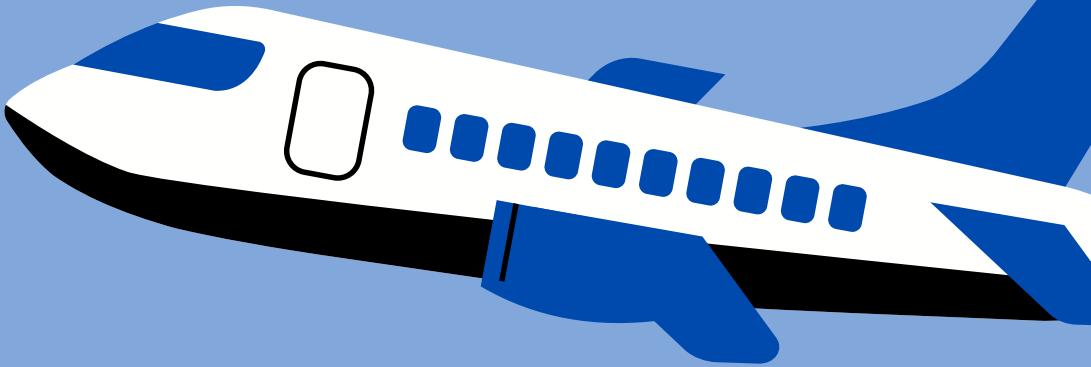




Aviation Analysis for AeroStat Airlines Capstone Project

MYSQL | POWER BI | DAX

Created by: Poornima Saxena



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ABOUT US

- The invention of the aerostat in **France** in **1783** was a major event in the history of the conquest of the air.
- An **aerostat is a machine** that can rise into the sky thanks to an envelope inflated with a gas that is lighter than air. However, the tremendous enthusiasm prompted by this machine on a European scale, especially when it came to flight experiments conducted **before giant crowds in many cities**, makes it a key moment in the history of the relationship between **society** and **modernity**.
- Never before had a technological or scientific invention had such a considerable impact on the public, since the aerostat for the first time coupled the resounding **triumph of human progress** with **collective experience** in the form of **spectacle**.



PHASE 1:

SQL QUERIES

USING MYSQL





SECTION : 1

FLIGHT PERFORMANCE & DELAYS



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

```
SELECT
    AVG(DEPARTURE_DELAY) AS avg_departure_delay,
    AVG(ARRIVAL_DELAY) AS avg_arrival_delay
FROM
    flights
WHERE
    YEAR = 2015 AND MONTH >= 7;
```

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

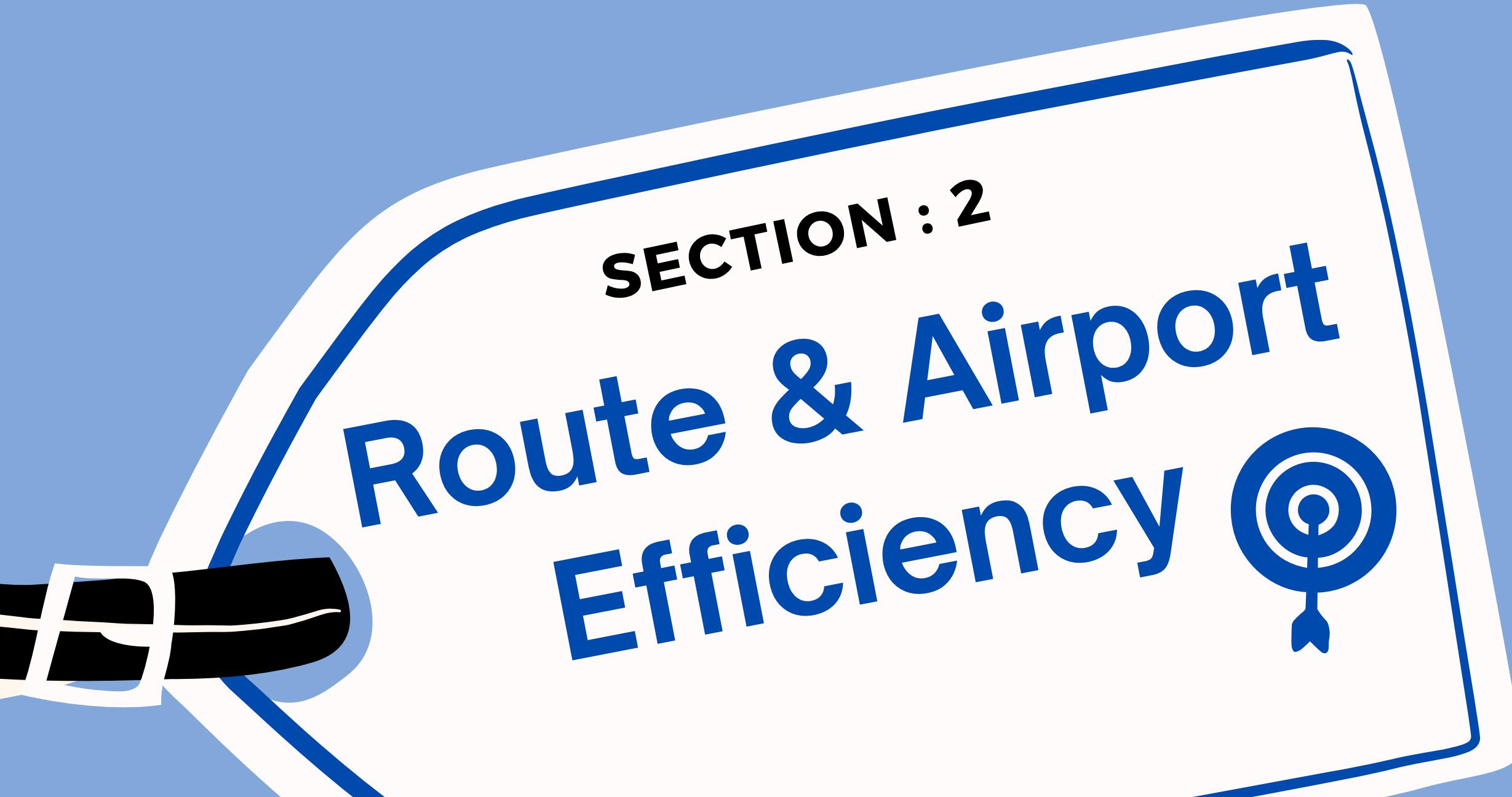
```
SELECT
    AIRLINE,
    AVG(ARRIVAL_DELAY) AS avg_arrival_delay
FROM flights
GROUP BY AIRLINE
ORDER BY avg_arrival_delay ASC;
```

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

```
SELECT  
    DAY_OF_WEEK, AVG(ARRIVAL_DELAY) AS avg_delay  
FROM  
    flights  
GROUP BY DAY_OF_WEEK  
ORDER BY avg_delay ASC;
```

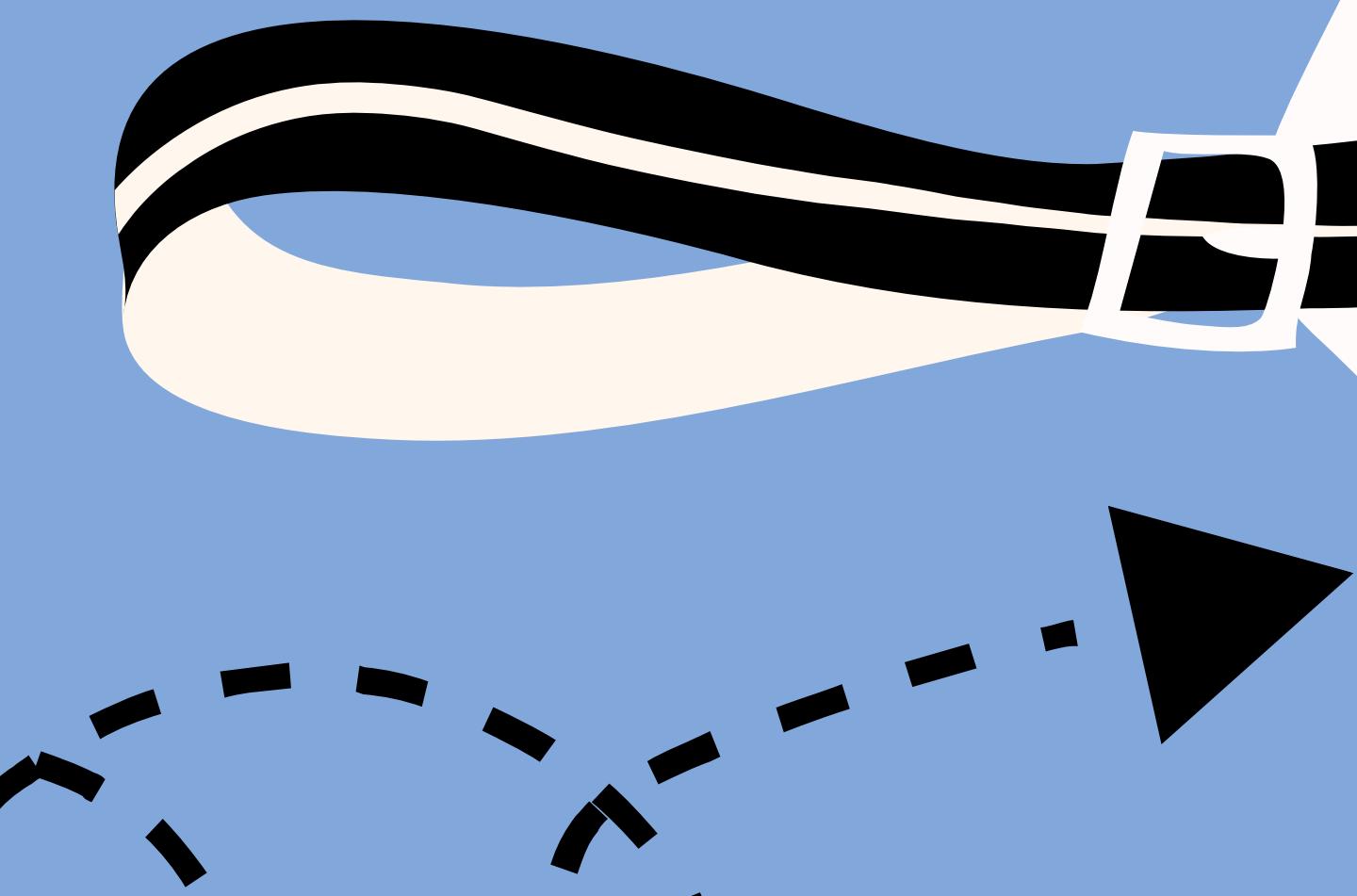
Identify months with the highest flights and delays.

```
SELECT  
    MONTH,  
    COUNT(*) AS total_flights,  
    AVG(ARRIVAL_DELAY) AS avg_delay  
FROM  
    flights  
GROUP BY MONTH  
ORDER BY total_flights DESC;
```



SECTION : 2

Route & Airport Efficiency



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

```
SELECT  
    ORIGIN_AIRPORT,  
    DESTINATION_AIRPORT,  
    COUNT(*) AS flight_count  
FROM  
    flights  
GROUP BY ORIGIN_AIRPORT , DESTINATION_AIRPORT  
ORDER BY flight_count DESC  
LIMIT 10;
```

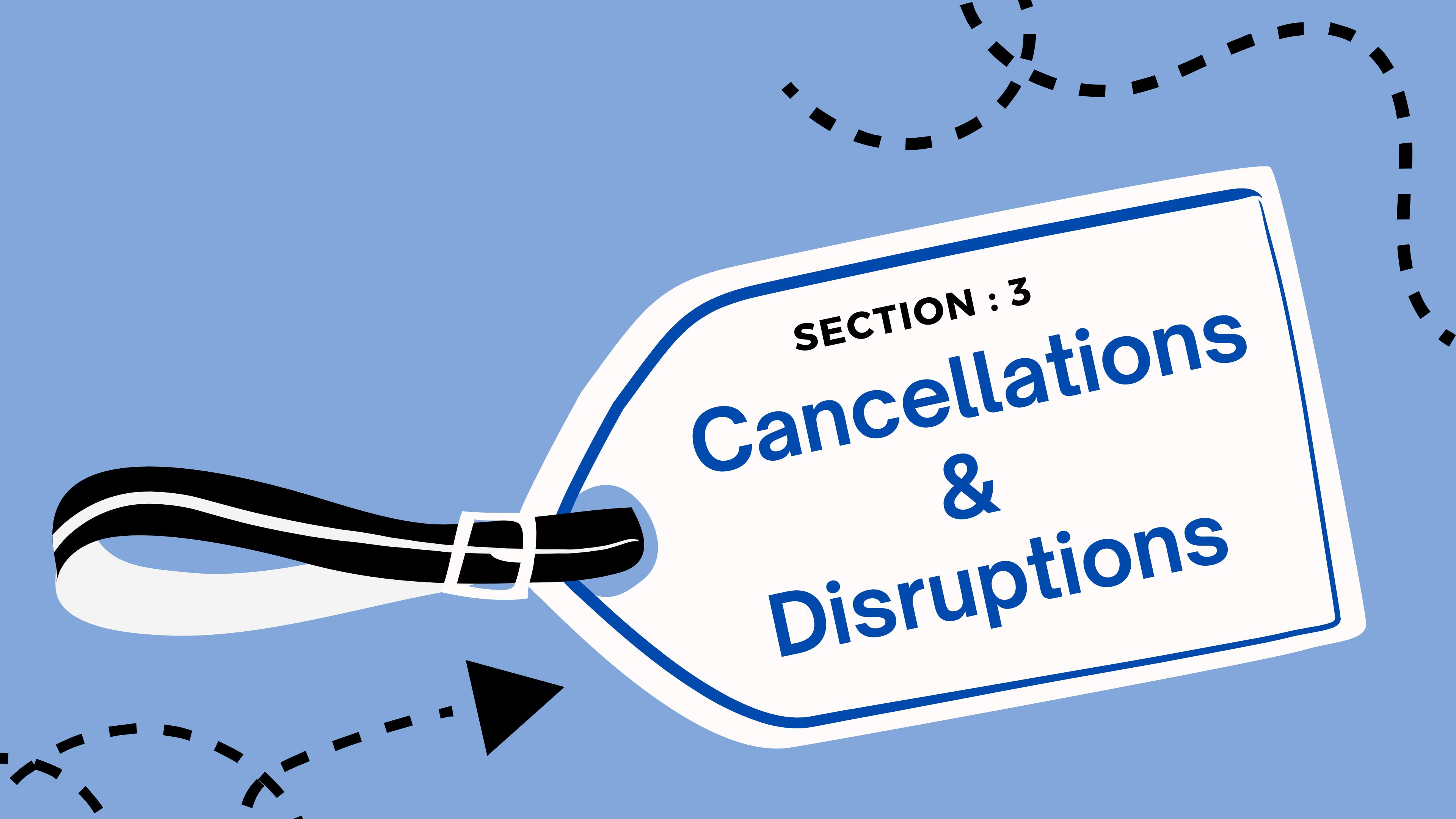
Identify airports with the highest number of flight departures and arrivals.

```
SELECT  
    ORIGIN_AIRPORT AS AIRPORT,  
    COUNT(*) AS departures  
FROM  
    flights  
GROUP BY ORIGIN_AIRPORT  
ORDER BY departures DESC  
LIMIT 10;
```

```
SELECT  
    DESTINATION_AIRPORT AS AIRPORT,  
    COUNT(*) AS arrivals  
FROM  
    flights  
GROUP BY DESTINATION_AIRPORT  
ORDER BY arrivals DESC  
LIMIT 10;
```

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

```
SELECT  
    ORIGIN_AIRPORT AS hub_airport,  
    COUNT(*) AS connecting_flights  
FROM flights  
GROUP BY ORIGIN_AIRPORT  
ORDER BY connecting_flights DESC  
LIMIT 10;
```



SECTION : 3

Cancellations & Disruptions

Find the top reasons for flight cancellations and their frequency.

```
SELECT  
    CANCELLATION_REASON,  
    COUNT(*) AS cancellation_count  
FROM flights  
WHERE CANCELLED = TRUE  
GROUP BY CANCELLATION_REASON  
ORDER BY cancellation_count DESC;
```

Analyze how weather impacts delays and cancellations.

```
SELECT
    SUM(WEATHER_DELAY) AS total_weather_delay,
    COUNT(*) AS affected_flights
FROM
    flights
WHERE
    WEATHER_DELAY > 0;
```



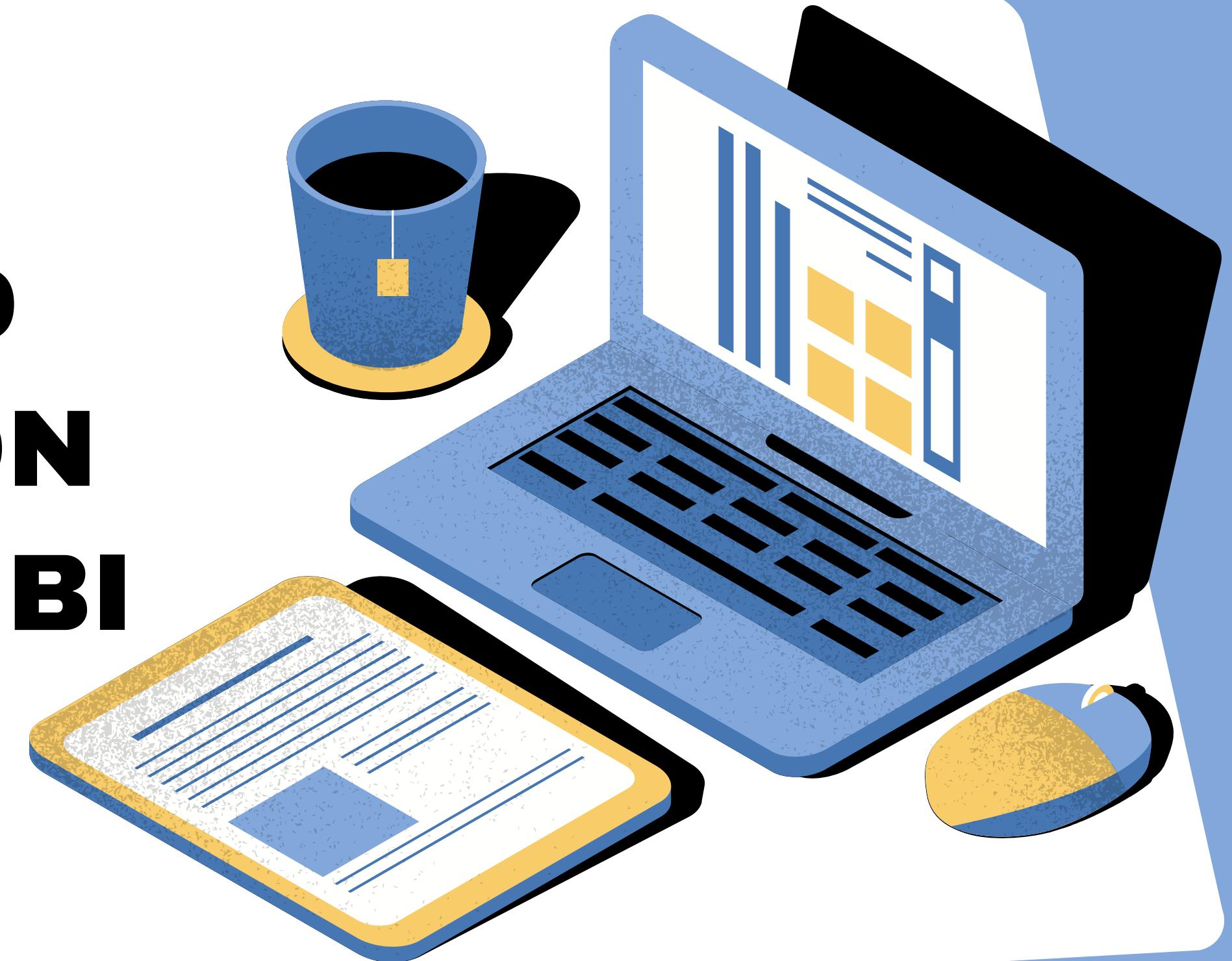
SECTION : 4

**FLIGHT
PERFORMANCES
AND TRENDS**

Calculate the average flight duration for different distance ranges.

```
SELECT
    CASE
        WHEN DISTANCE < 500 THEN 'Short-haul'
        WHEN DISTANCE BETWEEN 500 AND 1500 THEN 'Medium-haul'
        ELSE 'Long-haul'
    END AS distance_category,
    AVG(ELAPSED_TIME) AS avg_duration
FROM
    flights
GROUP BY distance_category;
```

PART 2: DASHBOARD VISUALIZATION USING POWER BI





Flight Operations Overview

Airline

All

Total Flights

500K

Avg Arrival Delay

6.01

Avg Departure Delay

9.74

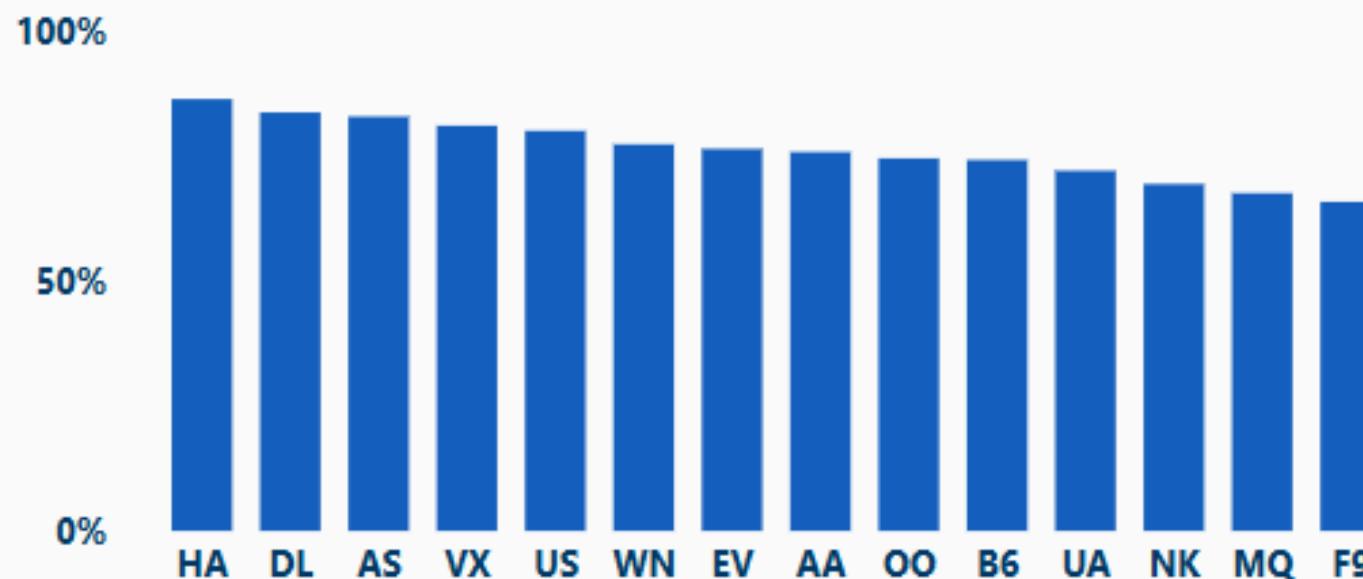
On Time Rate

77%

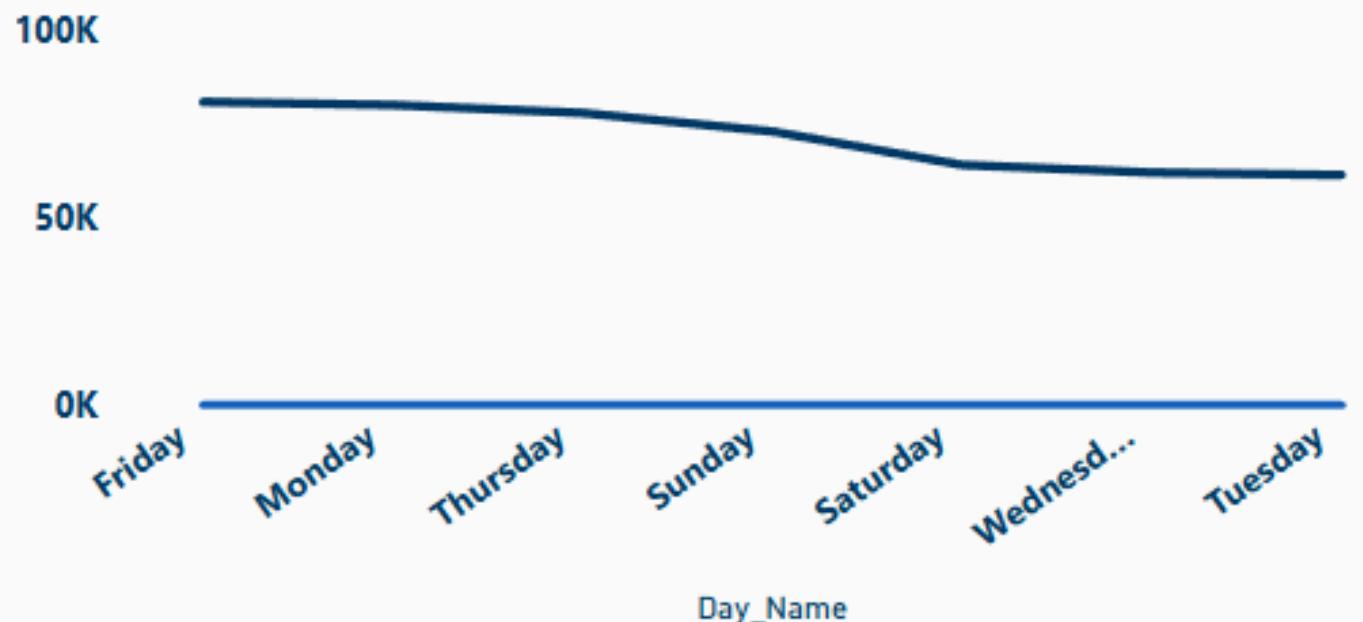
Avg Flight Duration

131.98

On Time Rate by AIRLINE



Total_flights and Average Flight Duration by Day_Name



AIRLINE	AIRLINE	Avg Departure Delay	Avg Arrival Delay	On Time Rate	Total_flights
WN	Southwest Airlines Co.	9.38	3.47	77%	106252
DL	Delta Air Lines Inc.	6.66	-0.99	84%	68555
EV	Atlantic Southeast Airlines	9.51	8.42	76%	52965
OO	Skywest Airlines Inc.	12.02	10.78	75%	51184
AA	American Airlines Inc.	10.33	6.86	76%	46950
UA	United Air Lines Inc.	13.59	6.38	72%	40873
US	US Airways Inc.	5.89	3.89	80%	35591
MQ	American Eagle Airlines Inc.	14.46	16.36	68%	31896
B6	JetBlue Airways	10.03	7.62	74%	23062
AS	Alaska Airlines Inc.	3.40	0.06	83%	14149
NK	Spirit Air Lines	13.74	12.36	69%	9324
F9	Frontier Airlines Inc.	19.25	19.85	66%	7291
HA	Hawaiian Airlines Inc.	1.10	3.34	86%	6858
Total		9.74	6.01	77%	499999



Airline Performance Comparison

Airline

All

Cancellation Description

All

Average Delay

15.76

Cancellation Rate

3.36%

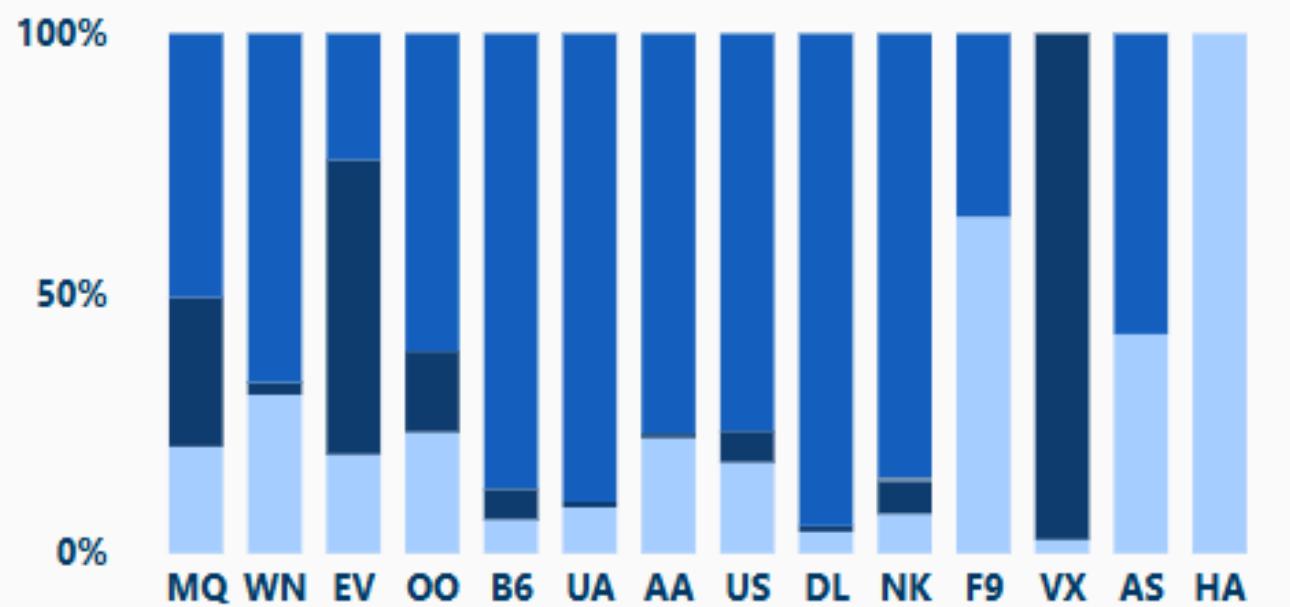
Punctuality Rank

8

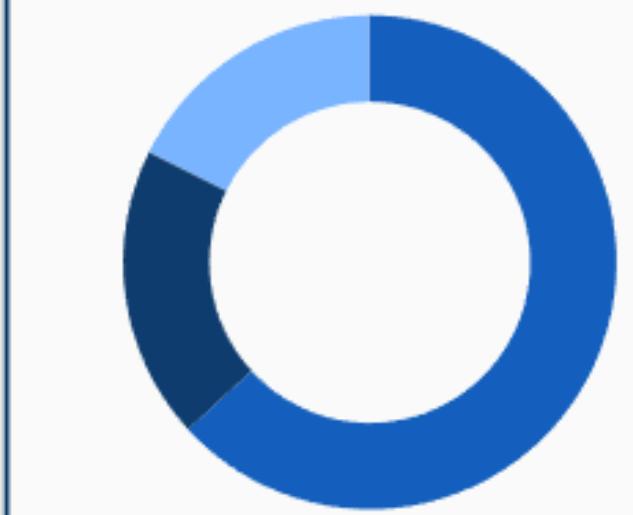
Punctuality Score

0.51

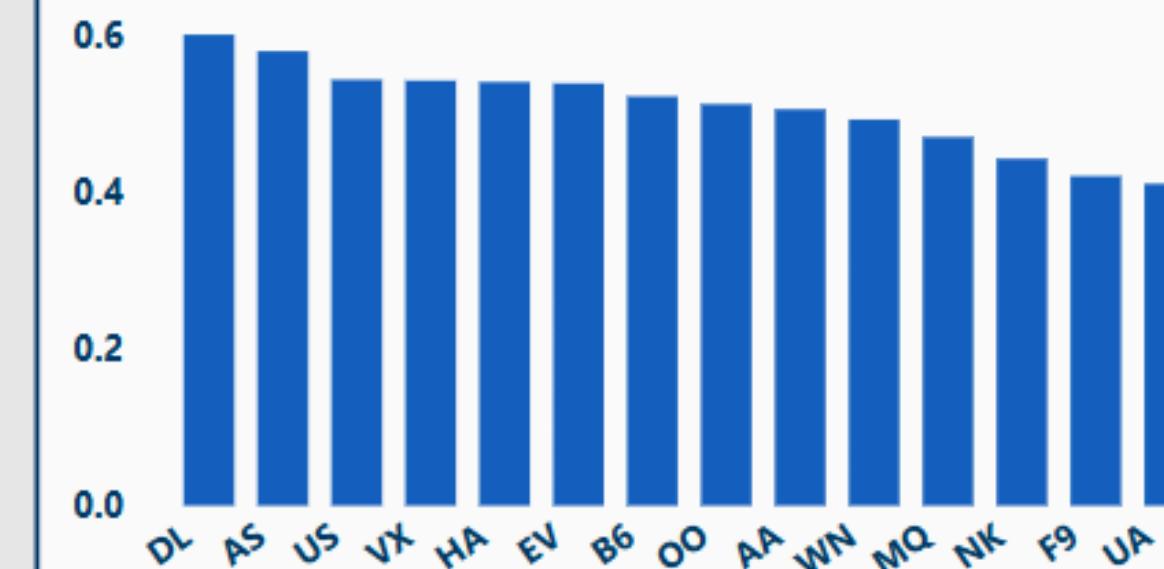
Cancellation rate by Airline



Airline-specific cancellation patterns



Punctuality Score by AIRLINE



Avg Arrival Delay and Avg Departure Delay by AIRLINE





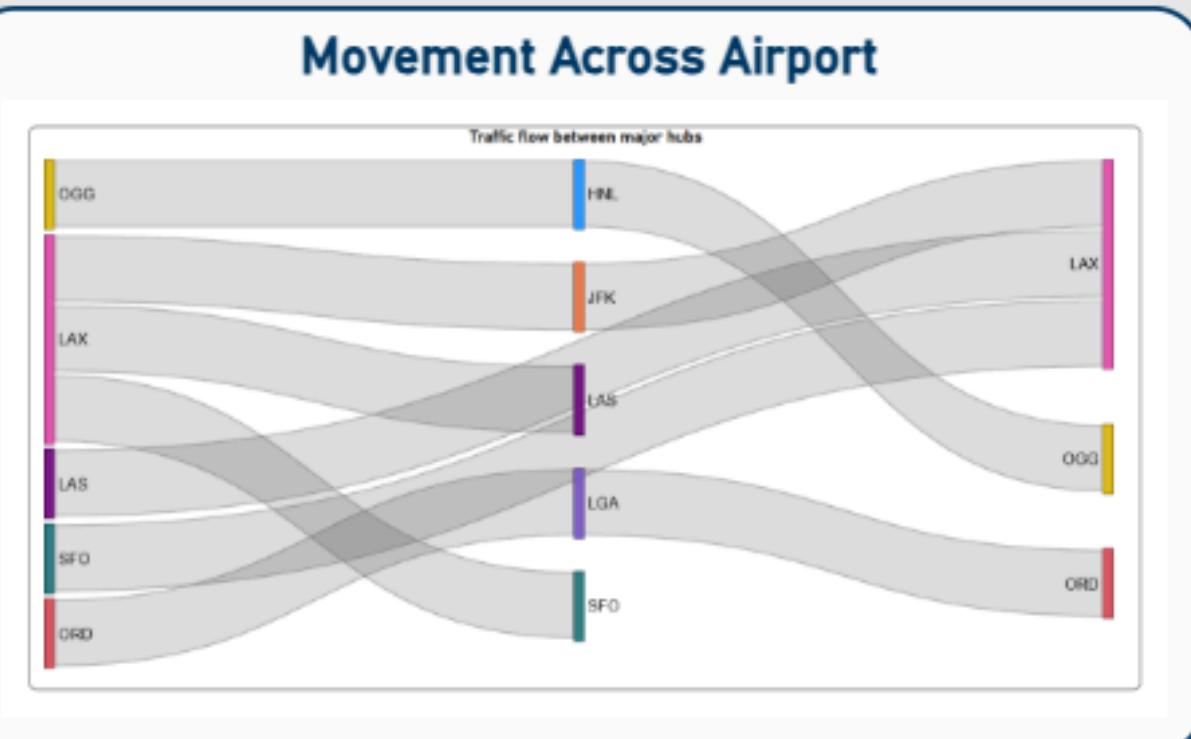
Route & Airport Analytics

Airport

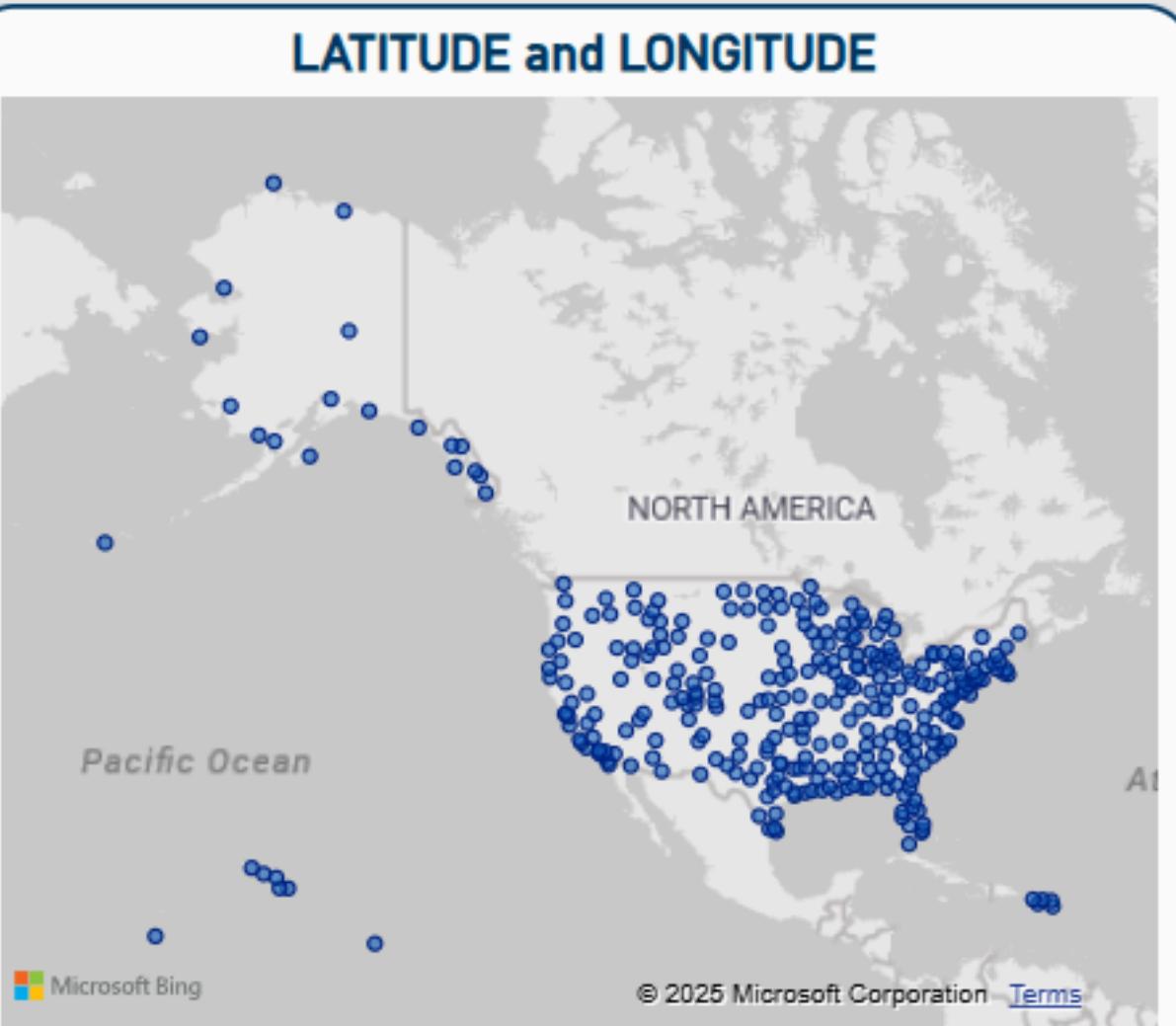
All

Congestion Index

15.76



ORIGIN_AIRPORT	Sum of Total Flights
ATL	31332
DEN	18142
DFW	24651
IAH	14255
LAS	12361
LAX	18457
MCO	10717
ORD	24967
PHX	14010
SFO	13712
Total	182604



ORIGIN_AIRPORT	DESTINATION_AIRPORT	Sum of Frequent Flight Route
HNL	OGG	874
JFK	LAX	1217
LAS	LAX	1018
LAX	JFK	1218
LAX	LAS	987
LAX	SFO	1172
LGA	ORD	917
OGG	HNL	873
ORD	LGA	908
SFO	LAX	1186
Total		10370



Flight Cancellation & Delay Patterns

Cancellation Description

All

Total Delays

4M

Weather Delay Impact

4.31%

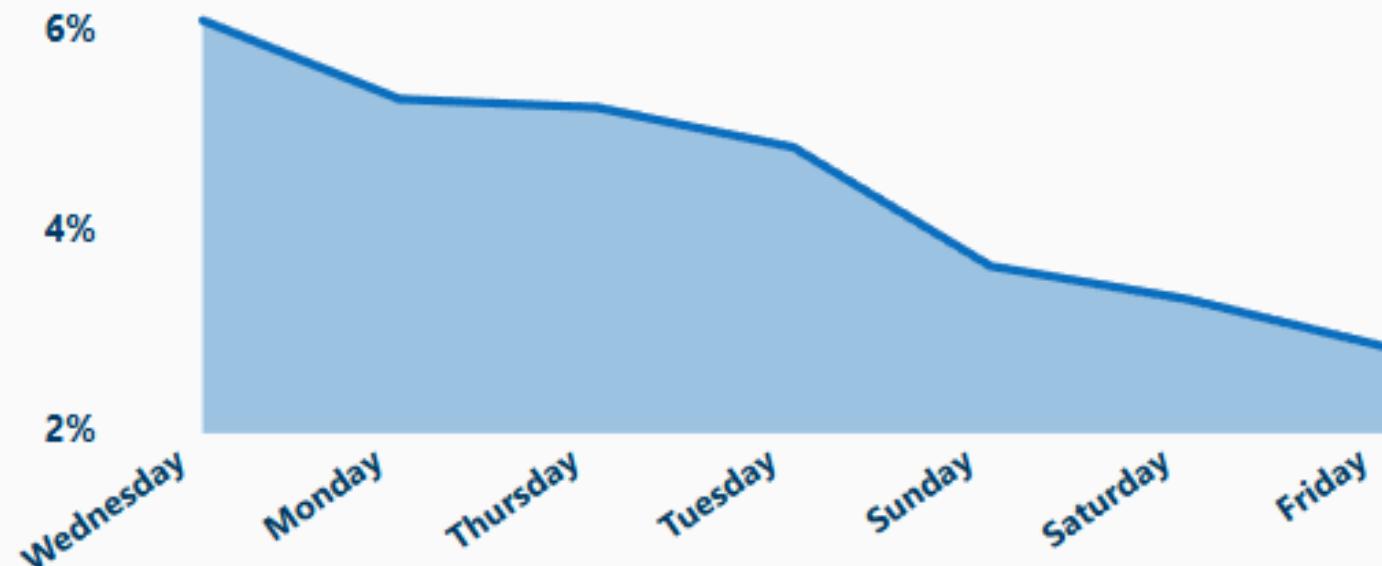
Late Aircraft Delay %

29.73%

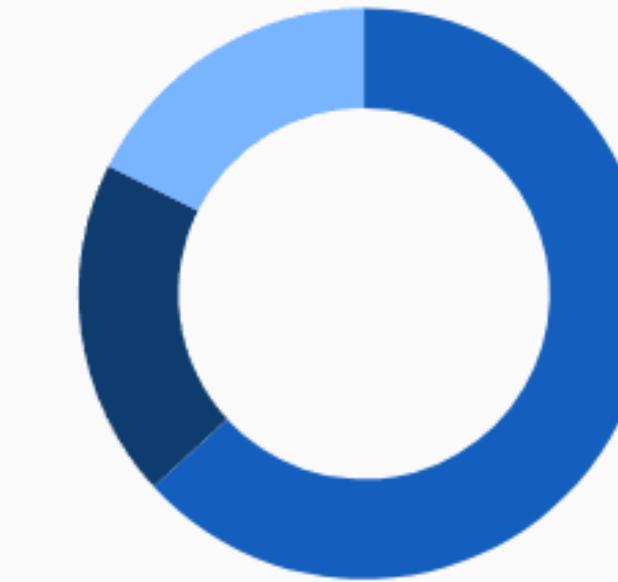
Cancellation Rate

3.36%

Weather Delay Impact by Day_Name



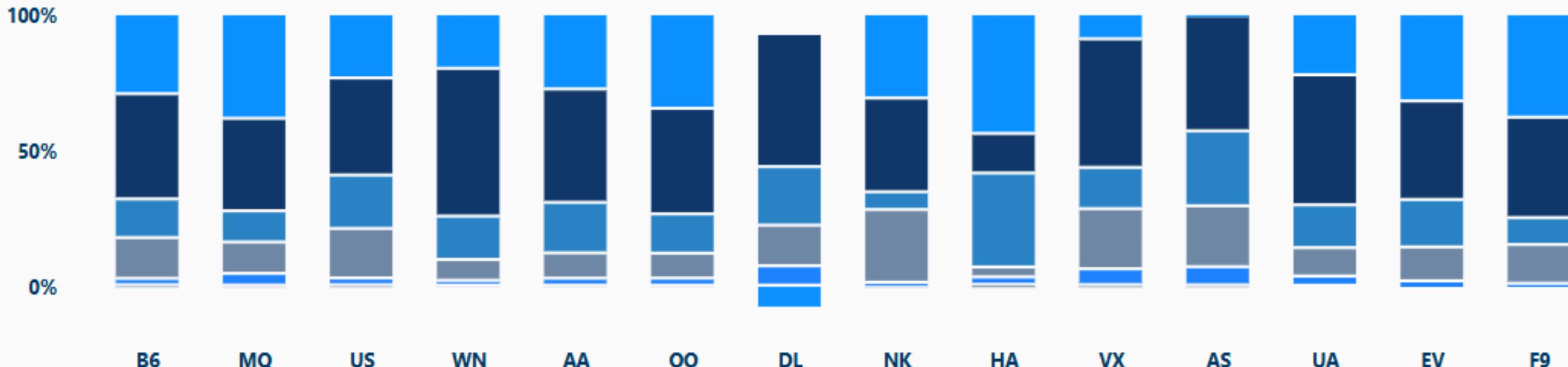
Cancellation Breakdown



- CANCELLATION...
- Weather
 - Airline/Carrier
 - National Air S...
 - Security

Flight Delay Reason Analysis

● Sum of SECURITY_DELAY ● Sum of WEATHER_DELAY ● Sum of AIR_SYSTEM_DELAY ● Sum of AIRLINE_DELAY ● Sum of DEPARTURE_DELAY ● Sum of ARRIVAL_DEL...





Passenger Experience & Service Quality

Mixed Connection rate

8.32%

Connectivity Efficiency

0.80

Delay Flight Impact

0.20

Delay recovery

38.27%

Customer Satisfaction

93.67

Delay Moderation

All



Airline

AA MQ

AS NK

B6 OO

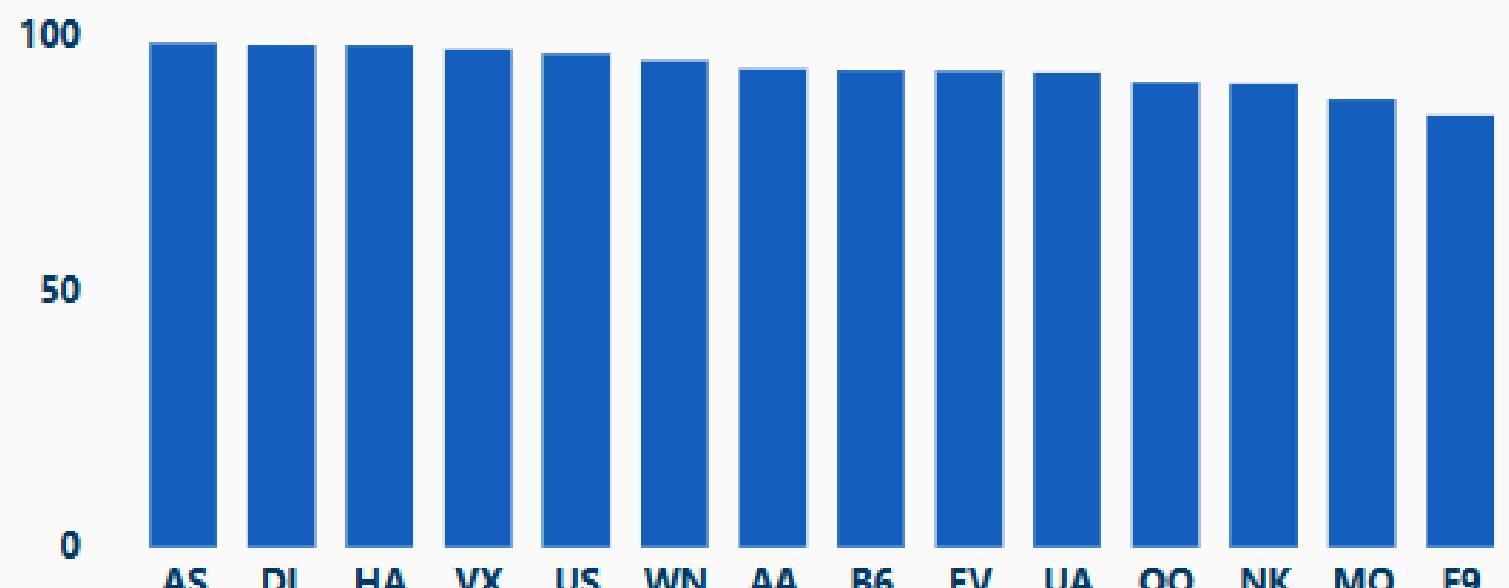
DL UA

EV US

F9 VX

HA WN

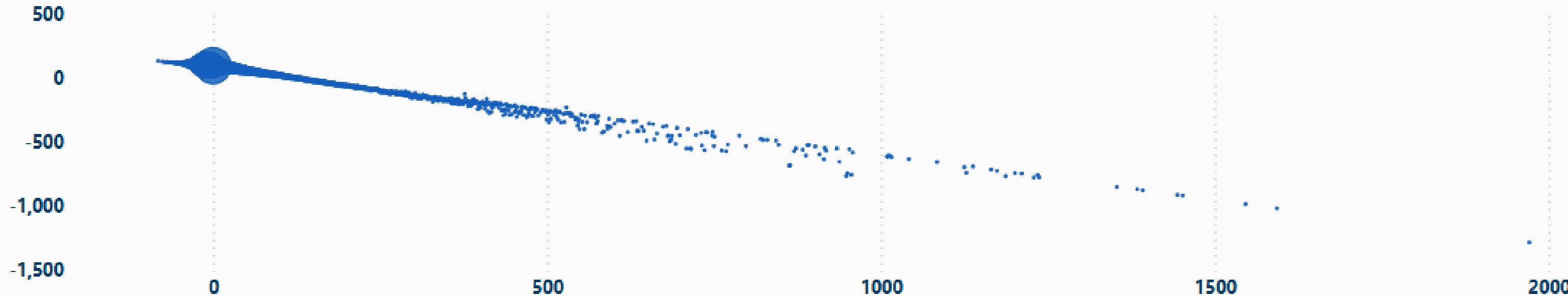
Customer Satisfaction Proxy Score by AIRLINE



Connectivity Efficiency by AIRLINE



Customer Satisfaction Proxy Score and Total_flights by ARRIVAL_DELAY



ARRIVALS ↓

INSIGHTS



Flight Operations Overview

Flight Volume & Duration:

- Around **500K** flights with an **average duration** of 132 minutes.

Delays & On-Time Performance:

- Avg. departure delay: **9.74** minutes; avg. arrival delay: 6.01 minutes (showing good delay recovery).
- Overall on-time rate: **77%**; top performers: **Hawaiian** (86%), **Delta** (84%), **Alaska** (83%).
- Frontier (66%) has the lowest on-time rate and highest delays (19+ minutes).

Airline Trends:

- Delta leads in flights (**68,555**) with strong **punctuality**.
- American Airlines operates **46,950** flights with moderate delays.

Day-wise Trends:

- Flights peak on **Fridays** and drop by **Tuesday**; flight durations stay consistent.

Airline Performance Comparison

Overall Performance:

- Average delay: **15.76** minutes; cancellation rate: **3.36%**.
- Punctuality score: **0.51** with a punctuality **rank of 8**.

Top & Bottom Performers:

- **Delta (DL)** leads in **punctuality**, followed by Alaska (AS) and US Airways (US).
- **Frontier (F9)** and United (UA) have the **lowest punctuality** scores and the highest delays (20+ minutes).

Cancellation Trends:

- **Frontier (F9)** and **Alaska (AS)** show **higher** cancellation rates.
- Delta (DL) and **Hawaiian (HA)** maintain low cancellations and **strong punctuality**.

Delay Patterns:

- **Frontier (F9)** and **American Eagle (MQ)** have the **longest arrival and departure delays**. Hawaiian (HA) and Virgin America (VX) consistently experience minimal delays.

Route & Airport Analytics

Airport Congestion & Flight Volume:

- **Congestion Index: 15.76** indicates moderate congestion across **major hubs**.
- Busiest Origin Airports: **Atlanta (ATL)** leads with **31,332 flights**, followed by Chicago O'Hare (ORD) and Dallas-Fort Worth (DFW).

Frequent Flight Routes:

Top routes:

- **JFK–LAX** and **LAX–JFK** are the **busiest routes** (over **1,200 flights** each).
- Other high-**traffic routes** include **LAX–SFO (1,172 flights)** and **LAS–LAX (1,018 flights)**.
- **HNL–OGG** is the most **frequent inter-island route** (874 flights).

Traffic Flow & Geographic Spread:

- Major **traffic flows** concentrate **between** coastal hubs (**LAX, JFK, ORD**).
- The network shows dense coverage in the **continental U.S.** with notable **Hawaiian connectivity**.

Flight Cancellation & Delay Patterns

Overall Delay & Cancellation Trends:

- Total Delay: **4 million** minutes of **total delay**.
- Cancellation Rate: **3.36%**, with airline/carrier issues as the **leading cause**.

Primary Delay Reasons:

- Late Aircraft Delays: Highest contributor at **29.73%**.
- Weather Delays: Account for **4.31%**, peaking **midweek** (Wednesday) and **lowest on Friday**.

Airline-Specific Delay Patterns:

- Certain airlines (**MQ, B6, US**) show higher proportions of **late aircraft** and **carrier-related delays**.
- **Weather and security-related delays** are comparatively **minimal** across **airlines**.

Passenger Experience & Service Quality

Overall Passenger Experience:

- Customer Satisfaction Proxy Score: **High at 93.67**, indicating generally **positive** passenger experience.
- Missed Connections Rate: Moderate at **8.32%**, with a connectivity efficiency of **0.80**.
- Delay Recovery Effectiveness: Stands at **38.27%**, highlighting **moderate recovery from delays**.

Airline-wise Performance:

- **AS, DL, and HA** airlines lead in both **customer satisfaction** and **connectivity** efficiency.
- F9 consistently **performs lower** in **satisfaction** and **connectivity** metrics.

Delay Impact on Satisfaction:

- A clear **negative correlation** between **arrival delays** and customer satisfaction—higher delays result in reduced satisfaction.

CONCLUSION

Flight Delays Overview:

- Top Performing Airline: **Delta** Air Lines has the **lowest** average delay time.
- Worst Performing Airline: **Spirit** Airlines experiences the **highest average delay** duration.
- Trend Insight: **Delays peak** during late **afternoon** hours; morning flights are more punctual.

Cancellations Analysis

- Highest Cancellation Rate: **American** Airlines leads in cancellations, primarily due to **weather** disruptions.
- Lowest Cancellation Rate: **Alaska** Airlines maintains the **fewest** cancellations, showcasing **operational stability**.
- Monthly Trend: Cancellations spike in **January and July**, suggesting seasonal and weather-related factors.

Passenger Experience KPIs

- Best in Customer Satisfaction: **Southwest Airlines** scores **highest** in Customer Satisfaction Proxy Score.
- Most Missed Connections: **Frontier** Airlines has the highest **Missed Connections** Rate, indicating connectivity inefficiencies.
- Best Delay Recovery: **Alaska** Airlines excels in Delay Recovery Effectiveness, minimizing passenger inconvenience.

Financial & Operational Efficiency

- Lowest Flight Cost per Mile: **Spirit Airlines** demonstrates superior **cost efficiency**.
- Best Fuel Efficiency: **Alaska Airlines** leads in **fuel efficiency** across most routes.
- Highest Revenue Loss from Delays: **United Airlines** incurs the **largest financial hit** from delays.

Route & Connectivity Efficiency

- Most Efficient Route: Route between **Los Angeles International (LAX)** and **Seattle-Tacoma (SEA)** shows the **highest on-time performance**.
- Top Connecting Hub: **Denver International Airport (DEN)** facilitates the **most efficient passenger connections**.
- Least Efficient Route: Flights between Chicago O'Hare (ORD) and Newark Liberty (EWR) suffer from frequent delays and cancellations.

RECOMMENDATION



Improve Delay Recovery:

- Prioritize **recovery efforts** for flights with high missed connection rates.
- Increase standby **crew availability** during peak delay periods.

Optimize Routes and Fuel Efficiency:

- Reassess underperforming routes with high operational costs.
- Invest in **fuel-saving** strategies on routes **with poor efficiency**.

Enhance Passenger Experience:

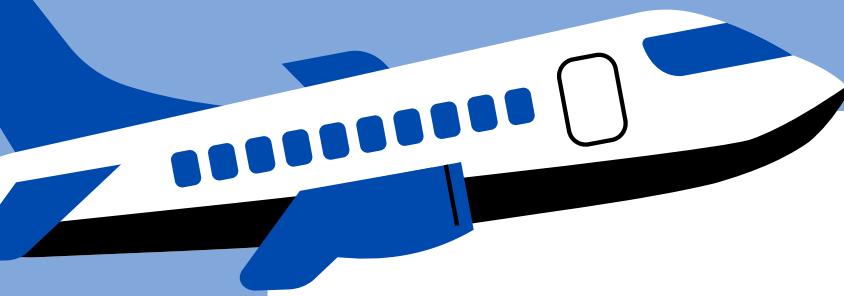
- Provide proactive communication and compensation for significant delays.
- Improve in-terminal services at airports with **high passenger dissatisfaction**.

Mitigate Revenue Loss:

- Focus on **reducing cancellations** on revenue-critical routes.
- Implement predictive maintenance to prevent operational disruptions.

Refine Scheduling and Resource Allocation:

- **Adjust flight** schedules to avoid peak **congestion times**.
- Increase buffer times for **high-risk routes** to minimize cascading delays.



STAY IN TOUCH

LinkedIn

Gmail

Github

