A1: Analysis of Carrier On-Time Performance

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1. Executive summary

This study uses flight data from the Bureau of Transportation Statistics to examine domestic airline on-time performance in the United States. Although legacy carriers still hold a significant market share, Southwest's rise indicates they may face competition. Seasonal patterns show lower delay frequencies on Fridays and at month's end. Airport delays caused by weather at locations like Pago Pago and Portsmouth highlight the necessity of preventative measures like updated weather forecasts and infrastructure upgrades. Although the insights offer a good starting point, the report recognizes the dataset's limits and urges further investigation to comprehend seasonal fluctuations fully. Airlines can use these findings to maximize productivity, reduce wait times, and strengthen resilience in the ever-changing world of air travel.

2. Introduction

In the aviation industry, punctual performance is crucial for both airlines and passengers. Flying times are one of the most critical factors, and they significantly impact cost and itinerary planning. The complex network of interrelated schedules is susceptible to disruptions from delays and cancellations, which may be costly for airlines and inconvenient for travelers. Acknowledging the complexities of this relationship, this analysis explores the complex terrain of punctuality in the domestic airline sector in the United States. Using extensive data from the Bureau of Transportation Statistics, our research attempts to identify the fundamental causes of flight delays, providing priceless insights into the complex operations of the aviation industry.

3. Number of flights per airline

The legacy carriers American, Delta, and United still dominate the US skies, operating the most flights by far in 2023 due to their massive size and scale with 138,943, 116,273, and 102,205 flights, respectively. However, Southwest Airlines is rising rapidly as a low-cost powerhouse, taking over third place from United, with 112,430 flights this year (ref. chart 1 and query 1). Though dwarfed by the "Big Three," Southwest's ascent shows budget airlines becoming increasingly threatening legacy dominance. With Southwest matching the flight volumes of United and significantly outpacing other discount peers like JetBlue (6th) and Spirit (7th), the industry could see the balance of power shift towards leaner, lower-cost carriers making inroads on market share. The numbers indicate that travelers have an

appetite for competitive budget fares. If Southwest and similar airlines continue aggressive expansion despite economic turbulence, the democratization of the airline industry led by scrappy upstarts could force a reckoning for traditional giants relying on brand loyalty.

4. Seasonality of delay

Friday experiences the fewest delays in a week, registering only 850 minutes of delay (see chart 2 and query 2). Furthermore, there are fewer delays at the end of the month; the 25th, 22nd, and 27th, for example, recorded delays of 784, 803, and 812 minutes, respectively, indicating the dates with the fewest instances of delays (ref. chart 3 and query 3). It is important to remember that the data is only as representative as January 2023, limiting its potential. Furthermore, the lack of sufficient data made it impossible to analyze delays per hour or month thoroughly.

5. Delays compared to plane age

While the general trend seems to suggest that planes used earlier in the month experienced higher delays, with the highest number of delays being 991 minutes on the 9th, 970 minutes on the 14th, and 966 minutes on the 5th, it is essential to note that the age of the planes is not explicitly considered in the given data as the first usage of the plane in the dataset was considered as the first usage of the plane overall (ref. chart 4-5 and query 4). Furthermore, the data about the delays should span over a more extended timeframe.

6. Number of people flying between different locations over time

Assuming that the number of flights is proportional to the number of passengers between two locations. The number of people flying between different locations is relatively constant for travel with fewer flights (ref. chart 6 and query 5). However, some seasonality can be found for travels with a higher number of flights. For example, the flights from Boston to New York have a weekly dip (ref. chart 6 and query 5). When investigated deeper, the number of flights on Saturday is lower. This makes sense as New York is a tourist destination, and most people want to go for at least the whole weekend. However, once more, the amount of data does not permit us to make a reliable overview of the situation.

7. Percentage of flights delayed due to the weather

Considering that the analysis only consists of January 2023, the airport with the highest percentage of delays due to weather is Pago Pago International Airport, with 45.45%. This is more than 10% more than the second highest, namely Portsmouth International Airport (31.58%) (ref. chart 7 and query 6). Both airports are known for their lousy weather during January. Pago Pago is known for its extreme weather conditions, including tropical storms, cyclones, and heavy rainfall. These conditions can lead to flight delays and cancellations, making it difficult for planes to take off or land safely. Additionally, the airport is relatively small and lacks the same infrastructure and resources as larger airports, which can also contribute to delays. For Portsmouth International Airport, the cold temperatures and inclement weather are making it difficult to maintain the airplanes and the traffic, leading to delays.

8. Insights

Due to weather, significant differences in on-time performance are found at airports such as Pago Pago (45.45%) and Portsmouth (31.58%). This brings to light a problem for airplanes operating in areas that frequently experience bad weather, requiring extensive modifications.

By investing in modern weather forecasts, airlines can monitor conditions proactively and prevent interruptions. Adjusting the schedule dynamically based on current weather information maximizes operational effectiveness and minimizes delays.

Working with local government to improve infrastructure, such as airport fortification against bad weather and deicing capabilities. Creating alliances and pooling resources enhances the aviation ecosystem's overall resilience.

Airlines can prepare for inclement weather by creating specialized contingency plans with standardized procedures and reactions. Plans are refined by regular drills, ensuring efficient implementation.

Recognizing that weather universally affects on-time performance, airlines that apply these insights strengthen their operations, stay resilient, and meet high criteria for on-time performance in various locations.

Second, a clear temporal pattern emerges from the study, showing that Fridays and the end of the month had lower frequencies of delays. Airlines can significantly benefit from

understanding and recognizing these seasonal fluctuations when optimizing their operational strategy, particularly regarding scheduling and resource allocation. This strategic optimization—motivated by comprehension of seasonal patterns—can improve on-time performance within time periods.

However, it is crucial to acknowledge the context and limitations associated with the available data. Due to the dataset's limitation to January 2023, it may not fully capture the range of seasonal variations influencing on-time performance. Therefore, more research is necessary for a more complete and nuanced knowledge of these variances. A more extensive data set spanning several months and seasons would offer an all-encompassing perspective, enabling airlines to make better decisions based on a more comprehensive temporal context.

In the face of this limitation, the identified insight serves as a foundational starting point for airlines. It motivates us to explore the intricacies of seasonal patterns in more detail, setting the stage for further research projects. Despite its limited breadth, this preliminary insight encourages airlines to investigate compensatory actions and tactics, promoting a proactive approach to handling variations in on-time performance throughout the year.

Optimizing operational efficiency remains paramount as airlines navigate the dynamic air travel landscape. By leveraging insights derived from seasonal variations, airlines can tailor their approaches, introducing scheduling and resource allocation flexibility. This adaptability contributes not only to minimizing delays but also to enhancing overall operational resilience.

In conclusion, while the present insight is based on limited data, it catalyzes airlines to embark on a more comprehensive exploration of influences on on-time performance. Embracing a proactive stance in understanding and adapting to these patterns positions airlines to make informed decisions that positively impact the reliability and efficiency of their services across diverse temporal contexts.

9. Annex

Chart 1:

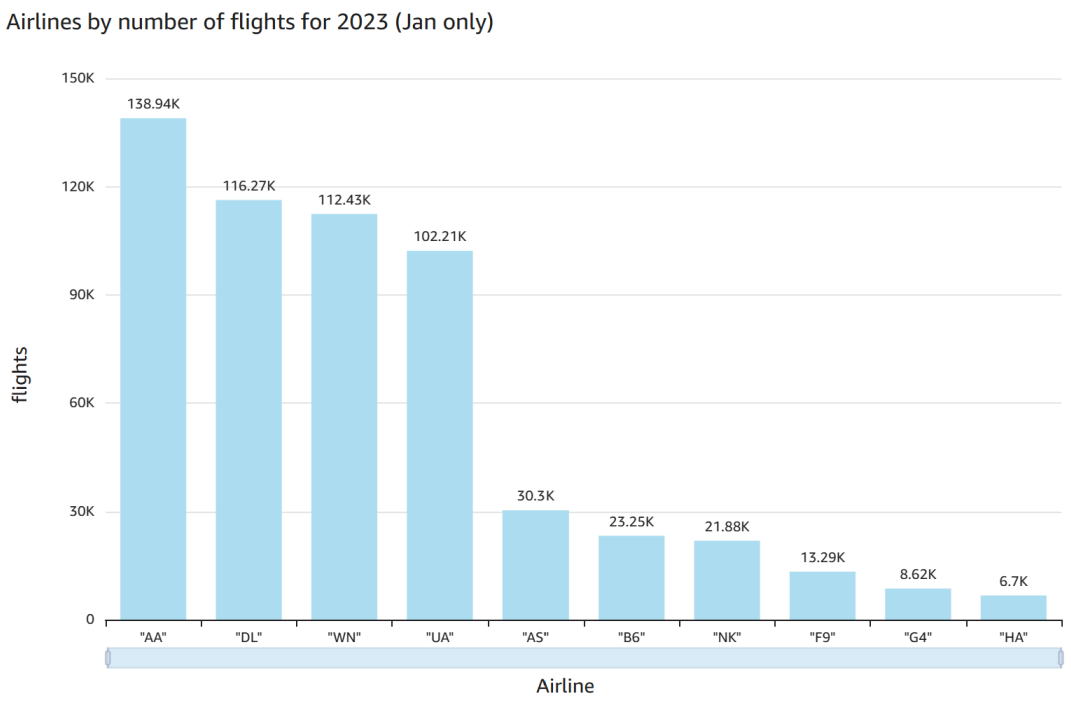


Chart 2:

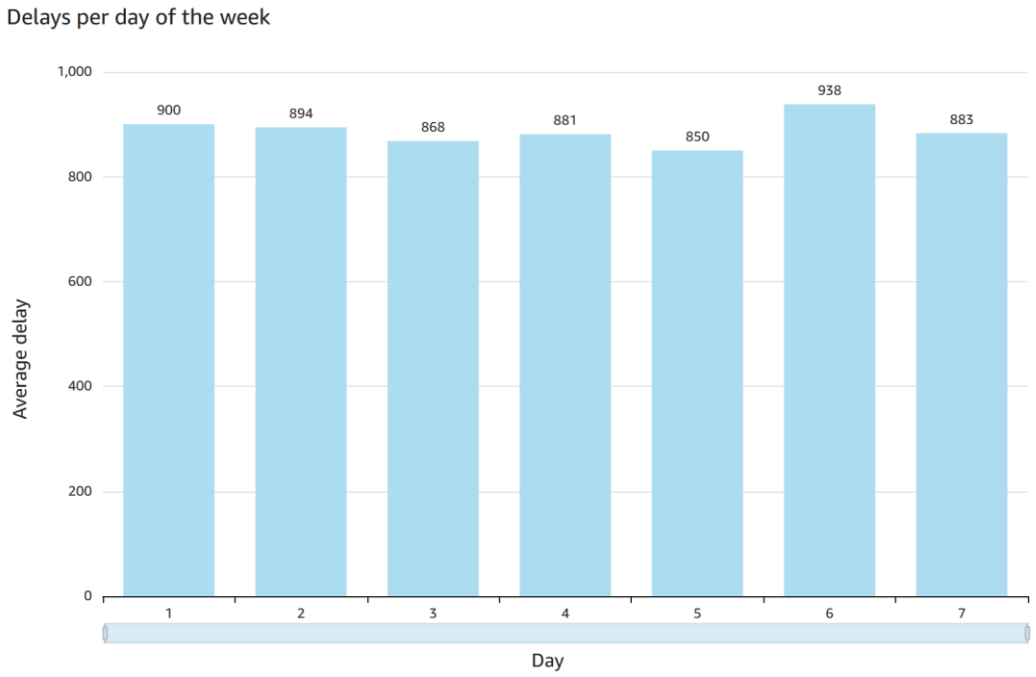


Chart 3:

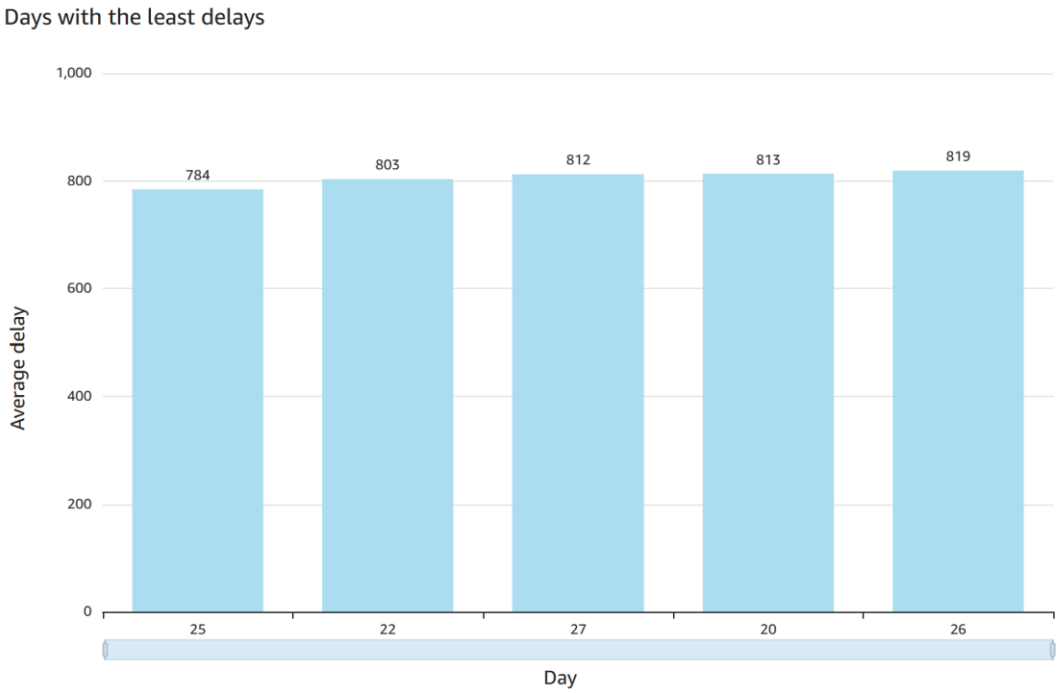
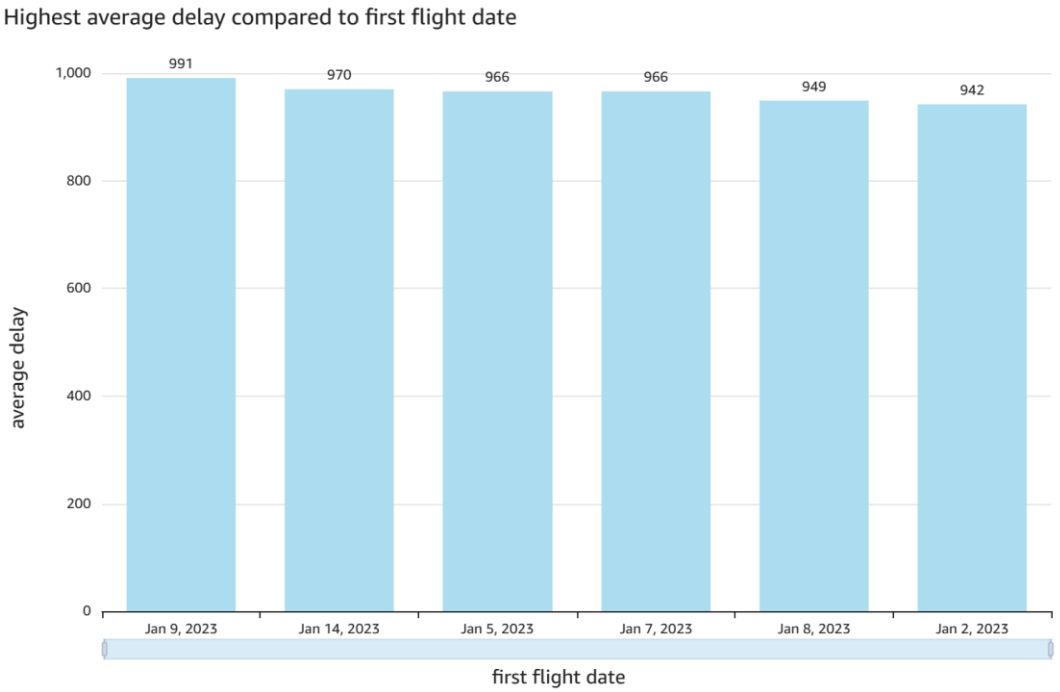


Chart 4:



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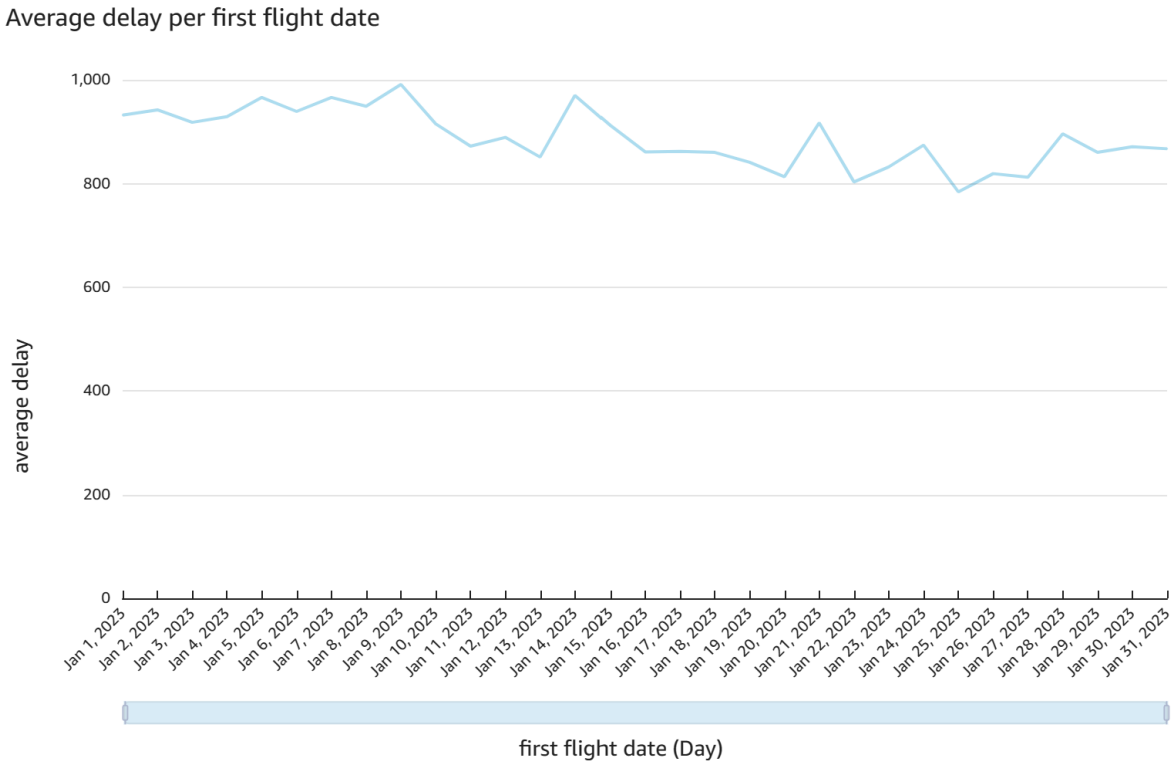
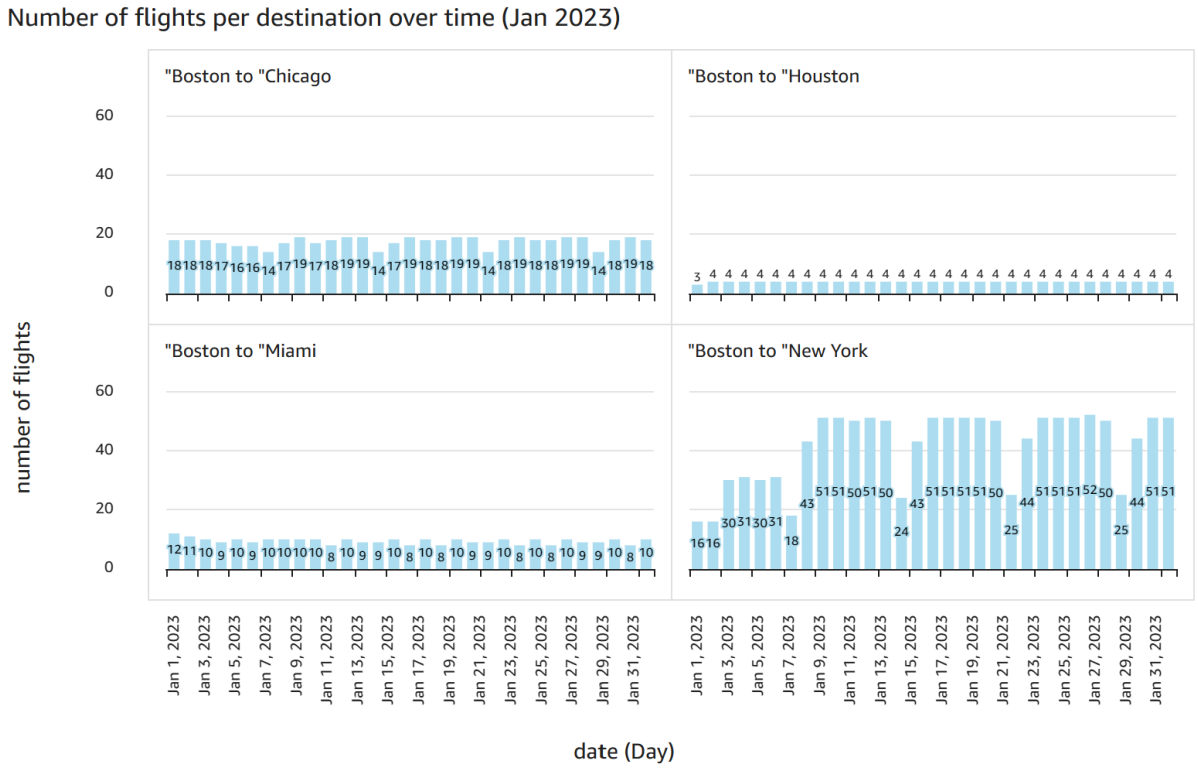


Chart 6:



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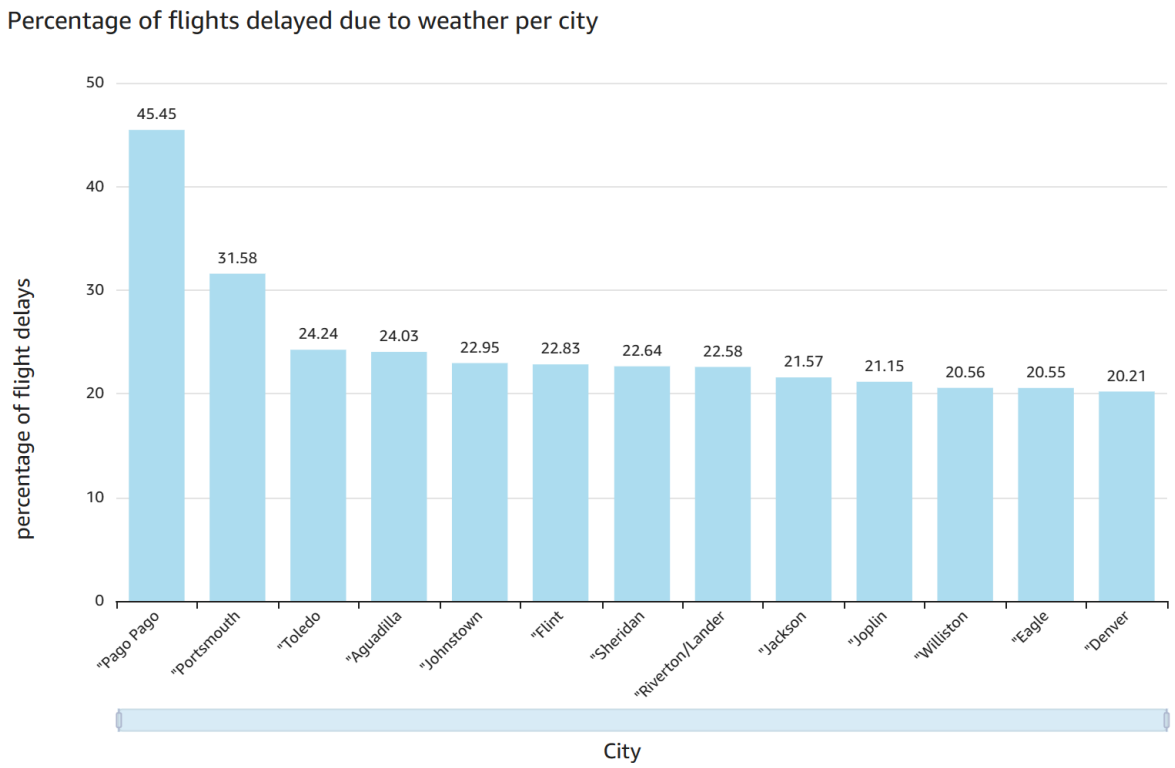
Percentage of flights delayed due to weather per city
percentage of flight delays
50
40
30
20
10
0
45.45
31.58
24.24
24.03
22.95
22.83
22.64
22.58
21.57
21.15
20.56
20.55
20.21
"Pago Pago
"Portsmouth
"Toledo
"Aguadilla
"Johnstown
"Flint
"Sheridan
"Riverton/Lander
"Jackson
"Joplin
"Williston
"Eagle
"Denver
City