

Analysis of The US Civil Flights Using Power BI

ITIS414 Project Report

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Abstract

The US aviation industry faces multiple operational challenges, which includes increasing in flight delays and cancellations also the impacts of adverse weather conditions. This project uses the data analytics and visualization tool Power BI to analyze flight performance in 2023, focusing on the variables leading to delays and cancellations across airlines in the United States. Using a dataset that includes flight details, weather conditions, and aircraft characteristics, the project identifies patterns and trends in operational inefficiencies. Key factors such as weather, airline-specific characteristics, and aircraft type are analyzed to offer valuable insights. By providing data-driven recommendations, the project aims to contribute to more efficient flight scheduling, better resource allocation, and an overall improvement in on-time performance within the United States civil flight industry.

Key Words— Power BI, flight delays, cancellations, weather conditions, airline performance, aircraft characteristics, data analytics, operational efficiency, customer satisfaction, US aviation, on-time performance.

I. INTRODUCTION

The growing use of technology and the internet has led to a rise in flights as a primary mode of transportation. However, the sector faces challenges like airport congestion, flight delays, and environmental impacts. To address these, companies and airports are utilizing data analytics tools like Power BI to track and analyze air operations, aiming to improve efficiency and passenger experience.

II. SIMILAR WORK

Airlines and airports are increasingly turning to Power BI and other business intelligence (BI) tools to enhance their operations. By tracking and analyzing real-time flight data—such as delays, cancellations, and on-time performance—airlines can make more informed decisions that improve efficiency and customer satisfaction. This data-driven approach is particularly effective when paired with insights from key performance indicators (KPIs) like passenger flow, baggage handling, and security check efficiency at airports. For example, airports use Power BI to monitor these KPIs, which helps identify areas where service levels can be improved, thus enhancing the overall passenger experience [2]. Additionally, Power BI's advanced analytics capabilities enable airlines to predict and address flight disruptions, optimizing operations and minimizing delays [1]. This synergy between airline operations and airport performance management creates a more streamlined and efficient air travel experience.

III. PROBLEM STATEMENT

The US aviation industry in 2023 faces operational challenges due to increasing flight volumes, delays, and environmental concerns. Despite advancements in technology, airlines struggle with optimizing on-time performance, managing flight disruptions, and reducing their carbon footprint. This project seeks to analyze flight data using tools like Power BI to identify the key factors affecting operational efficiency and to propose data-driven solutions for improving the overall performance of US flights.

IV. TOOLS USED

We utilized Power BI software for the project's data analysis and conclusions. Power BI is a data visualization and analytical tool that offers businesses visually engaging and interactive insights.

V. DATASET USED

The dataset used for our project was obtained from Kaggle, it is titled “2023 US Civil Flights Delay, Meteo, and Aircrafts”. The dataset contains detailed information of flights in the United States during 2023, It consists of 5 csv files, including fields related to flight delays, meteorological data, and aircraft details [3].

VI. OBJECTIVES

The objectives for this project is to use Power BI to analyze factors that affect flight delays and cancellations in 2023 in the United States, Identify the impact of weather conditions on flight performance, investigate the relationship between airline and aircraft characteristics with flight delays, it aims to discover patterns and trends that signal operational inefficiencies, enhance customer satisfaction.

VII. APPLYING BUSINESS INTELLIGENCE ON DATASET

Setting the research goal, gathering the data, preparing the data to begin analysis, and visualizing the data analysis are the first steps in using business intelligence tools to investigate the dataset.

a. Data Preparation

Preparing the data for analysis and visualization came next after establishing the research objective and gathering the dataset. Carefully inspecting empty cells and fixing any faults caused on by data entry problems were part of the data preparation process. The dataset was prepared for precise analysis and insightful visualizations as a result.

b. Analysis and Visualization

Through the use of Power BI and business intelligence techniques, we were able to extract valuable insights from the dataset. The following important findings came from the analysis and visualization phase:

1- Most Arrival & Departure Delays

The monthly arrival and departure delays for a year are displayed in this graph. Arrival delays are shown by the blue line, and departure delays are shown by the orange line. Both arrival and departure delays peak in the summer and then decrease after the year ends, according to the graph's irregular trend. Seasonal trends can be examined using this data, and possible areas for transportation system enhancement may be found.

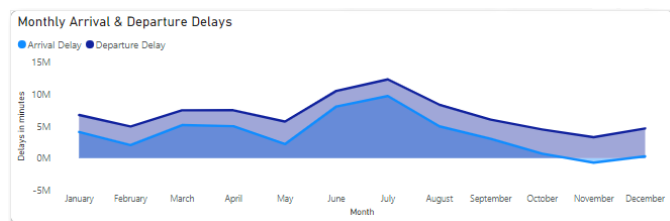


Figure 1 Most Arrival & Departure Delays

2- Average Delay Reasons in minutes

The average delay reasons, given in minutes, are displayed in this graph. With an average delay of about 20 minutes, airlines are the main cause of delays. While weather and security have relatively minor effects on delays, late aircraft and the National Aviation System (NAS) are additional significant causes. The main causes of delays in the transportation system can be found with the use of this data.

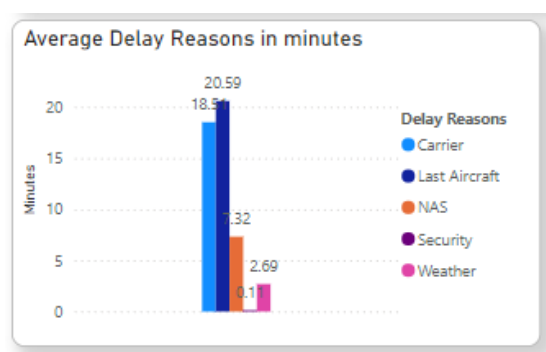


Figure 2 Average Delay Reasons in minutes

3- Top 5 most delayed Flights by Airlines

The top 5 most delayed flights by airline are displayed in this graph. With 652,000 delayed flights, Southwest Airlines leads the pack, followed by American Airlines, Delta Air Lines, United Airlines, and SkyWest Airlines. By showing which airlines suffer the most delays, the data can be used to identify operational areas that require improvement.

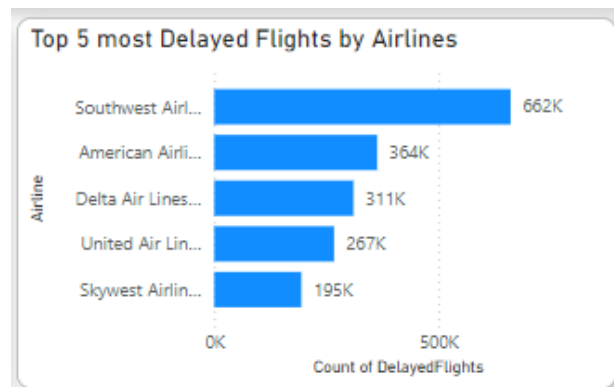


Figure 3 Sales by Region

4- Monthly Cancelled flights in the US

The United States' monthly flight cancellations over a one-year period are displayed in this graph. The number of flights that are canceled changes throughout the year, rising in the summer and falling in the second half. Analysis of the variables affecting the changes and the identification of possible areas for air transportation system improvement can both benefit from the graph's visual representation of seasonal trends in flight cancellations.

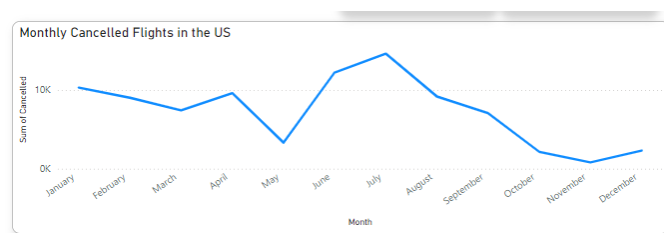


Figure 4 Most Selling Publisher

5- Cancelled Flights per Airline

This pie chart shows the percentage of cancelled flights per airline in the US. Southwest Airlines has the highest percentage at 16.29%, followed by United Airlines Inc. at 12%, Delta Air Lines Inc. at 11.88%, and American Airlines Inc. at 11.18%. The data provides insights into which airlines experience the most flight cancellations, which can help identify areas for improvement in their operations.

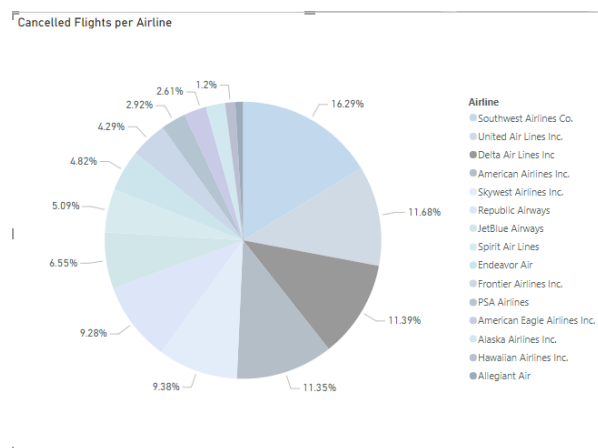


Figure 5 Cancelled flights per Airline

6- Cancelled flights per Airport

This graph shows the number of cancelled flights per airport in the US. The airport with the highest number of cancelled flights is DFW, followed by LGA, DEN, EVR, ORD, and JFK. The data provides insights into the airports that experience the most disruptions, which can help identify infrastructure or operational issues that need to be addressed.

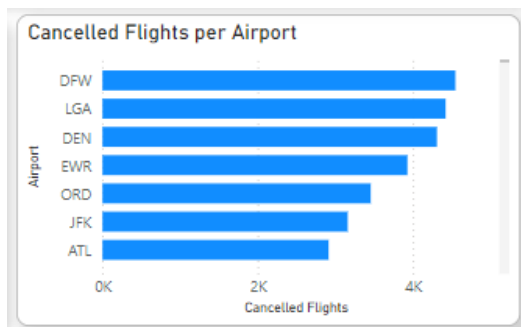


Figure 6 Cancelled flights per Airport

7- Flights Timing

The number of flights by time of day is displayed in this graph, which is divided into morning, afternoon, evening, and night. The morning and afternoon hours see the most flights, while the evening and nighttime hours see the fewest flights. The patterns of flight activity throughout the day can be better understood by airlines and airports with the use of this data, which can aid with operational planning, scheduling, and resource allocation.

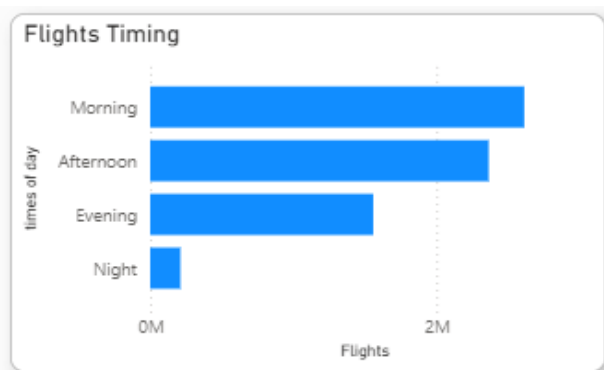


Figure 7 Flights Timing

8- Cumulative Number of Flights per city

The total number of flights in each American city is displayed on this heat map. Higher flight concentrations are indicated by greater blue areas, while lower flight volumes are represented by lighter blue areas. The regions with the highest air activity are the major cities, including the West Coast, Chicago, and the Northeast corridor. Decisions about infrastructure planning and resource allocation can be influenced by this data, which can also reveal information about the busiest transit hubs.



Figure 8 Cumulative Number of Flights per city

9- Weekly number of flights

This graph shows the weekly number of flights across the different days of the week. The data indicates that Friday has the highest number of flights, around 19,000, followed by Thursday, Monday, and Sunday, all with around 18,000 flights. The weekends, particularly Saturday, see a lower number of flights compared to the weekdays. This information can help airlines and airports plan and allocate resources more effectively to accommodate the fluctuations in flight volumes throughout the week.

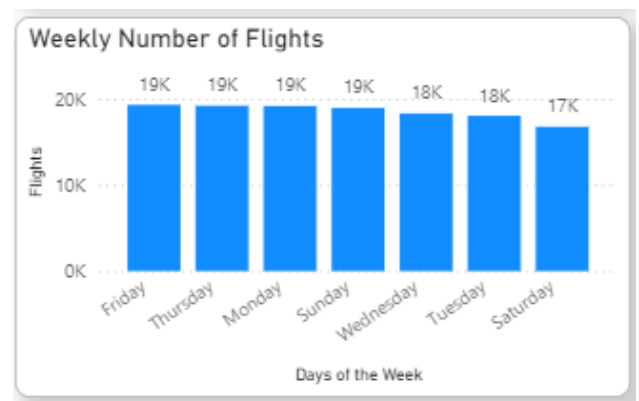


Figure 9 weekly numbers of flights

10- Average Wind Speed

This pie chart shows the average wind speed, with the blue portion indicating the wind speed value of 12.42 and the gray portion representing the remaining 24.85. This data provides information about the typical wind conditions, which can be important for various aviation-related operations and planning, such as runway selection, flight planning, and safety considerations.

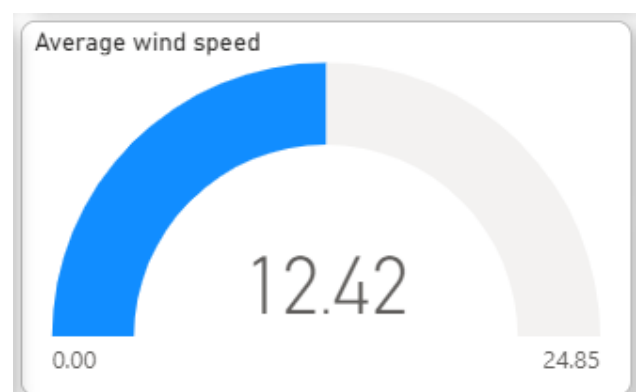


Figure 10 Average wind speed

VIII. DISCUSSION

The analysis of flight data in the United States for 2023 using analytical tools has provided valuable insights into various aspects of the industry. The discussion highlights key findings and explores their implications for travelers, airlines, and airports. Below are the main results arranged in order:

- Volume of Air Traffic:

More than 6 million flights were recorded, indicating a significant volume of air traffic in the United States. These figures emphasize the importance of enhancing the services of airlines and airports to meet travelers' needs, improving their experience, and reducing issues related to cancellations and delays.

- Cancelled and Delayed Flights:

The number of cancelled flights exceeded 100,000, while over 2 million flights were delayed. These results highlight the necessity for improved flight management and communication with travelers regarding expected flight times. Airlines should develop strategies to minimize delays and cancellations.

- Flight Timing:

The analysis showed that most flights departed in the morning, suggesting a need for travelers to have alternative options during less busy times. Airlines can leverage this information to plan their schedules more efficiently.

- Identifying Busy Regions:

The heat map revealed that darker-colored cities represent areas with the highest number of flights. Airlines and airports should enhance their services in these regions to meet the high demand.

- Cancellation Peaks:

The analysis indicated that July was the month with the highest recorded cancellations, while November was the lowest. This information can help airlines plan their resources during peak times.

- Reasons for Delays:

It was identified that "last aircraft delays" were the primary reason for flight delays. Airlines should take steps to improve the management of aircraft scheduling to reduce delays caused by this issue, thereby enhancing the overall efficiency of air operations.

IX. FINDINGS AND CONCLUSION

In conclusion, our flight analysis project for 2023 offers valuable insights for U.S. travelers. By reviewing flight data, including cancellations and delays, we aim to help travelers choose the best airlines and airports, enhancing their travel experiences. Our analysis involved preparing, cleaning, managing, and visualizing the data, with a focus on addressing null values in the Delay reasons column and clarifying the days of the week. Through these insights, we aspire to assist travelers in avoiding unexpected disruptions and making informed travel decisions.

ACKNOWLEDGMENT

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[1] IATA Aviation Data and Analysis (2021). Optimizing Airline Operations through Data Analytics.

[2] Smith, J. (2019). *Leveraging BI for Airport Operations and Passenger Experience*. *International Journal of Aviation Management*, 43.

[3]<https://www.kaggle.com/datasets/bordanova/2023-us-civil-flights-delay-meteo-and-aircraft>

