

Flight Performance & Aviation Analytics



PRESENTED BY DISHA SINDHI



Welcome to the Flight Performance

- 01 INTRODUCTION
- 02 Problem statement
- 03 SQL queries
- 04 Power BI for visualization
- 05 Insights
- 06 Conclusion
- 07 Connect with me

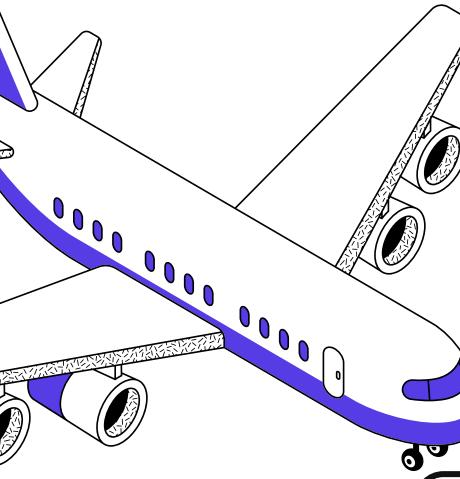
INTRODUCTION

The aviation industry operates in a highly dynamic environment where efficiency, punctuality, and cost management play a crucial role. Flight performance analytics helps airlines, airports, and aviation authorities optimize operations, minimize delays, and enhance customer satisfaction.

This project leverages data analytics and visualization to uncover key insights into flight operations, delays, cancellations, fuel efficiency, and financial impacts.

The aviation industry operates in a complex environment where efficiency, punctuality, and cost management are critical. Flight performance analytics helps airlines, airports, and aviation authorities optimize operations, reduce delays, and improve customer satisfaction.

This project utilizes SQL for querying and analyzing flight data, combined with Power BI for interactive visualizations. By leveraging these tools, we aim to extract insights and present them in an intuitive format for decision-makers.



Problem statement

As a Data Analyst at AeroStat Airlines, a global airline company that operates flights across multiple airports.

The company is facing challenges in flight punctuality, cancellations, route efficiency, and passenger experience.

My role is to analyze the dataset using SQL queries, Power BI/Tableau for visualization and extract meaningful insights for decision making.





Using SQL queries



Q1

Flight Delay Analysis :

- Calculate the average departure and arrival delay for all flights in the last 6 months.

SELECT

ROUND(AVG(DEPARTURE_DELAY), 0) AS DEPARTURE,

ROUND(AVG(ARRIVAL_DELAY), 0) AS ARRIVAL

FROM

flights

WHERE

flights.YEAR = 2015 AND flights.MONTH

Significance of the Query:

- It helps analyze airline punctuality by determining how much, on average, flights are delayed for a specific time period.
- Airlines and airports can use this data to identify trends in flight delays and optimize schedules.
- The query could be improved by specifying a particular month or a range of months to narrow down the analysis.

Q2

Most Frequent Routes :

- Identify the top 10 most popular flight routes based on the total number of flights.

```
SELECT  
    DESTINATION_AIRPORT,  
    AIRLINE,  
    COUNT(FLIGHT_NUMBER) AS flight_no  
FROM  
    flights  
GROUP BY DESTINATION_AIRPORT , AIRLINE  
ORDER BY flight_no DESC  
LIMIT 10;
```

Significance of the Query:

- Helps determine the busiest routes for airlines.
- Shows which airlines dominate specific destinations.
- Assists airlines and airports in optimizing flight scheduling and resource allocation.

Q3

Airline Performance Ranking :

- Rank airlines by their on-time performance (lowest average delay).

```
SELECT
    AIRLINE,
    ROUND(AVG(DEPARTURE_DELAY + ARRIVAL_DELAY), 2) AS Avg_Delay,
    RANK() OVER (ORDER BY AVG(DEPARTURE_DELAY + ARRIVAL_DELAY) ASC) AS On_Time_Rank
FROM Flights
WHERE DEPARTURE_DELAY IS NOT NULL AND ARRIVAL_DELAY IS NOT NULL
GROUP BY AIRLINE
ORDER BY On_Time_Rank;
```

Significance of the Query:

- Airlines with the lowest average delay are ranked highest in on-time performance.
- Helps identify which airlines manage schedules efficiently.
- Shows which airlines are more reliable in terms of minimizing delays.

Q4

Cancellation Trends :

- Find the top reasons for flight cancellations and their frequency.

SELECT

CANCELLATION_REASON, COUNT(*) AS Cancellation_Count

FROM

Flights

WHERE

CANCELLED = 1

GROUP BY CANCELLATION_REASON

ORDER BY Cancellation_Count DESC;

Significance of the Query:

- Helps determine whether weather, airline issues, air traffic control, or other factors contribute most to cancellations.
- Airlines and airports can take preventive measures to reduce common cancellation reasons.
- Frequent cancellations due to specific reasons can help in policy decisions to improve customer satisfaction.

Q5

Airport Congestion Analysis :

- Identify airports with the highest number of flight departures and arrivals.

```
SELECT
    AIRPORT,SUM(Departures) AS Total_Departures,
    SUM(Arrivals) AS Total_Arrivals,
    SUM(Departures + Arrivals) AS Total_Flights
FROM (SELECT ORIGIN_AIRPORT AS AIRPORT,COUNT(*) AS Departures,0 AS Arrivals
      FROM Flights
     GROUP BY ORIGIN_AIRPORT
UNION ALL
SELECT
    DESTINATION_AIRPORT AS AIRPORT,0 AS Departures,COUNT(*) AS Arrivals
      FROM Flights
     GROUP BY DESTINATION_AIRPORT
) AS FlightData
GROUP BY AIRPORT
ORDER BY Total_Flights DESC
LIMIT 10;
```

Significance of the Query:

- Helps determine which airports handle the highest number of flights
- Airports with high traffic may require better infrastructure and resource management.
- Airlines can use this data to optimize flight schedules and route networks.

Q6

Weather-Related Disruptions :

- Analyze how weather impacts delays and cancellations.

```
SELECT  
    COUNT(*) AS Total_Cancellations,  
    COUNT(CASE  
        WHEN CANCELLATION_REASON = 'Weather' THEN 1  
    END) AS Weather_Cancellations,  
    ROUND(100 * COUNT(CASE  
        WHEN CANCELLATION_REASON = 'Weather' THEN 1  
    END) / COUNT(*),  
    2) AS Weather_Cancellation_Percentage  
FROM  
    Flights  
WHERE  
    CANCELLED = 1;
```

Significance of the Query:

- Determines the overall number of canceled flights..
- Identifies how many flights were canceled due to weather conditions.
- Calculates the percentage of cancellations caused by weather, helping airlines and airports assess its impact

Q7

Flight Distance & Duration Trends :

- Calculate the average flight duration for different distance ranges.

```
SELECT
    CASE
        WHEN DISTANCE <= 500 THEN '0-500'
        WHEN DISTANCE <= 1000 THEN '501-1000'
        WHEN DISTANCE <= 2000 THEN '1001-2000'
        WHEN DISTANCE <= 3000 THEN '2001-3000'
        ELSE '3001+'
    END AS Distance_Range,
    COUNT(*) AS Flight_Count,
    ROUND(AVG(AIR_TIME), 2) AS Avg_Flight_Duration
FROM Flights
WHERE AIR_TIME IS NOT NULL
GROUP BY Distance_Range
ORDER BY MIN(DISTANCE);
```

Significance of the Query:

- Helps analyze how many flights fall into different distance categories.
- Useful for estimating expected travel times for various flight distances.
- Airlines can optimize flight schedules based on typical durations for different distances.

Q8

Day-of-Week Flight Performance :

- Find which day of the week has the highest on-time flight performance.

SELECT

Day_OF_WEEK,

AVG(DEPARTURE_DELAY + ARRIVAL_DELAY) AS avg_Delay

From flights

group by Day_OF_WEEK

order by avg_Delay ASC

Limit 1;

Significance of the Query:

- Helps passengers choose the best day for travel with minimal delays.e.
- Airlines can use this data to optimize scheduling and reduce congestion on high-delay days.
- Airports and airlines can analyze trends and implement strategies to improve punctuality on other days.

Q9

Seasonality in Air Traffic :

- Identify which months have the highest number of flights and delays.

SELECT

MONTH,

COUNT(*) AS Total_Flights,

avg(Departure_Delay + Arrival_Delay) as Avg_delay

FROM Flights

WHERE CANCELLED = 0

GROUP BY MONTH

ORDER BY Total_Flights DESC, Avg_delay DESC;

Significance of the Query:

- Helps determine which months experience the highest flight traffic.
- Provides insights into how delays vary across different months..
- Airlines and airports can use this to allocate resources efficiently during high-traffic periods.

Q10

Passenger Connectivity & Hub Efficiency :

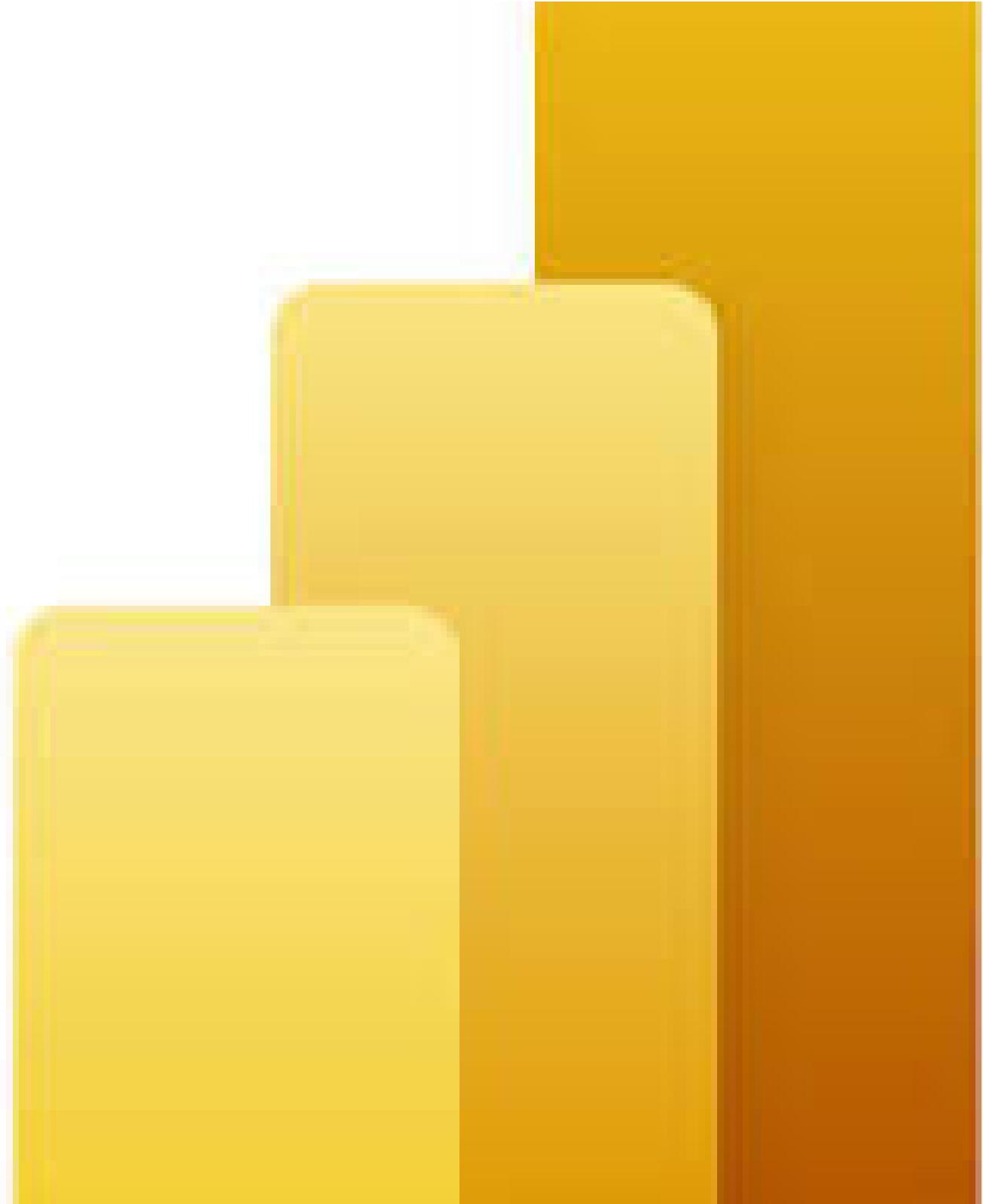
- Identify which airports act as the largest hubs based on the number of connecting flights.

```
SELECT  
    ORIGIN_AIRPORT AS Airport,  
    COUNT(*) AS Departing_Flights,  
    RANK() OVER (ORDER BY COUNT(*) DESC) AS Hub_Rank  
FROM Flights  
WHERE CANCELLED = 0  
GROUP BY ORIGIN_AIRPORT  
ORDER BY Departing_Flights DESC  
LIMIT 10;
```

Significance of the Query:

- Helps determine which airports handle the highest number of departures.
- The RANK() function assigns a ranking based on flight volume, making it easier to compare airports.
- Useful for airlines and airport authorities to optimize resources and manage congestion.

Using Power BI for visualization



Flight Operations Overview

1M

Total Flights

59.55

On-Time Performance

137

Avg Flight Duration

11.33

Avg Departure Delay

7.61

Avg Arrival Delay

ARRIVAL_DELAY

All

FLIGHT_NUMBER

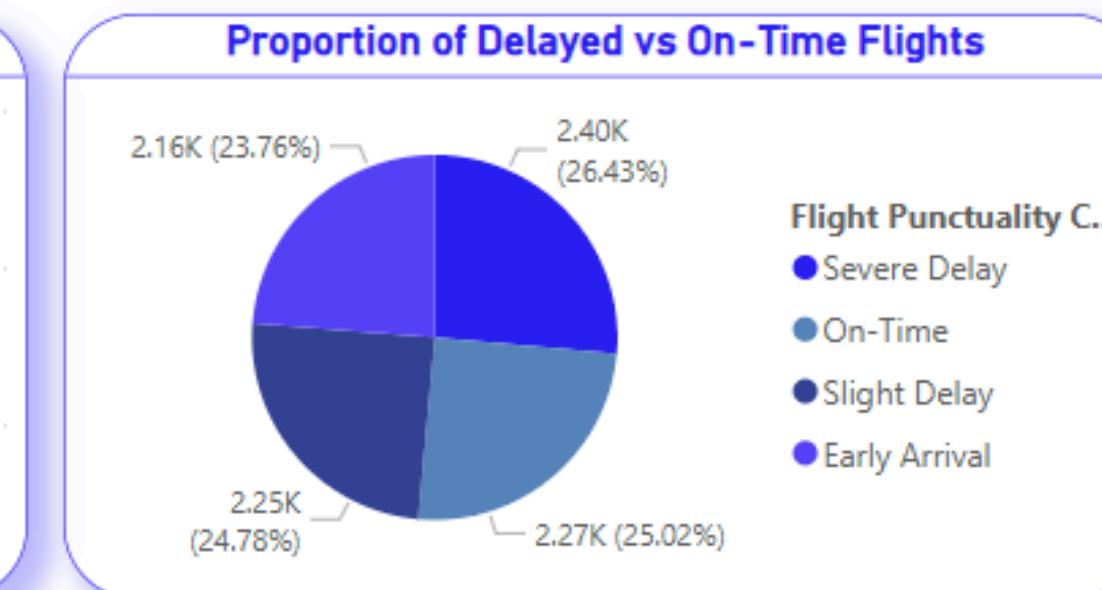
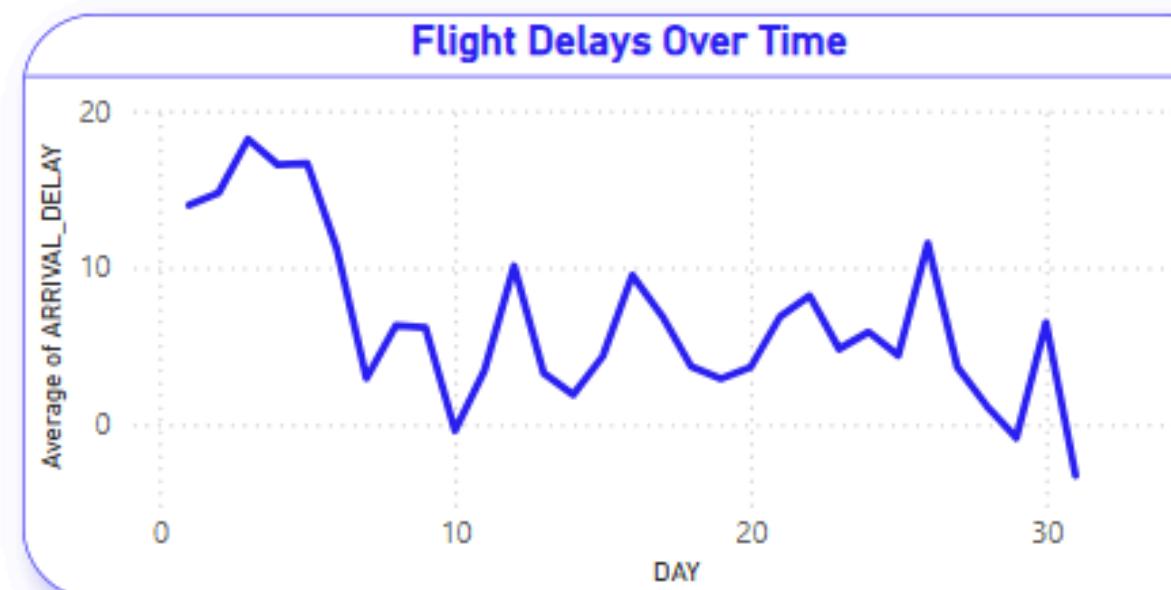
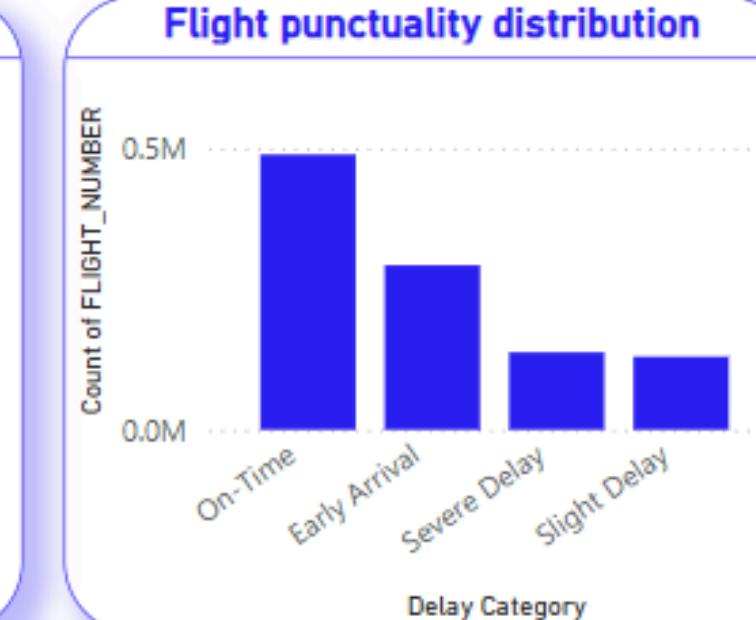
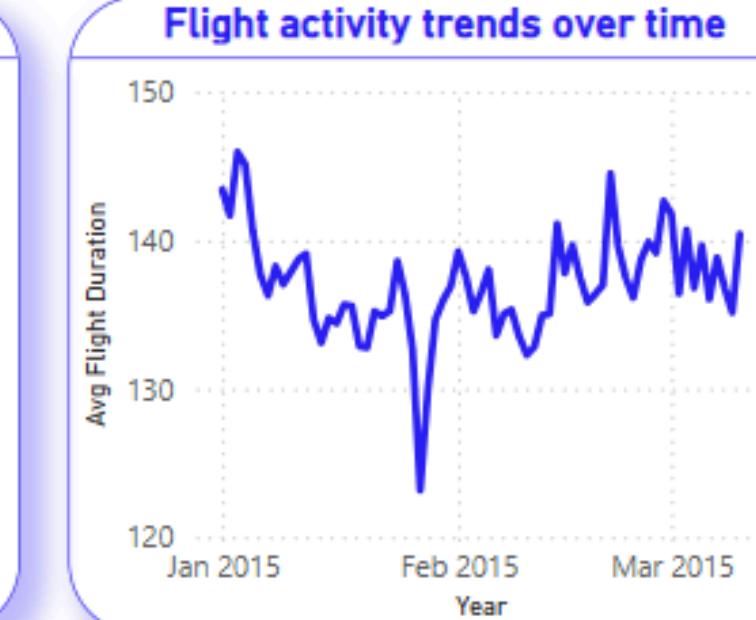
1 9794

DEPARTURE_DELAY

All

DAY

All



Airline Performance Comparison

1M

Total Flights

3.86

Cancellation Rate

7

Average Delay

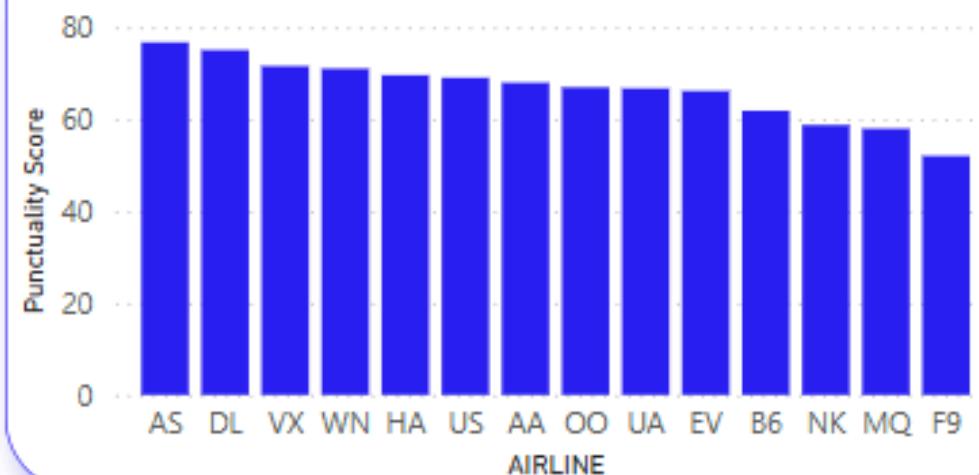
68.27

Punctuality Score

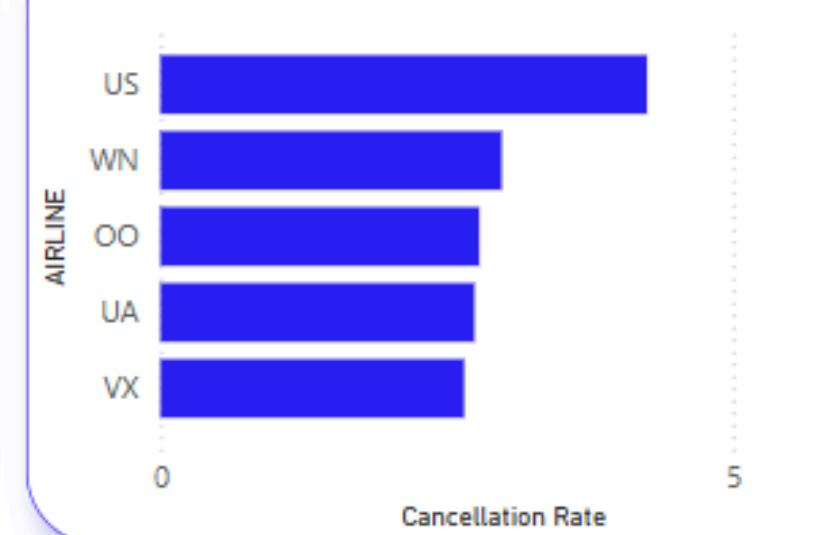
7.61

Avg Arrival Delay

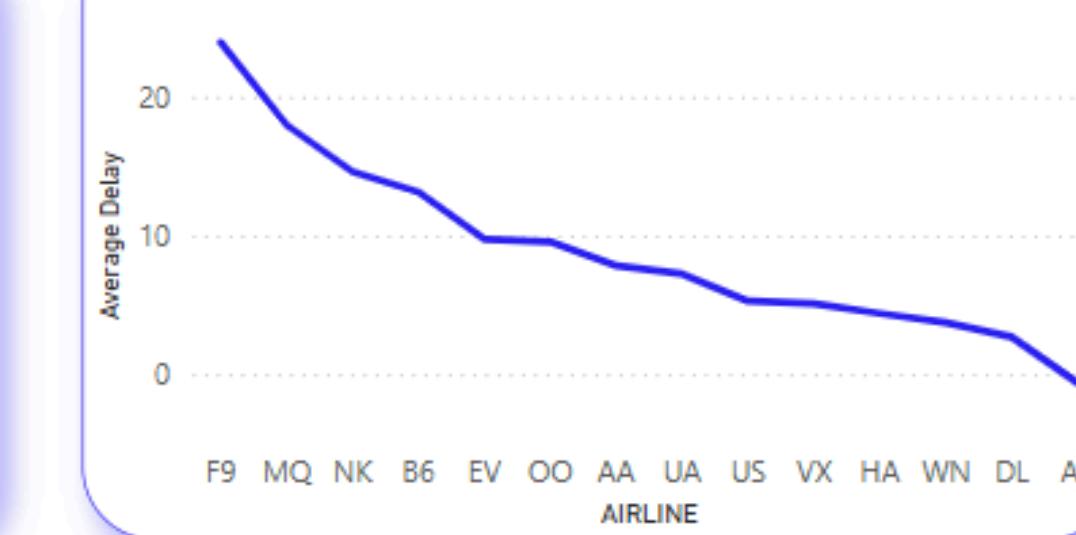
Punctuality Score by AIRLINE



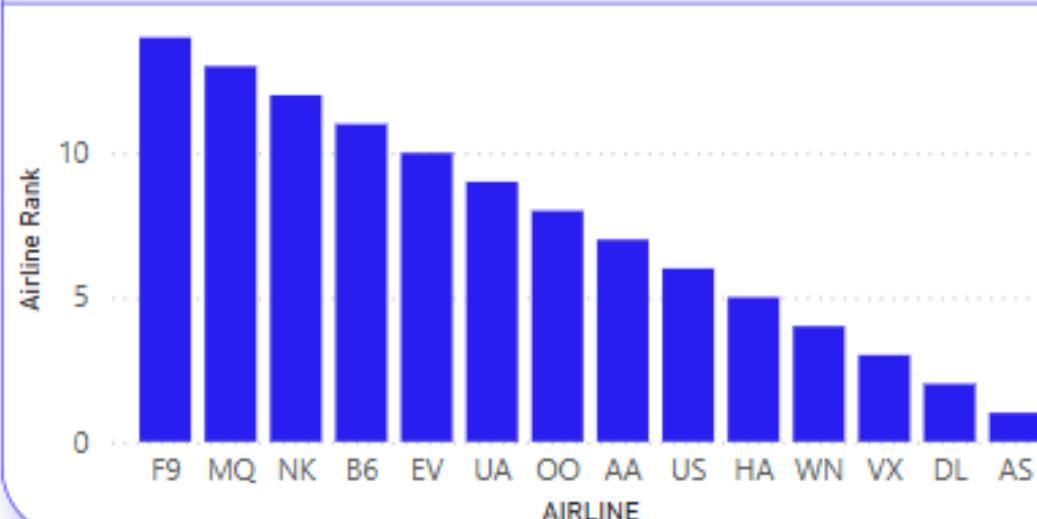
Cancellation Rate by AIRLINE



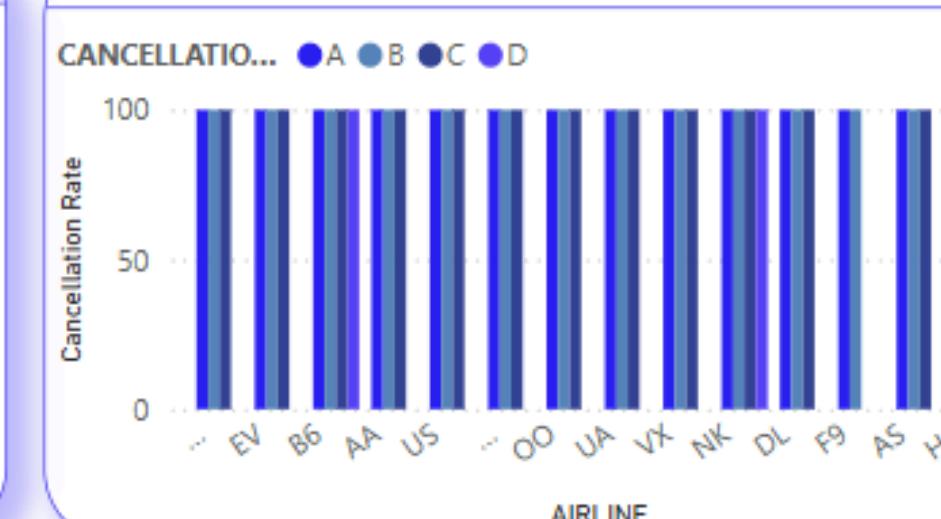
Average Delay by AIRLINE



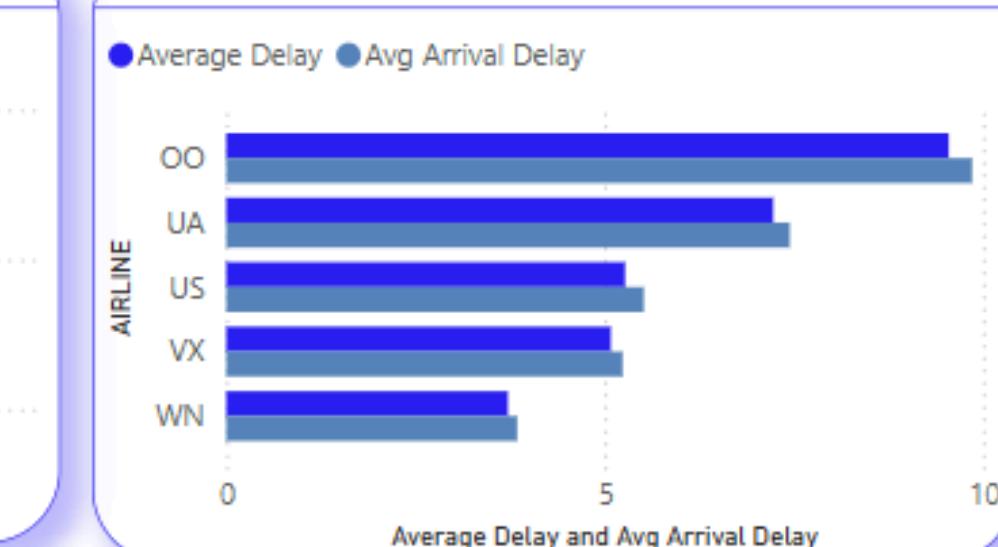
Ranking of airlines based on punctuality



Airline-specific cancellation patterns



Delay trends across airlines



Route & Airport Analytics

19

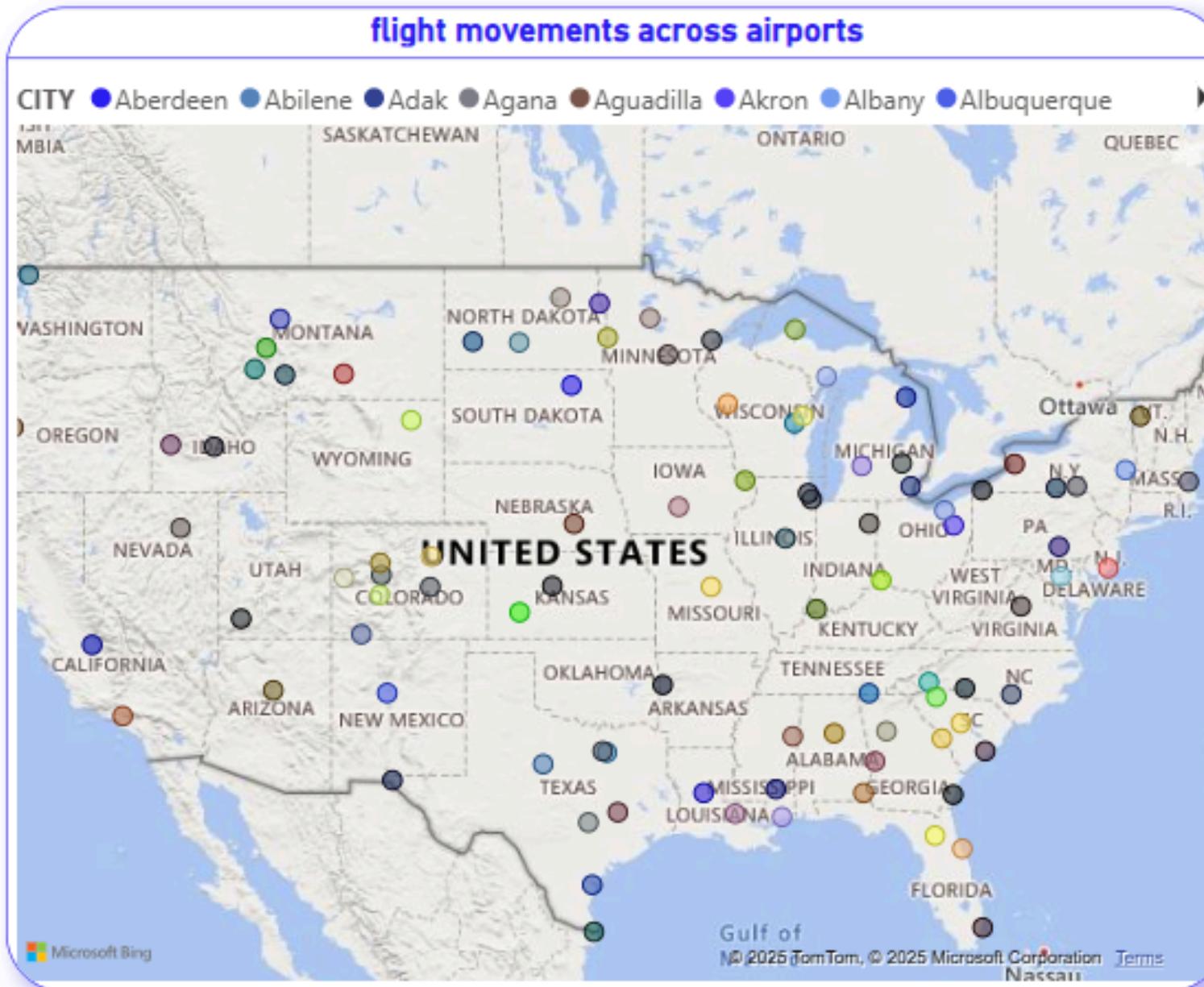
Total Delay

18.21

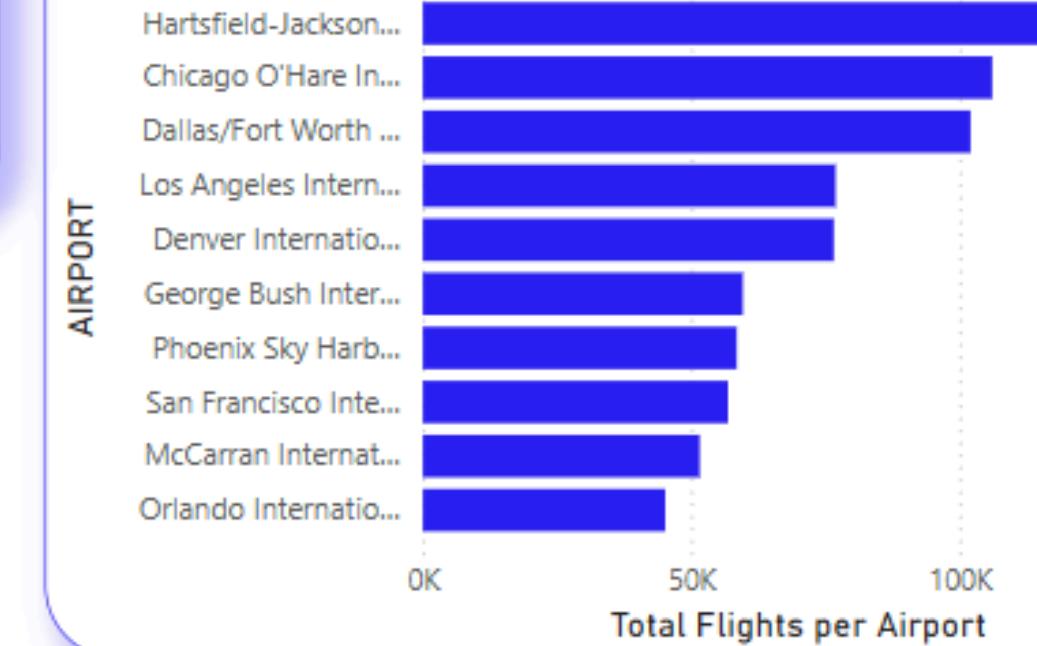
Airport Congestion Index

2M

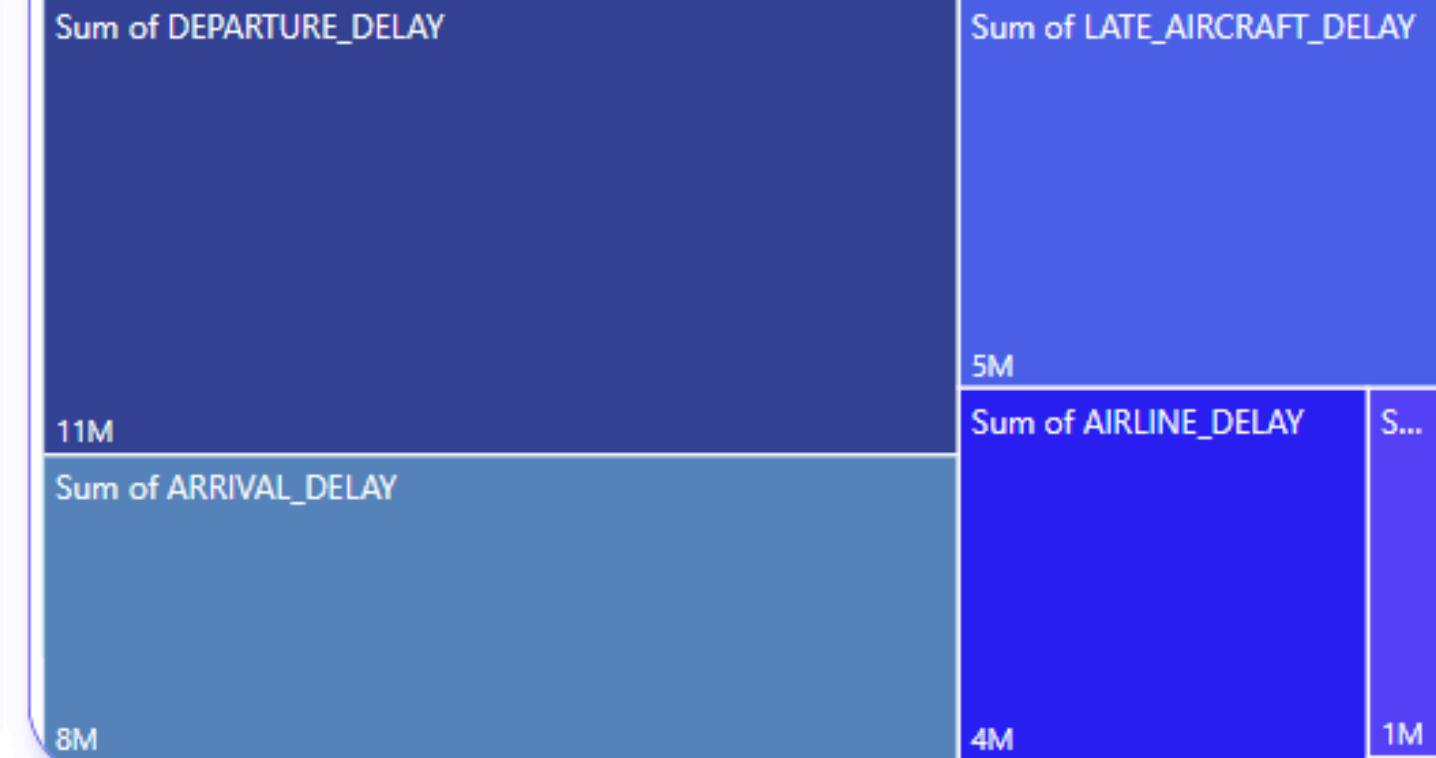
Total Flights per Airport



Top 10 Busiest Airports



Delay Trend



Flight Cancellation & Delay Patterns

3.86

Cancellation Rate

3.55

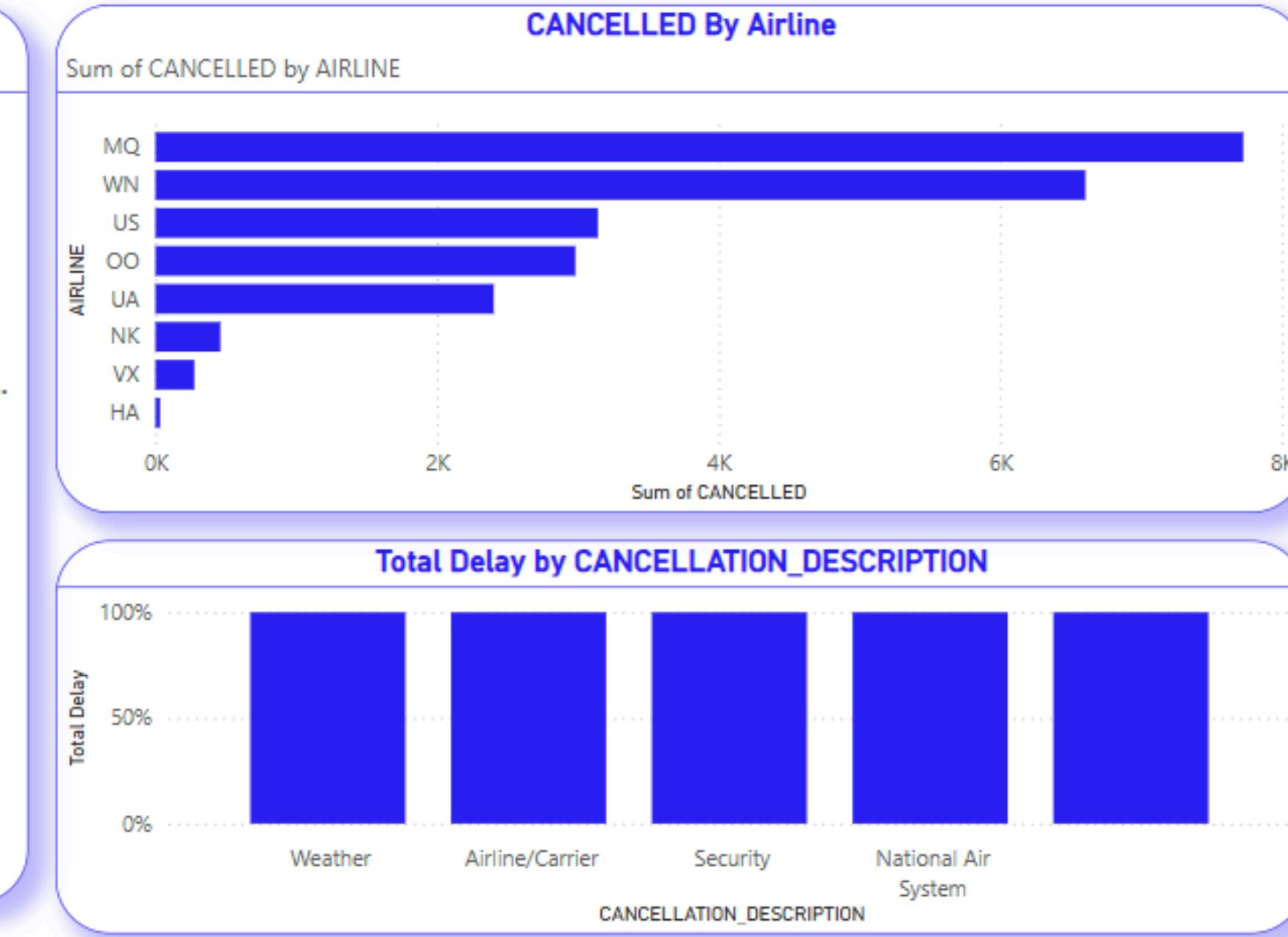
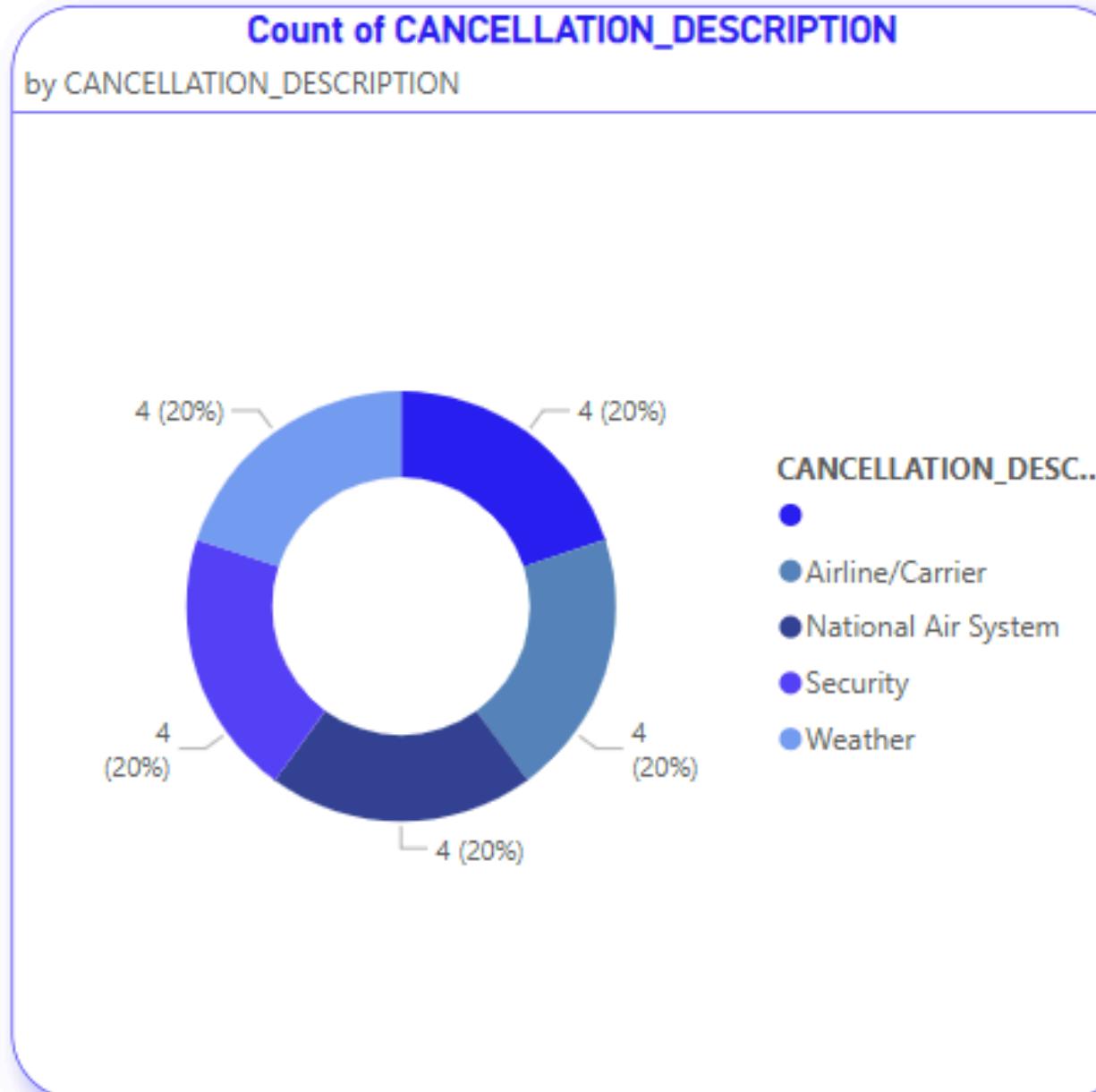
Weather_Delay_Impact

19.26%

Late_Aircraft_Contribution

220K

Delay_Contribution



Passenger Experience & Service Quality

91.72

Customer Satisfaction Score

9%

Missed Connections Rate

33.1%

Delay Recovery Effectiveness

1049K

TOTAL_CANCELLED

CANCELLATION_DES...

All

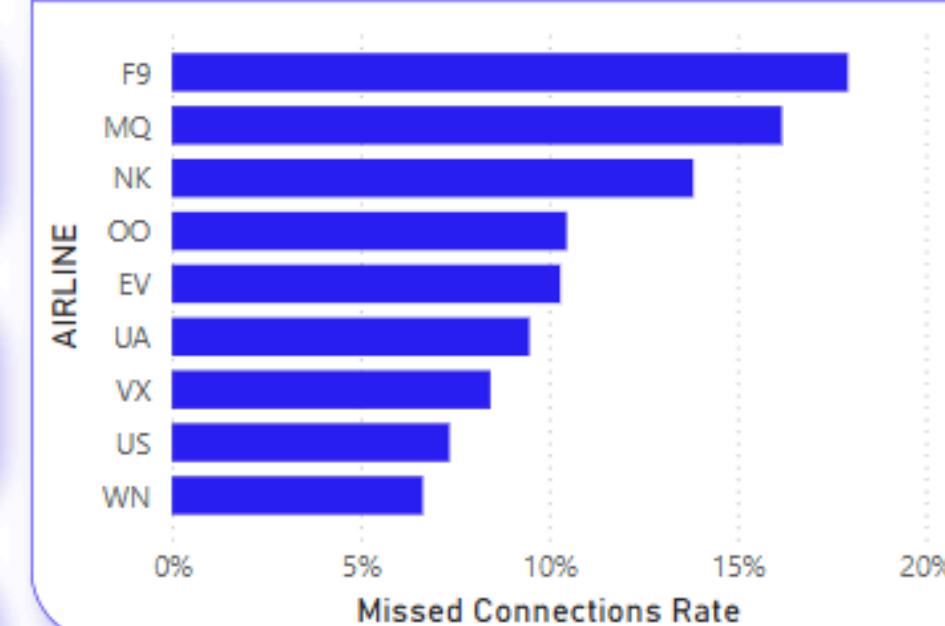
CANCELLED

All

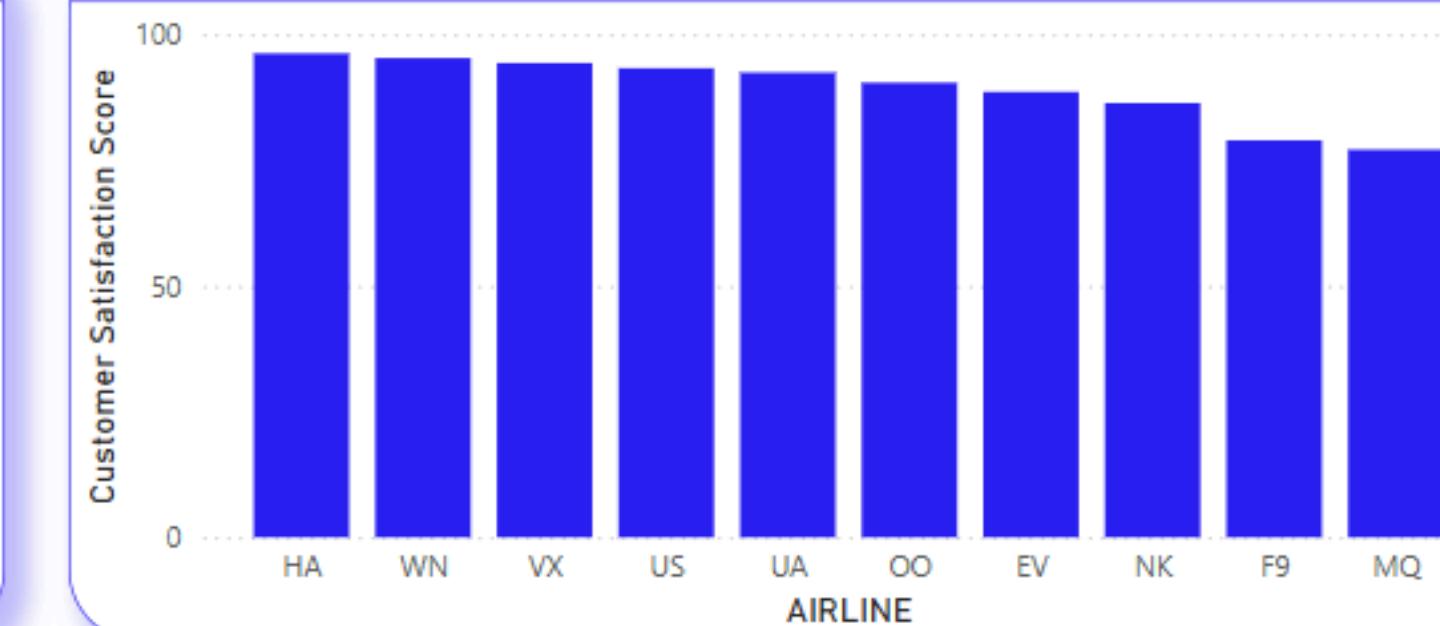
AIRLINE

All

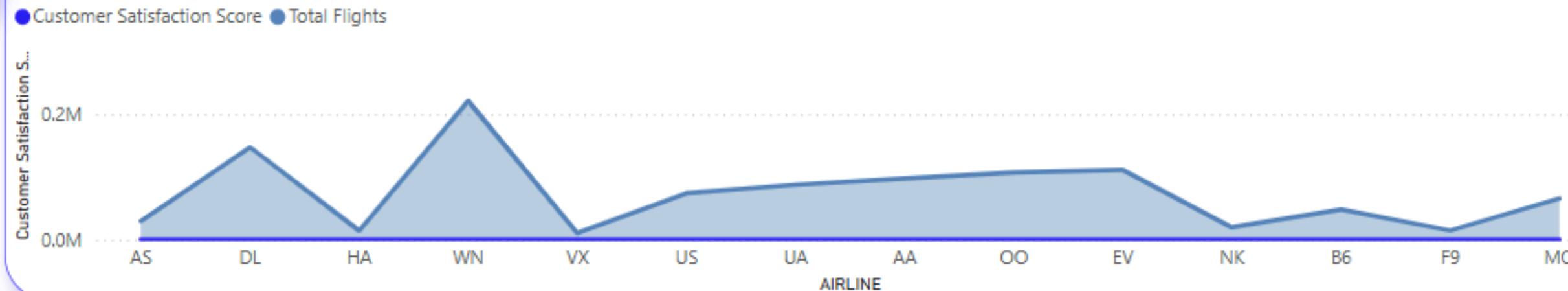
Missed Connections Rate by AIRLINE



Customer Satisfaction Score by AIRLINE



Customer Satisfaction Score and Total Flights by AIRLINE





Insights

for SQL analysis and Dashboard



SQL analysis

1

Flight Delay Analysis :

- On average, flights tend to leave 11 minutes late but make up some time in the air, arriving with an 8-minute delay.
- Possible reasons: Efficient air traffic control, favorable weather conditions, or schedule padding by airlines.

2

Most Frequent Routes :

- Delta Airlines (DL) operates the most flights to ATL (42,289 flights).
- This confirms Atlanta's role as a major hub, as it houses Delta's headquarters and a significant hub at Hartsfield-Jackson Atlanta International Airport one of the world's busiest airports.

3

Airline Performance Ranking :

- Alaska Airlines (AS) leads with an average delay of only 2.2 minutes, making it the most punctual airline in the dataset.
- Hawaiian Airlines (HA) follows closely, with an average delay of 5.94 minutes.
- Delta Airlines (DL), a major carrier, ranks 3rd, indicating strong operational efficiency.

4

Cancellation Trends :

- Cancellation Reason 'B' is the most common, accounting for 28,260 cancellations.
- Cancellation Reason 'A' follows with 6,974 cancellations.
- Cancellation Reason 'C' has 5,291 cancellations, while Reason 'D' is the least frequent with just 2 cancellations.

5

Airport Congestion Analysis :

- Hartsfield–Jackson Atlanta International Airport (ATL) is the busiest with 133,340 flights.
- Chicago O'Hare International Airport (ORD) and Dallas/Fort Worth International Airport (DFW) follow with 106,021 and 101,970 flights, respectively.
- The Top 5 busiest airports are ATL, ORD, DFW, LAX, and DEN.

6

Weather-Related Disruptions :

- Total Cancellations: 40,527 flights were canceled.
- Data might be incomplete or missing values for weather-related cancellations.

7

Flight Distance & Duration Trends :

- The majority of flights fall within the 0-500 miles range (375,982 flights) and 501-1000 miles range (349,159 flights).
- Short-haul flights (0-1000 miles) account for a significant portion of total air traffic.

8

Day-of-Week Flight Performance :

- Day 3 (Tuesday) has the lowest average delay of 12.35 minutes.
- This suggests fewer disruptions on Tuesdays compared to other days.

9

Seasonality in Air Traffic :

- January (Month 1) has the highest flight volume (457,986 flights) with an average delay of 15.50 mins.
- February (Month 2) follows with 408,674 flights and an average delay of 20.09 mins.
- March (Month 3) has 141,388 flights but the highest average delay (26.09 mins).
- Insight: Flight delays tend to increase as months progress, possibly due to seasonal trends or operational factors.

10

Passenger Connectivity & Hub Efficiency :

- Atlanta (ATL) is the busiest airport with 65,186 departing flights.
- Chicago O'Hare (ORD) and Dallas/Fort Worth (DFW) follow with 49,720 and 47,355 flights, respectively.
- Observations: Major hub airports play a critical role in national connectivity, with ATL leading in departures.

Flight Operations Overview

1. Overall Flight Performance

- Total Flights: 1 Million flights were recorded.
- On-Time Performance: 59.55% of flights were on time.
- Average Flight Duration: 137 minutes.
- Average Departure Delay: 11.33 minutes.
- Average Arrival Delay: 7.61 minutes.

2. Airline On-Time Performance

- Airlines like VX(62.83), WN(62.04) and US(59.84) have the best on-time performance.
- Other airlines show lower punctuality rates.

3. Flight Activity Trends Over Time

- Flight durations fluctuate, with some days showing significantly lower averages.
- There are visible spikes and drops in flight duration.
- Lower averages = 123
- Higher averages = 143

4. Flight Punctuality Distribution

- The majority of flights are on time.
- A notable portion of flights experience early arrivals.
- Severe delays occur but are relatively less frequent.

5. Flight Delays Over Time

- Some days have significantly higher delays than others.
- The pattern suggests fluctuations rather than a constant increase or decrease.

6. Proportion of Delayed vs. On-Time Flights

- On-Time Flights are the largest proportion.
- Slight Delays and Severe Delays account for a smaller portion.
- Early Arrivals also make up a significant share.

Airline Performance Comparison

1. Key Insights

- Total Flights: 1 Million.
- Cancellation Rate: 3.86%.
- Average Delay: 7 minutes.
- Punctuality Score: 68.27.
- Average Arrival Delay: 7.61 minutes.

2. Punctuality Score by Airline

- Top performers with the highest punctuality scores include AS(76.71), DL(75.03), VX(71.54) WN(71.00) and HA(69.97).
- Lower-ranked airlines F9(52.09), MQ(57.94), NK(58.72) have significantly worse punctuality.

3. Cancellation Rate by Airline

- Highest cancellation rates are observed for US(4.29)
- VX(2.65) has the lowest cancellation rate.

4. Average Delay by Airline

- F9(24) and MQ(18) experience the highest average delays.
- AS(-1) and DL(3) have the lowest delays.

5. Ranking of Airlines Based on Punctuality

- F9(14) and MQ(13) rank the lowest, meaning they have the most delays.
- AS(1) and DL(2) rank the highest, showing their efficiency in maintaining flight schedules.

6. Airline-Specific Cancellation Patterns

- Cancellation rates appear uniform across most airlines.
- Certain airlines experience more frequent cancellations, possibly due to operational challenges or external factors.

Route & Airport Analytics

1. Key Insights

- Total Delay: 19 likely referring to a delay index or count of delay categories
- Airport Congestion Index: 18.21, indicating a moderate congestion level.
- Total Flights per Airport: 2M, suggesting high air traffic volume.

2. Busiest Airports

- Hartsfield-Jackson (Atlanta) – The busiest airport.
- Chicago O'Hare, Dallas/Fort Worth, and Los Angeles International also handle significant traffic.

3. Flight Movements Across Airports

- The map visualization shows flight activity across multiple U.S. airports.
- Different airports are represented with color-coded markers.

4. Delay Trends

- Departure Delays: Highest among delay categories (11M instances).
- Arrival Delays: Second highest (8M instances).
- Late Aircraft Delay & Airline Delay: Both contribute significantly (5M & 4M, respectively)

Flight Cancellation & Delay Par

1. Cancellation and Delay Overview

- Cancellation Rate: 3.86% – indicating a relatively low cancellation frequency.
- Weather Delay Impact: 3.55 – suggesting weather-related issues are a notable factor.
- Late Aircraft Contribution: 19.26% – meaning almost 1/5 of delays are due to late aircraft arrivals.
- Delay Contribution: 220K – total delay impact in measurable units.

2. Cancellation Breakdown

- The cancellation reasons are evenly distributed among:
- Weather
- Airline/Carrier Issues
- National Air System
- Security Issues
- Each contributing 20% to total cancellations.

3. Cancellations by Airline

- Airlines with the highest cancellations:
- MQ (Top Contributor)
- WN (Second Highest)
- US, OO, UA also have significant cancellation counts.
- Smaller airlines (VX, HA) have minimal cancellations.

4. Total Delay Contribution by Cancellation Type

- All cancellation types (weather, airline, security, national air system) contribute equally to total delay.
- No single reason dominates delay patterns, suggesting a well-distributed impact

Passenger Experience & Service Quality

1. Customer Satisfaction & Flight Performance

- Customer Satisfaction Score: 91.72, indicating strong overall passenger satisfaction.
- Missed Connections Rate: 9%, showing a moderate level of passengers missing their connecting flights.
- Delay Recovery Effectiveness: 33.1%, meaning only a third of delays are effectively managed.
- Total Cancellations: 1.049 million, indicating a substantial number of flight cancellations.

2. Missed Connections Rate by Airline

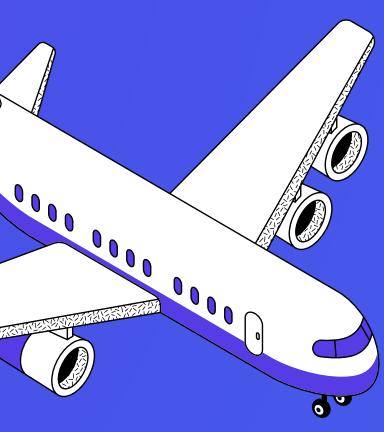
- Top airlines with the highest missed connections rate:
- F9 (Frontier) – Highest
- MQ, NK, and OO also have high missed connection rates.
- WN (Southwest) – Lowest missed connections rate.

3. Customer Satisfaction by Airline

- Highest Satisfaction Airlines:
HA (Hawaiian), WN (Southwest), vx (Virgin America)
- Lowest Satisfaction Airlines:
F9 (Frontier) and MQ (Envoy Air)

4. Customer Satisfaction vs. Total Flights

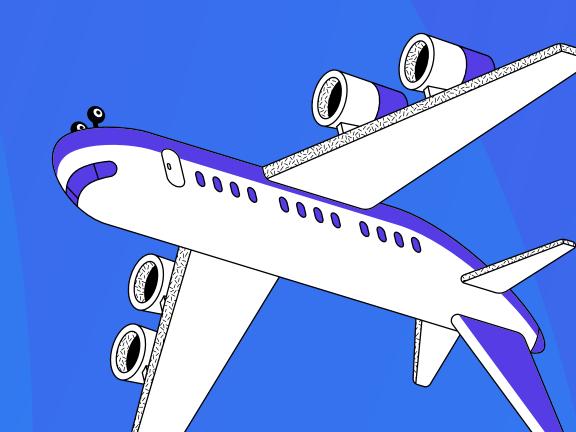
- WN (Southwest) handles a high number of flights while maintaining high satisfaction.
- HA (Hawaiian) has fewer flights but leads in satisfaction.
- F9 and MQ show lower satisfaction, potentially due to high missed connections and cancellations.

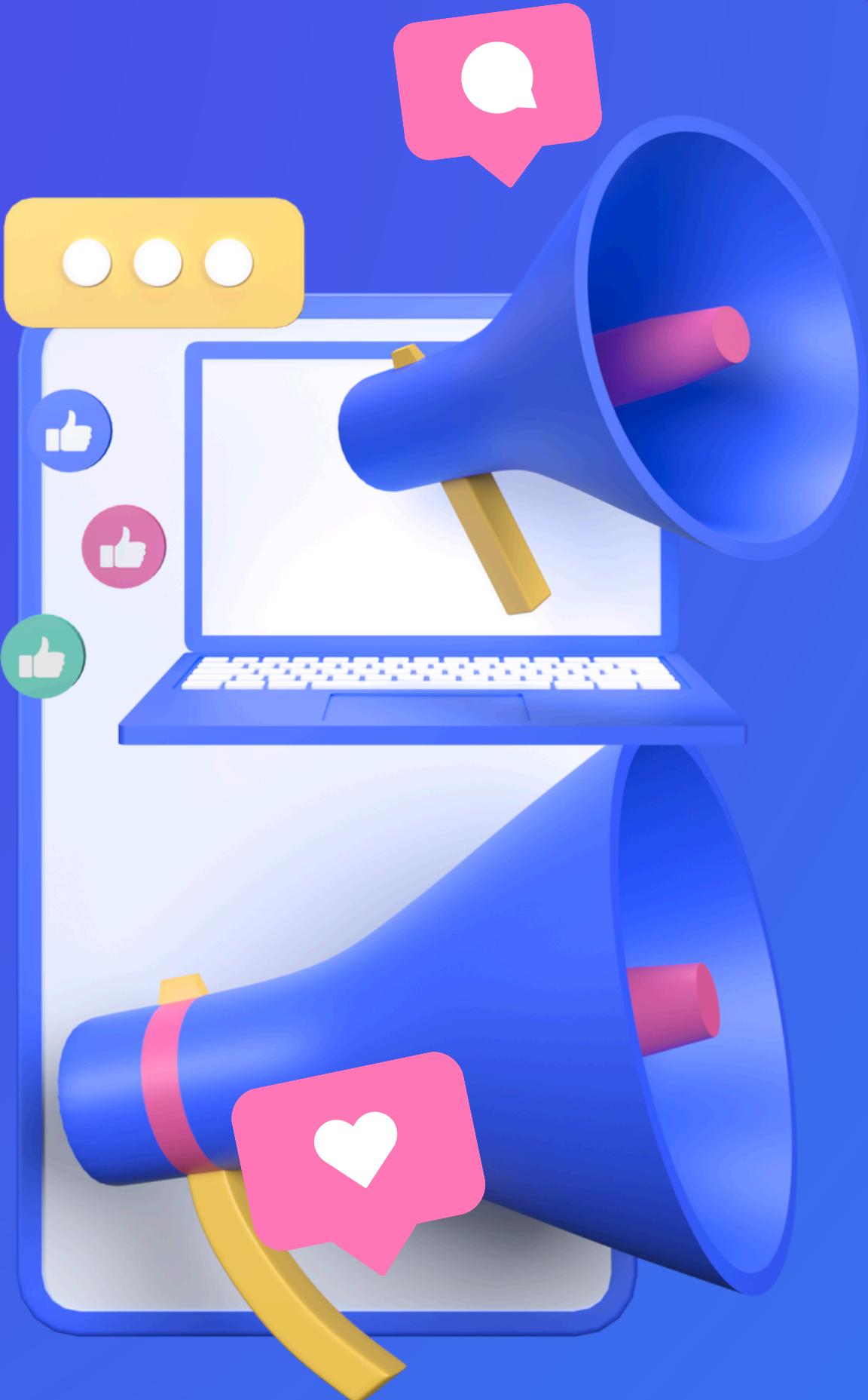


Conclusion

AeroStat Airlines faces challenges in flight punctuality, cancellations, and passenger experience. The analysis has identified key bottlenecks, including weather disruptions, late aircraft delays, high congestion at certain airports, and airline-specific inefficiencies. Addressing these issues through data-driven decision-making, route optimization, better scheduling, and improved customer service strategies will help enhance operational efficiency, reduce costs, and improve overall airline performance.

AeroStat Airlines needs to adopt data-driven decision-making to enhance on-time performance, passenger experience, and operational efficiency. By implementing advanced analytics, predictive modeling, and process improvements, the airline can reduce delays, improve customer satisfaction, and optimize financial performance, ensuring a competitive advantage in the aviation industry.





Thank you
Connect with me

[Gmail](#)

[LinkedIn](#)

[Github](#)

