AIR TRAFFIC ANALYTICS: NAVIGATING PERFORMANCE AND DELAY FACTORS IN US DOMESTIC FLIGHTS

GROUP 3:
VISUALIZATIONS

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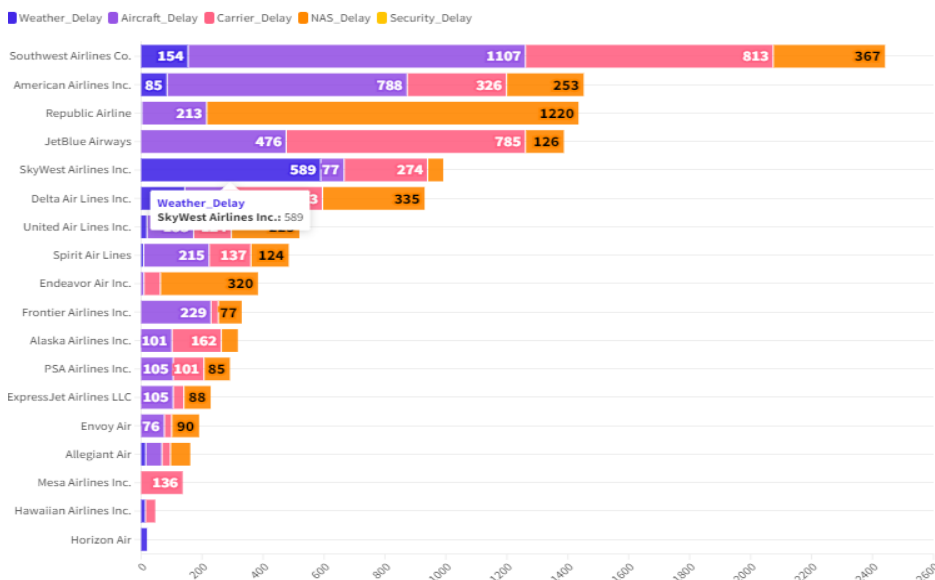Kruthika Srinivas Vasisht
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GRAPH 1
Delay due to Weather, Aircraft, Carrier, NAS, and Security of Airlines
Stacked Bar Graph
https://public.flourish.studio/visualisation/16785217/

Creating a stacked bar graph to illustrate delays due to various conditions like weather, aircraft, carrier, NAS (National Airspace System), and security delays across various flights can offer valuable insights into the factors contributing to flight delays. Here are some insights:

1. Trends Over Time: Analyzing delay data over time reveals temporal patterns in delay types. Seasonal fluctuations may show weather-related delays peaking during inclement weather seasons. Similarly, security delays might rise during periods of heightened security measures, reflecting dynamic operational challenges. Understanding these trends aids in proactive planning and resource allocation for efficient flight management.

2. Impact on Customer Experience: Delays can have a significant impact on passenger satisfaction and loyalty. By quantifying the frequency and duration of delays caused by different factors, airlines can better understand the aspects of their service that most affect the passenger experience and take steps to improve in those areas.

3. Operational Efficiency: Analyzing delay data can also help identify opportunities to improve operational efficiency. If aircraft-related delays are consistently high, airlines may need to invest in better maintenance procedures or adjust their scheduling practices to allow for more turnaround time between flights. By monitoring the frequency and duration of security-related delays, airlines and airports can ensure compliance with relevant regulations.

Utilizing a stacked bar graph to depict delays due to various factors in aviation offers valuable insights. Understanding temporal trends aids in proactive planning, while addressing delay types enhances operational efficiency. Ultimately, prioritizing customer satisfaction through targeted improvements remains paramount for airlines and airports alike.

As per our previous visualizations,
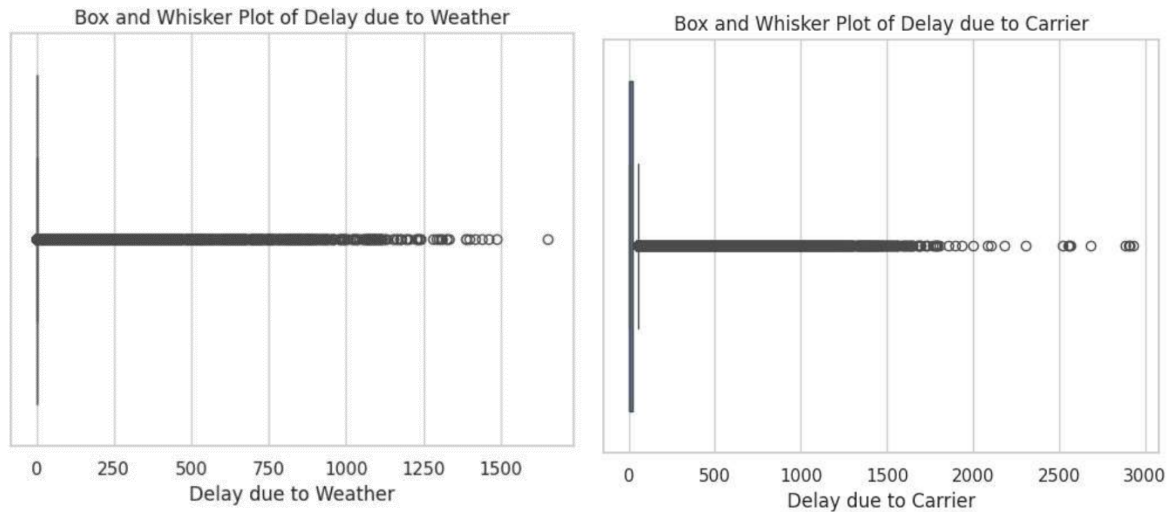
The above box and whisker plots from the Data Analysis part of the project lead to the following visualization. The observation for the graphs were:

- Planning should include strategies for typical short delays and occasional longer ones.
- Operational strategies should mainly address short delays, with contingencies for rare, longer disruptions.

Hence, utilizing a stacked bar graph to depict delays due to various factors in aviation offers valuable insights. Understanding temporal trends aids in proactive planning, while addressing delay types enhances operational efficiency. Ultimately, prioritizing customer satisfaction through targeted improvements remains paramount for airlines and airports alike.

GRAPH 2
Flight Departure vs Arrival Delay
Bubble Chart
https://public.flourish.studio/visualisation/16797066/
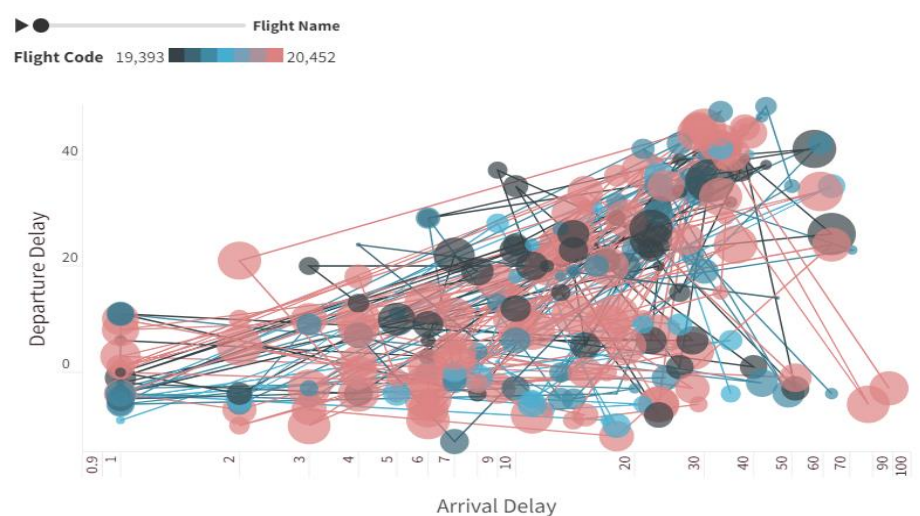
A bubble chart visualizing flight departure and arrival delays across various airlines, while also displaying flight details like name, code, number, and date offers several insights into the performance and reliability of different airlines and flights. Here are some potential insights:

1. Delay Comparison: The bubble chart facilitates straightforward comparison of departure and arrival delays across various airlines, enabling users to discern patterns of punctuality. This visual tool offers a rapid assessment of which airlines exhibit greater delays, whether in departures or arrivals, aiding in informed decision-making and travel planning.

2. Identifying Patterns: Users can analyze the data to identify any patterns or trends in delays across airlines, flight codes, or specific dates. For example, they may notice that certain airlines consistently experience delays on particular routes or during specific times of the year.

3. Network Connections Visualization: The incorporation of a play button in the network connections visualization provides users with an interactive experience to observe the intricate interplay between flights. By visually tracking flight paths and connections, users can grasp the cascading effects of delays, particularly within network hubs, enhancing their understanding of the broader operational dynamics in air travel.

4. Interactive Exploration: Hovering over bubbles in the visualization triggers the display of additional information, offering users more detailed insights. This interactive feature enables users to easily access relevant data points without cluttering the interface, promoting a seamless and efficient exploration of flight delays and associated details.

Overall, this type of visualization provides a comprehensive view of flight delays, allowing users to make informed decisions or identify areas for improvement in airline operations.

As per our previous visualizations,

Density Plot for Arrival Delay (Minutes)
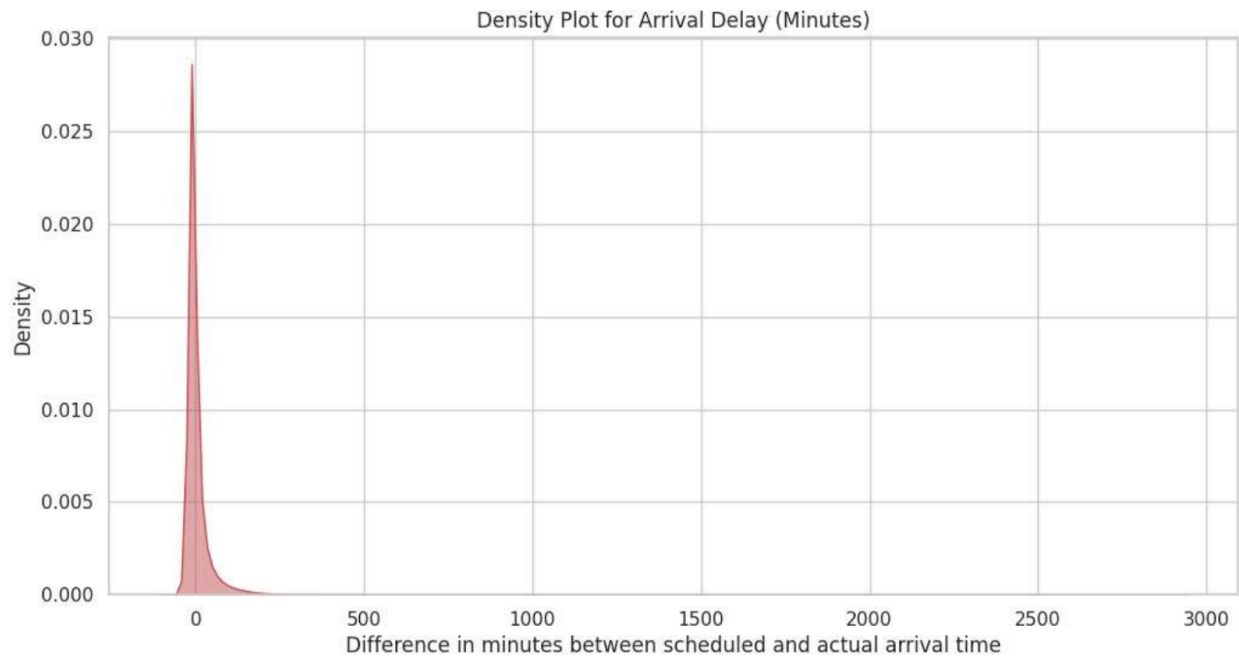
The above density plot from the Data Analysis part of the project leads to the following visualization. The observation for the graph was:
- Narrow peak shows limited variation in delays; the system is generally punctual.
- For operational efficiency, strategies to mitigate long delays could be beneficial.

Hence, this type of visualization provides a comprehensive view of flight delays, allowing users to make informed decisions or identify areas for improvement in airline operations.

GRAPH 3
Flight Duration and Origin-Destination Analysis
Tree Map
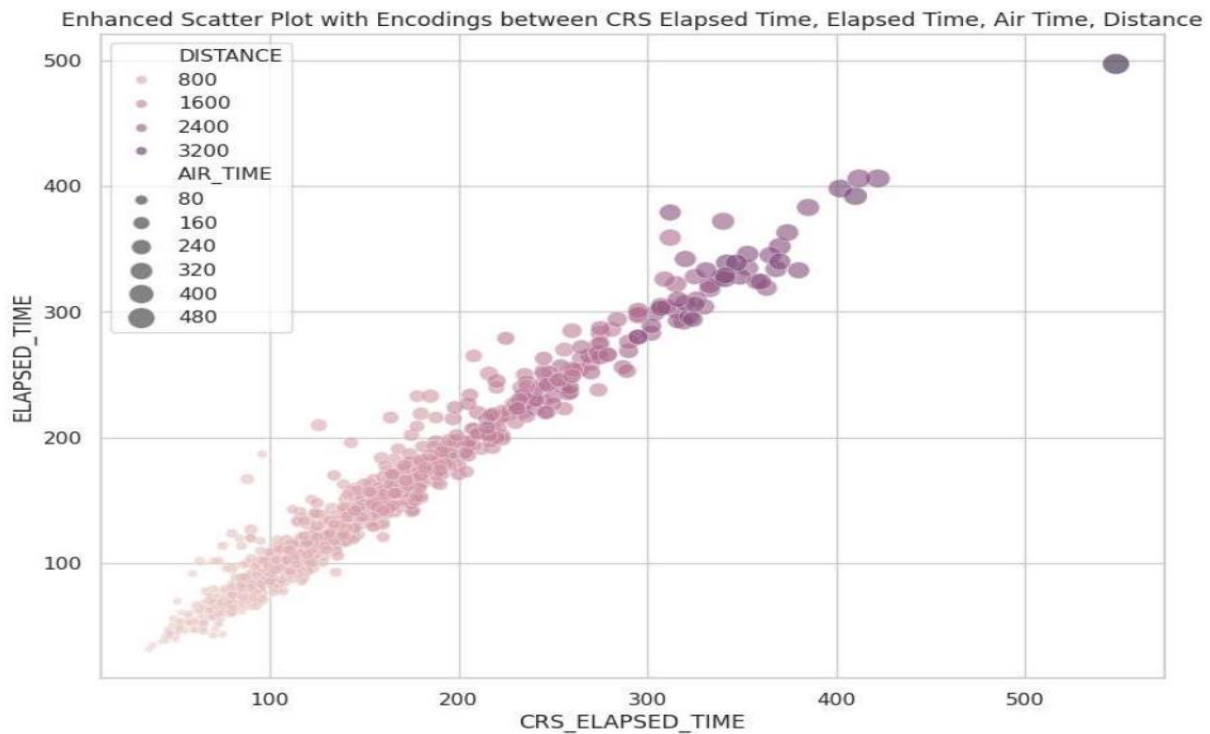https://public.flourish.studio/visualisation/16798001/

A tree map is a visualization tool commonly used to display hierarchical data in a nested, rectangular format. When applied to differentiate flights by air time and their origin and destination cities, it can offer several insights into the distribution and characteristics of flights.

1. Flight Distribution by Air Time: The tree map can visually represent the distribution of flights based on their duration or air time. Each rectangle within the tree map represents a flight, with the size of the rectangle proportional to the duration of the flight. This allows viewers to quickly identify flights with shorter or longer durations.

2. Origin-Destination Pairs: By organizing the tree map hierarchically, with origins at a higher level and destinations nested within them, the visualization can provide insights into the volume and characteristics of flights between different city pairs. Larger rectangles may represent more frequently traveled routes, while smaller ones may indicate less popular routes.

3. Identifying Busiest Routes: Within the tree map, clusters of larger rectangles can indicate high-traffic routes or hubs where many flights originate or terminate. This can be valuable information for airlines, airport operators, and travelers alike, helping them understand which routes are most in demand.

4. Regional Patterns: The tree map can also be organized to reflect regional patterns in air travel. By grouping cities by geographic region or continent, viewers can quickly identify trends in air traffic within specific areas. This can be useful for airlines in planning routes and schedules, as well as for travelers in understanding common travel corridors.

In summary, a tree map offers a powerful way to differentiate flights by air time and their origin-destination cities, providing valuable insights into air travel patterns, route preferences, and regional variations. By visualizing complex data in a hierarchical format, it enables stakeholders to make informed decisions related to airline operations, airport management, and travel planning.

As per our previous visualizations,

Enhanced Scatter Plot with Encodings between CRS Elapsed Time, Elapsed Time, Air Time, Distance

The above scatter plot using multiple encodings from the Data Analysis part of the project leads to the following visualization. The observation for the graph was:

- The scatter plot suggests several trends between the scheduled and actual flight times, as well as how distance and air time relate to these variables.
- A direct and proportional link exists between the planned and real-time durations of flights, indicating predictability in scheduling.
- Outliers are visible where the actual time far exceeds the scheduled time, hinting at possible delays or extended flights.

GRAPH 4
Performance of Airlines - Cancellation and Diversion of flights
Lines & columns (grouped) graph
https://public.flourish.studio/visualisation/16788269/
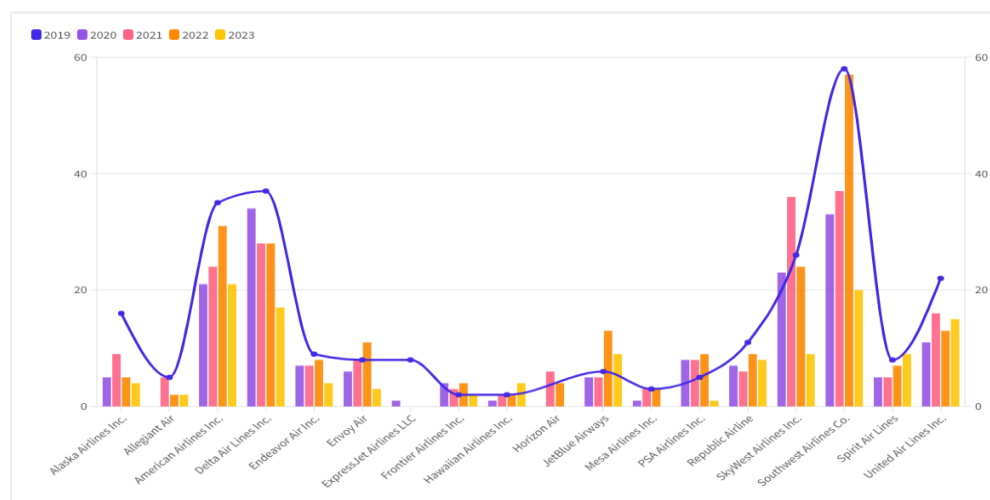
The graph is a multi-year comparison of flight cancellations and diversions for various airlines, showing both trends over time and comparing airlines against each other. The lines represent a cumulative trend across all airlines for each year, which emphasizes the peaks and troughs of flight disruptions.

1. Overall Industry Trends: The cumulative trend lines across all airlines for each year highlight the general trends in flight disruptions within the industry. Peaks indicate periods of higher disruptions, possibly due to external factors like weather events, air traffic control issues, or other operational challenges.

2. Yearly Performance Comparison: Comparing the cumulative trend lines for each year allows for a year-over-year analysis of flight disruptions. A consistent increase or decrease in disruptions over the years could indicate systemic issues or improvements in the industry's operational efficiency.

3. Airlines' Performance Comparison: By comparing individual airlines' lines on the graph, it's possible to assess how each carrier fares concerning flight cancellations and diversions. Airlines with consistently lower lines indicate better performance and reliability in maintaining their flight schedules.

4. Identifying Outliers: Sudden spikes or drops in an airline's trend line compared to others or compared to its own previous performance could indicate specific incidents or changes in operational procedures. Investigating these outliers can provide valuable insights into the factors affecting an airline's reliability.

5. Predictive Analysis: Analyzing historical data on flight disruptions can also aid in predictive analysis, allowing airlines to anticipate potential challenges and take proactive measures to minimize disruptions in the future. Overall, this multi-year comparison of flight cancellations and diversions offers a comprehensive view of the airline industry's performance and provides valuable insights for stakeholders, including airlines, regulators, and passengers, to make informed decisions and improvements.