Airline Delay Analysis Report

1. Introduction

This report examines the on-time performance and cancellation patterns of our airline's flights. By analyzing arrival delays, categorizing severity, and tracking cancellations, we aim to identify trends, pinpoint problem areas, and recommend actionable improvements to boost customer satisfaction and operational efficiency.

2. Methodology

Data Source: Flight-level data for the year 2015, including scheduled vs. actual arrival times and departure times and cancellation reasons, next one contain airline details, and other contains airport details.
Unified all three tables and calculated different required fields.

Key Measures:

- On-Time Performance = Flights with arrival delays < 15 min ÷ Flights with recorded arrivals
- Cancellation Rate = Canceled flights ÷ Total flights
- Total flights
- Average Departure and Arrival Delay
- Percentage contribution of each cancellation reason

Tools & Calculation:

- DAX Measures in Power BI (CALCULATE, COUNTROWS, FILTER, DIVIDE)
- SQL query analysis
- Visualizations: Pie chart for cancellation reason, bar chart and column chart for comparative analysis in different aspects.

3. Key Findings & Analysis

3.1 Flight Performance

On-Time (≤ 15 min): 84% of flights
Cancellation rate: 1.77% of flights
Delayed : 14% of flights
Insight: While most flights land on time, 14% experience delays over 15 minutes, representing a significant service risk and flight canceled mainly due to weather.

3.2 On-Time Performance Trend

Peak Performance: March (91% on-time)
Lowest Performance: December (62% on-time)
Insight: Holiday season operations see a dip, likely due to weather.

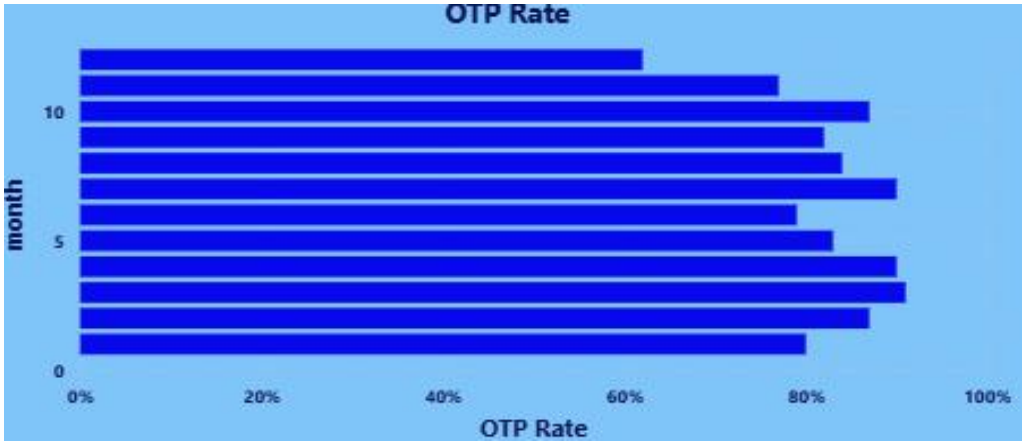


Figure 1: On time performance by month

3.3 Cancellation Rate by Month

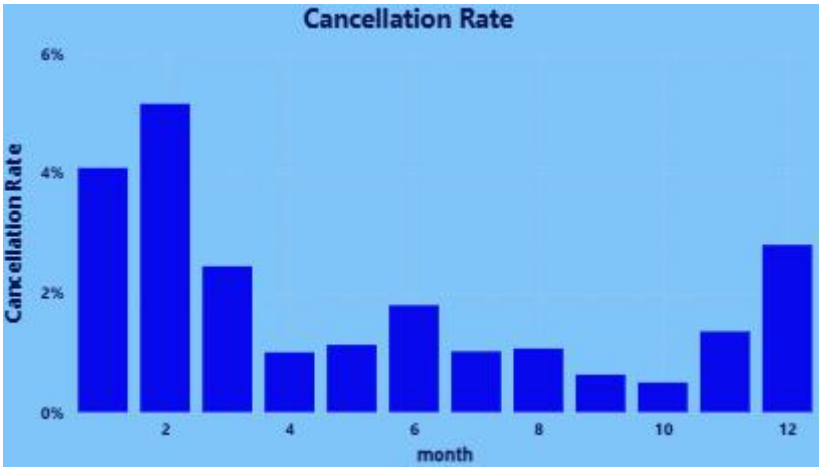


Figure 2: Monthly Cancellation Rate

Average Cancellation Rate: 1.8%
Highest: February (5.2%)
Lowest: October(0.5%)
Insight: Winter months incur more cancellations, correlating with severe weather patterns.

3.4 Delay Correlation

Average arrival and departure delay relate each other both go hand in hand, one is high other is also high. Likely affected by weather.

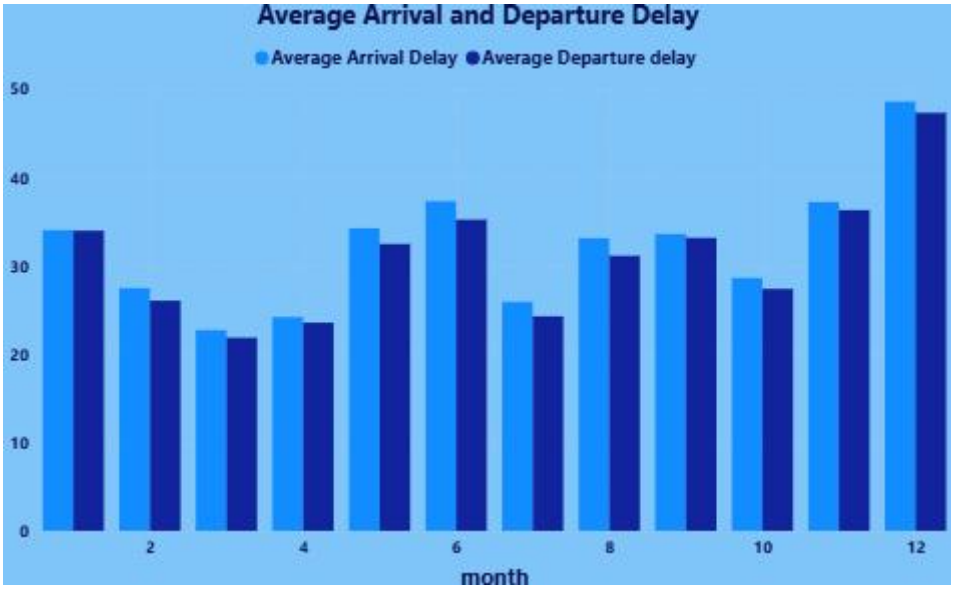


Figure 4: Average arrival and departure delay by month

4. In depth Insights

Table 1: Percentage contribution of cancellation by time of day

time_of_day	cancellation_reason	percentage_contribution
MORNING	B	20.64
EVENING	B	15.26
AFTERNOON	B	14.63
MORNING	A	11.85
AFTERNOON	A	7.64
EVENING	A	6.5
AFTERNOON	C	5.82
EVENING	C	5.68
MORNING	C	4.86
LATE NIGHT	B	3.82
LATE NIGHT	A	2.11
LATE NIGHT	C	1.16
LATE NIGHT	D	0.01
AFTERNOON	D	0.01
EVENING	D	0
MORNING	D	0

Insights: During morning cancellation due to weather condition with 20%. Late night cancellation is very low.

Table 2: Percentage contribution of cancellation by day of week

day_of_week	cancellation_reason	percentage_contribution
1	B	14.13
2	B	9.32
7	B	9.13

4	B	6.54
3	B	5.55
6	B	5.28
1	A	4.92
2	A	4.86
5	B	4.39
1	C	4.39
3	A	4.24
4	A	3.98
5	A	3.79
7	A	3.39
4	C	3.16
6	A	2.94
2	C	2.58
3	C	2.14
7	C	2.12
5	C	1.61
6	C	1.51
3	D	0.01
5	D	0.01
6	D	0
1	D	0
2	D	0

Insights: Sunday go most cancellation for all reasons. Most flights delayed on Sunday itself due to weekend rush.

- Air ssystem delay nalysis

average_airsysytem_delay	max_delay	min_delay	median_delay
25.38	1134	1	17

- Security delay analysis

average_security_delay	max_delay	min_delay	median_delay
23.24	573	1	15

- Airline delay analysis

average_airline_delay	max_delay	min_delay	median_delay
35.26	1340	1	17

- Aircraft delay analysis

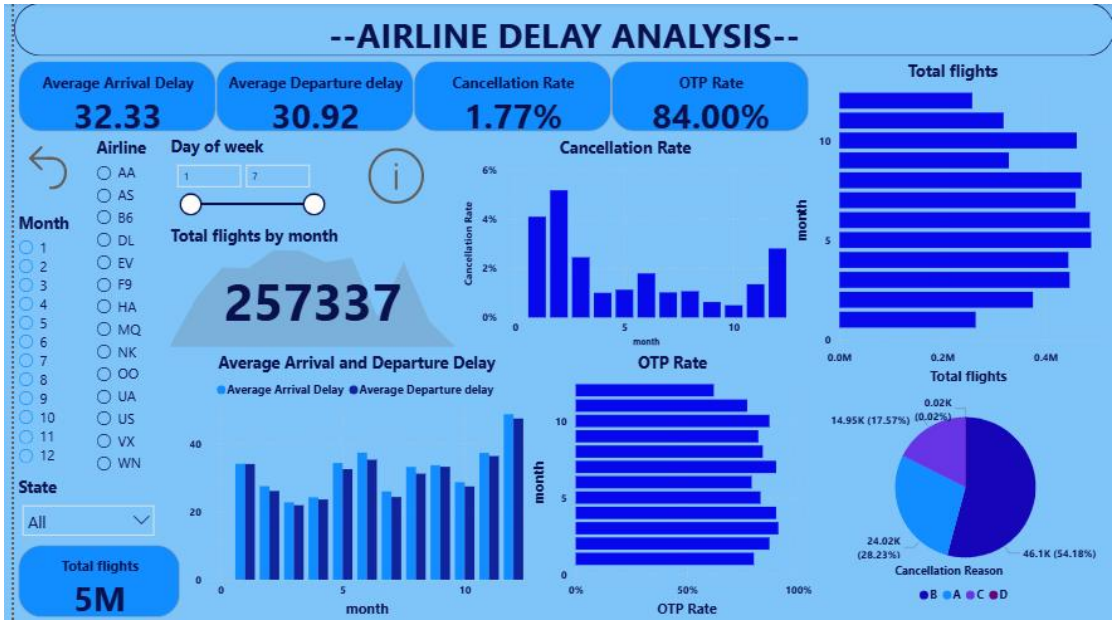
average_aircraft_delay	max_delay	min_delay	median_delay
44.81	1294	1	28

- Weather delay analysis

average_weather_delay	max_delay	min_delay	median_delay
47.9	1211	1	25

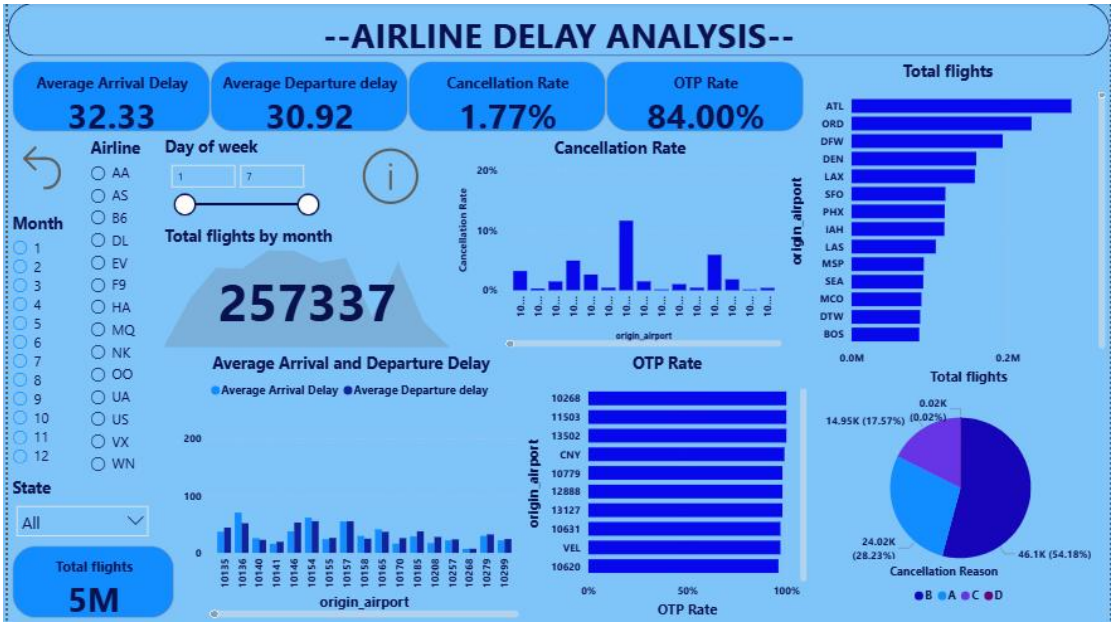
5. Dashboard Overview

Dashboard entities included defined KPIs which shows total flights, cancellation rate, average departure and arrival delays, OTP rate as well.
-Slicers for filtering month, day of week, airline, state are also added.
-Reset button for clearing all slicers.
-Info button for summary of dashboard.
-Visualization include column, bar, pie chart for corresponding comparison and distribution over several categories.



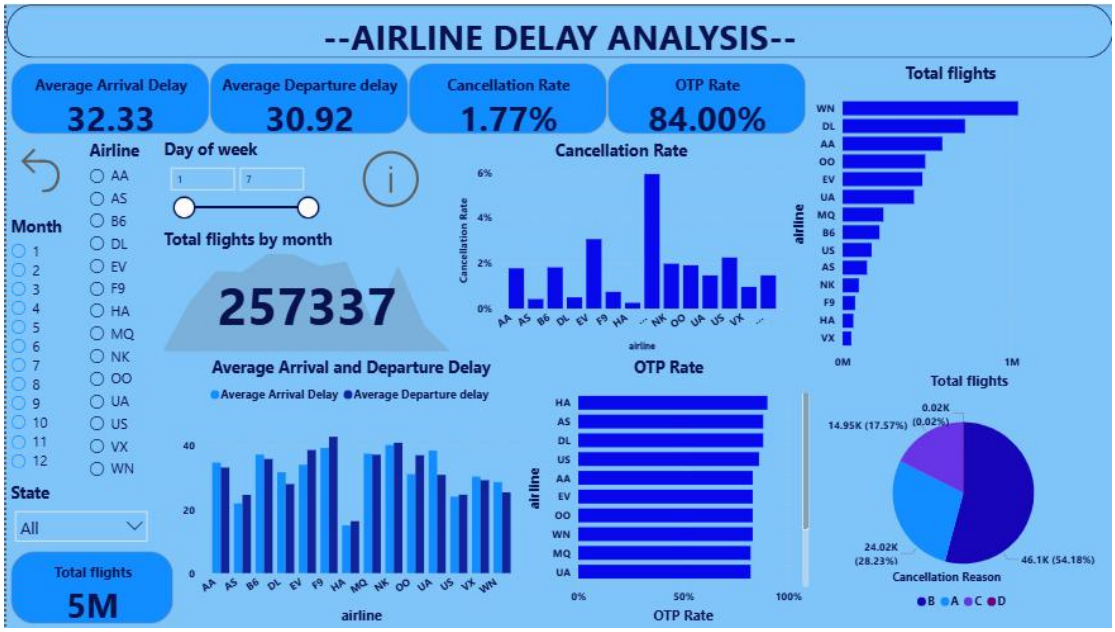
Dashboard 1: Monthly analysis

Insights: Cancellation rate highest in February and lowest in October,mostly cancellation rate fall under 2%. Average Arrival Delay and total Average Departure delay are positively correlated with each other. Average Arrival Delay and Average Departure delay diverged the most when the month was 6, when Average Arrival Delay were 2.08 higher than Average Departure delay. Across all 12 month, Total flights ranged from 257337 to 488094.



Dashboard 2: Airport analysis

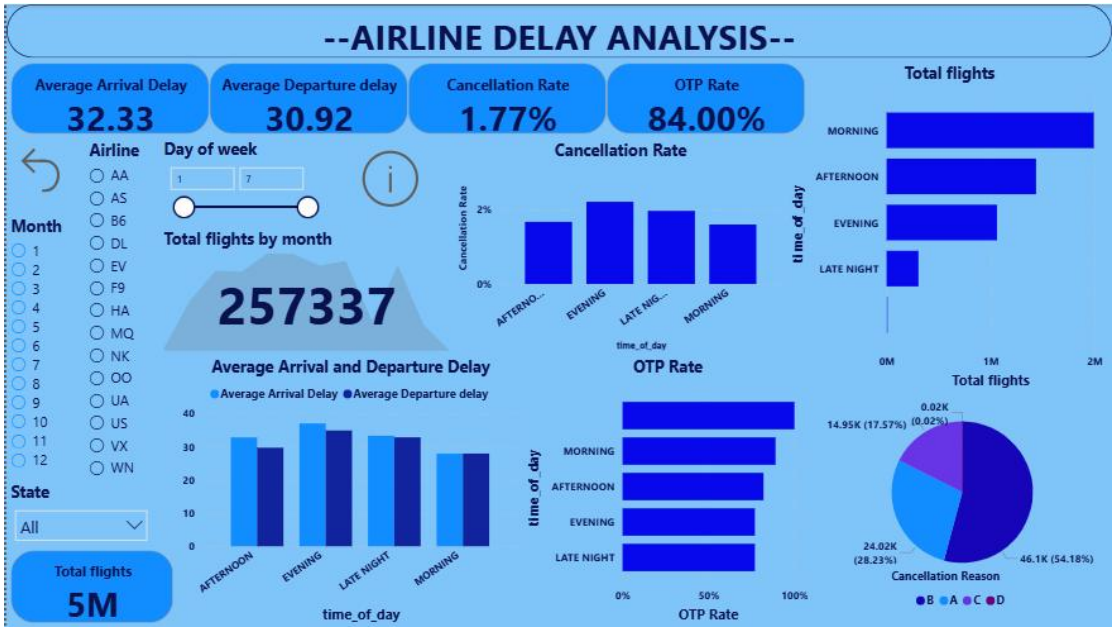
Insights: At 281739, ATL (Atlanta International) had the highest Total flights and was 93,91,200.00% higher than '11503' (Name unknown), which had the lowest Total flights at 3. ATL accounted for 5.88% of Total flights. Across all 628 airport, Total flights ranged from 3 to 281739. Average Arrival Delay and total Average Departure delay are negatively correlated with each other. Average Departure delay and Average Arrival Delay diverged the most when the airport was '11587' (Name Unknown), when Average Departure delay were 166.06 higher than Average Arrival Delay. ITH (Ithaca Tompkins) has cancellation rate of 16.7%.



Dashboard 3: Airline analysis

Insights: At 1038466, WN (Southwest Airlines) had the highest Total flights and was 1,938.81% higher than VX (Virgin America), which had the lowest Total flights at 50935. WN accounted for 21.66% of Total flights. Across all 14 airline, Total flights

ranged from 50935 to 1038466. Average Arrival Delay and total Average Departure delay are positively correlated with each other. Average Arrival Delay and Average Departure delay diverged the most when the airline was UA (United Airlines) , when Average Arrival Delay were 7.62 higher than Average Departure delay. MQ (Americian Eagle Airlines) has the highest cancellation rate of 5.9%.



Dashboard 4: Time of day analysis

Insights: Average Arrival Delay and Average Departure delay diverged the most when the time_of_day was AFTERNOON, when Average Arrival Delay were 3.11 higher than Average Departure delay.At 1991372, MORNING had the highest Total flights and was 19,91,37,15.00% higher than , which had the lowest Total flights at 306289. MORNING accounted for 41.53% of Total flights. Across all 4 time_of_day, Total flights ranged from 306289 to 1991372. Average Arrival Delay and total Average Departure delay are positively correlated with each other. Delay of flights are prominent at evening. Cancellation rate high at evening with more than 2%. On time performance is at morning.

6. Recommendations

- Winter Preparedness:
  - -Pre-position de-icing crews at key hubs
  - -Increase buffer times in schedules for December–February
- Operational Flexibility:
  - -Dynamic crew and aircraft re-routing to absorb delays
  - -On-call reserve crews during peak holiday periods
- Real-Time Alerts:
  - -Automated dashboard alerts when daily on-time drops below 75%
  - -Trigger contingency protocols (standby aircraft, passenger rebooking)
- Root-Cause Deep Dives:

-Investigate top 10 routes by delay volume for ground-handling or ATC constraints
-Partner with airport authorities to streamline turnaround processes

7. Conclusion

Our analysis shows strong overall punctuality (84% on-time) but highlights seasonal and category-specific vulnerabilities. Implementing targeted winter-operations strategies, enhancing real-time responsiveness, and focusing on high-delay routes will drive measurable improvements in both on-time performance and customer satisfaction.