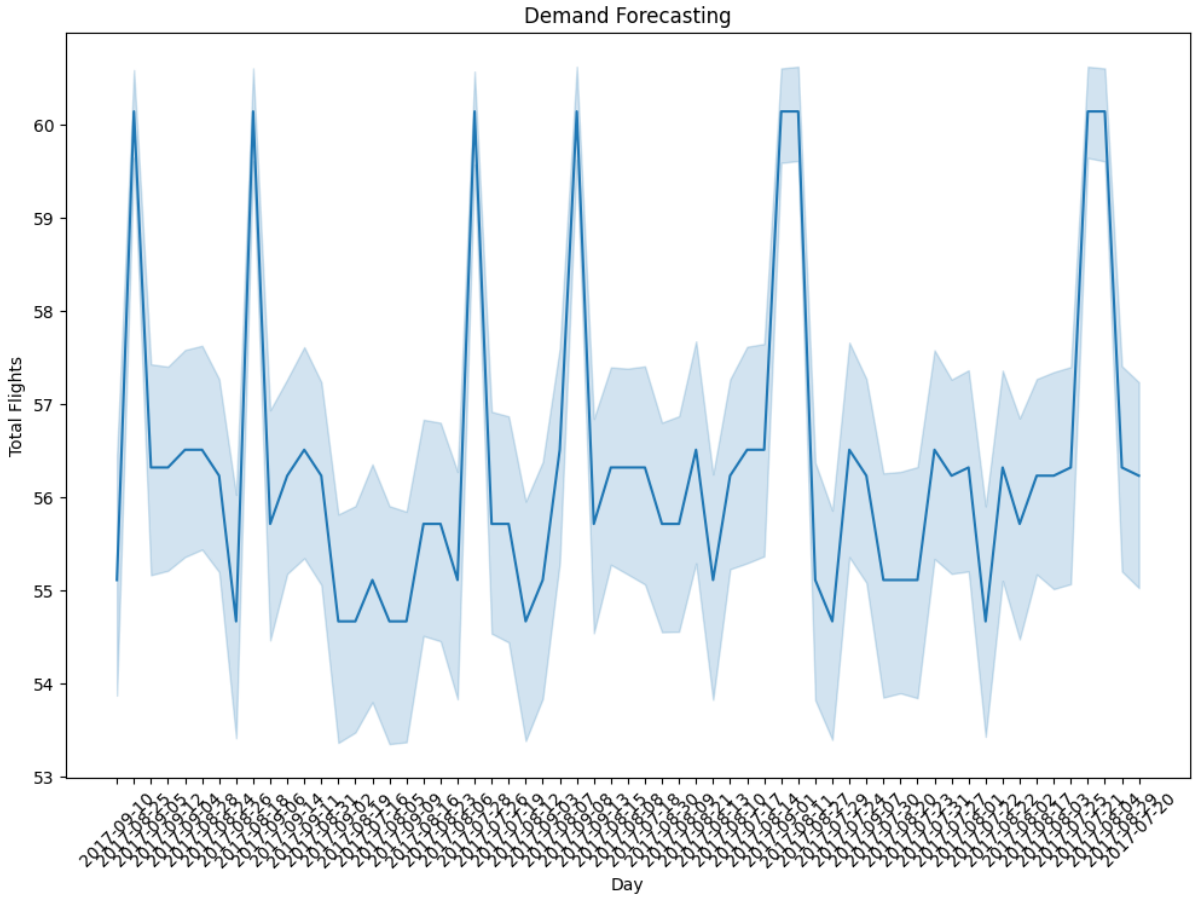


Plotting Demand Forecasting



Conclusion

In conclusion, airlines can maximize profitability by analysing revenue data and making informed decisions. Factors such as total revenue, average revenue per ticket, and average occupancy per aircraft play a crucial role in this analysis. By identifying areas for improvement, adjusting pricing strategies, and optimizing routes, airlines can increase their profitability. However, it's important for airlines to consider consumer happiness and safety while striving for profit. Balancing these factors is key to long-term success in the competitive airline industry. Adopting a data-driven approach to revenue analysis and optimization can lead to sustainable growth and success.