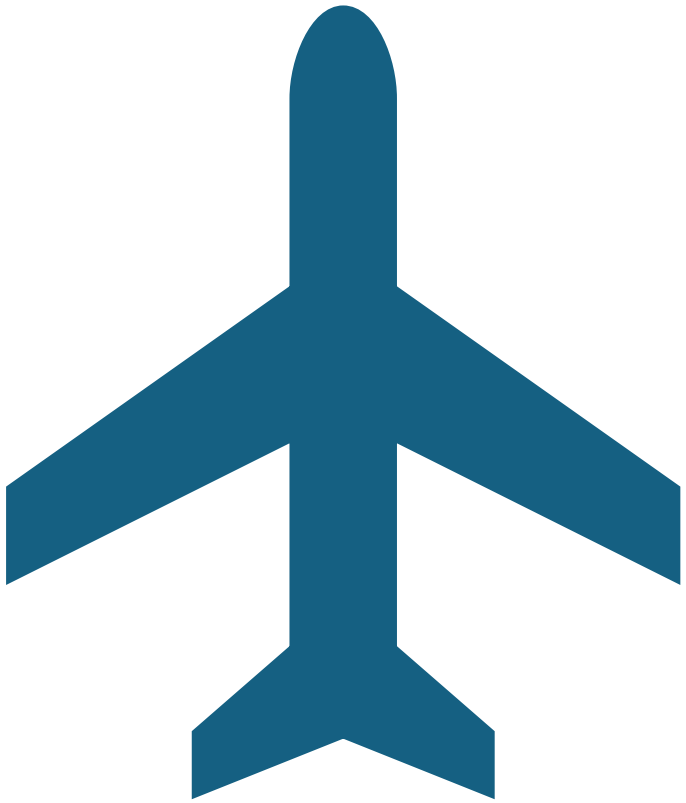
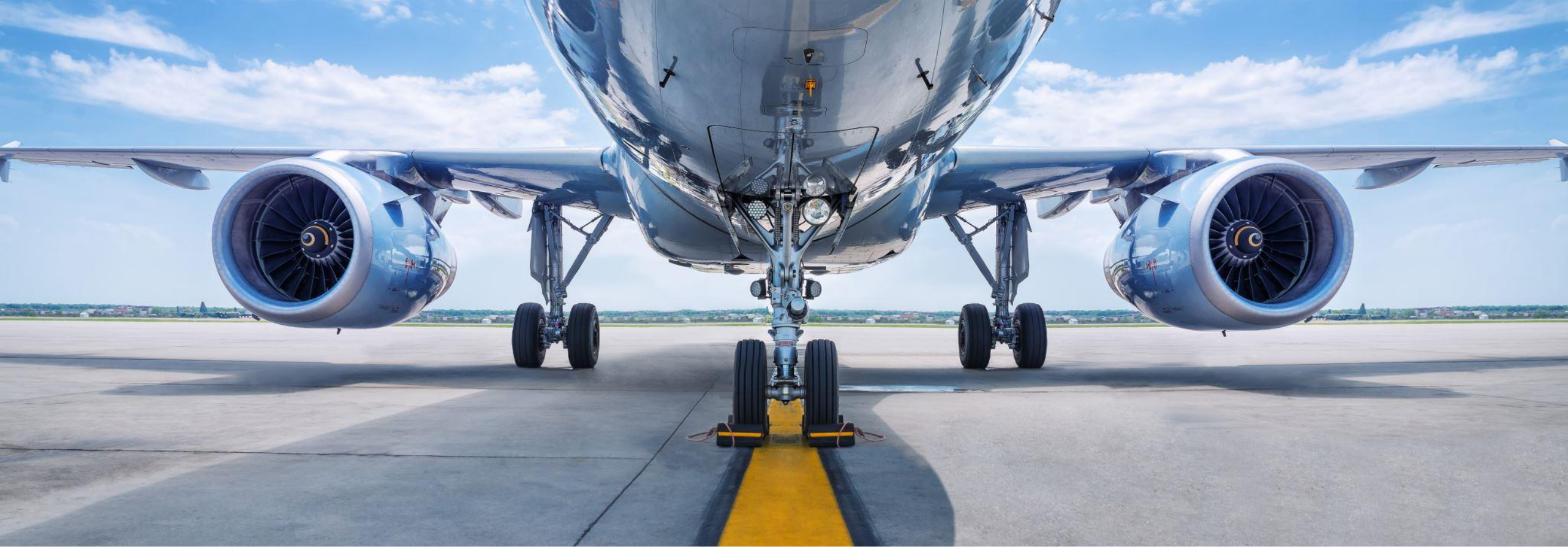


Airline Delay Analysis

CIS 4560 Professor Jongwook Woo

By

Cristian, DJ, Sarah, Monica, Kevin, Adrian



Why we chose this topic?

If you have ever taken a flight anywhere, chances are you have experienced your plane being delayed at take-off. There could have been an issue with weather, the airline, security, or the aircraft arriving late. But if you were ever curious to know what airlines, which airports, and for how long you or any other plane was delayed for, you will find that information here.

Agenda

- Data Source & Github
- Workflow Map – Data Analysis
- Types of Delays
  - Aircraft
  - Airline
  - Security
  - Weather
- Cancellations
- Flight Patterns
- Total Minutes
- Conclusion

Airline Legend

Code	Airline
9E	Endeavor Air Inc.
AA	American Airlines
AS	Aaska Airlines
B6	JetBlue Airways
CO	Continental Airlines
DL	Delta Airlines
EV	ExpressJet Airlines
F9	Frontier Airlines
FL	Air Tran
G4	Allegiant Air
HA	Hawaiian Airlines
MQ	American Eagle Airlines
NK	Spirit Airlines
NW	Northwest Airlines
OH	PSA Airlines
OO	Skywest Airlines
UA	United Airlines
US	US Ariways
WN	Southwest Airlines
XE	JetsuiteX
YV	Mesa Airlines
YX	Republic Airways
VX	Virgin America

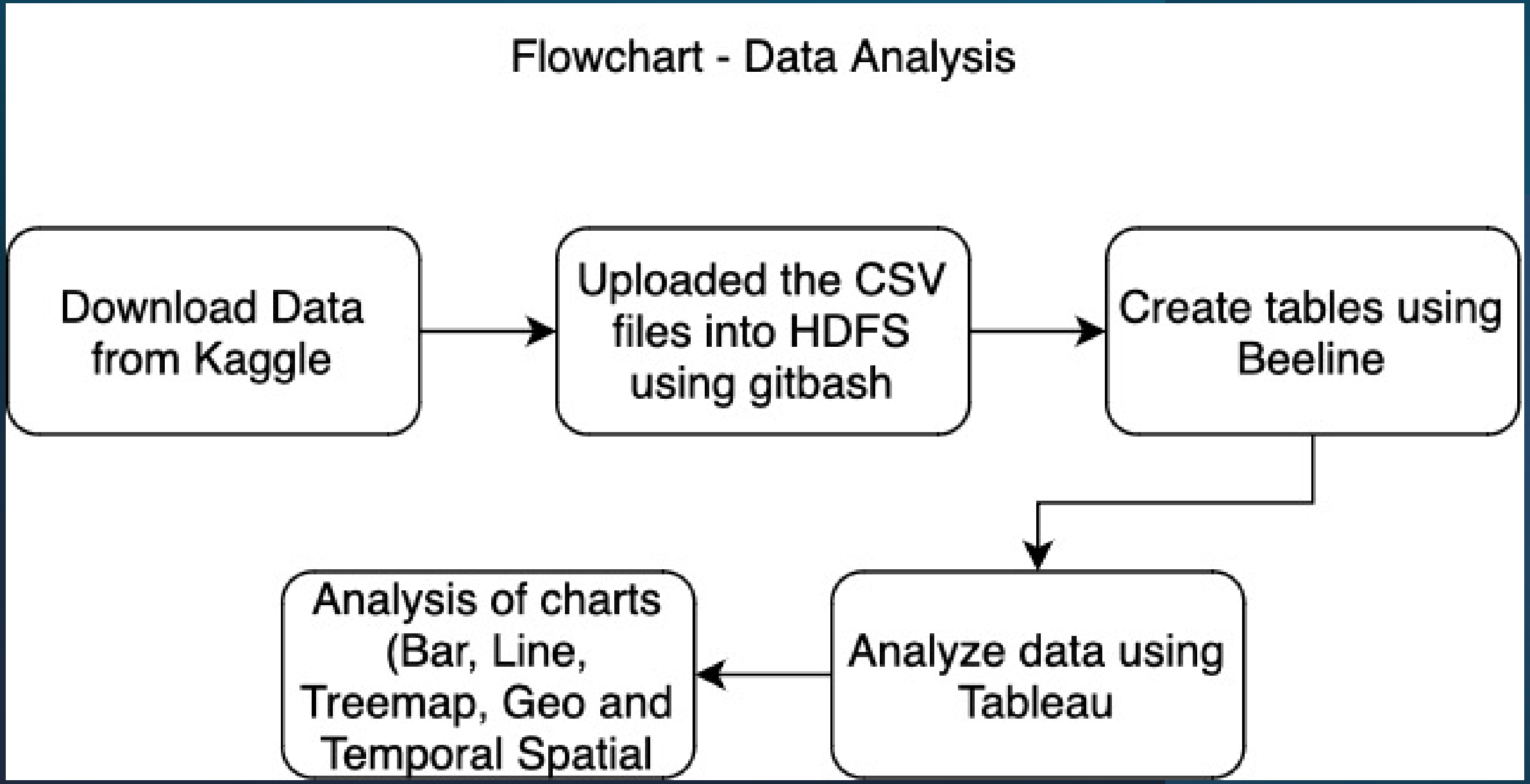
Data Source and Github

Data Source – Airline Delay Analysis (Kaggle)

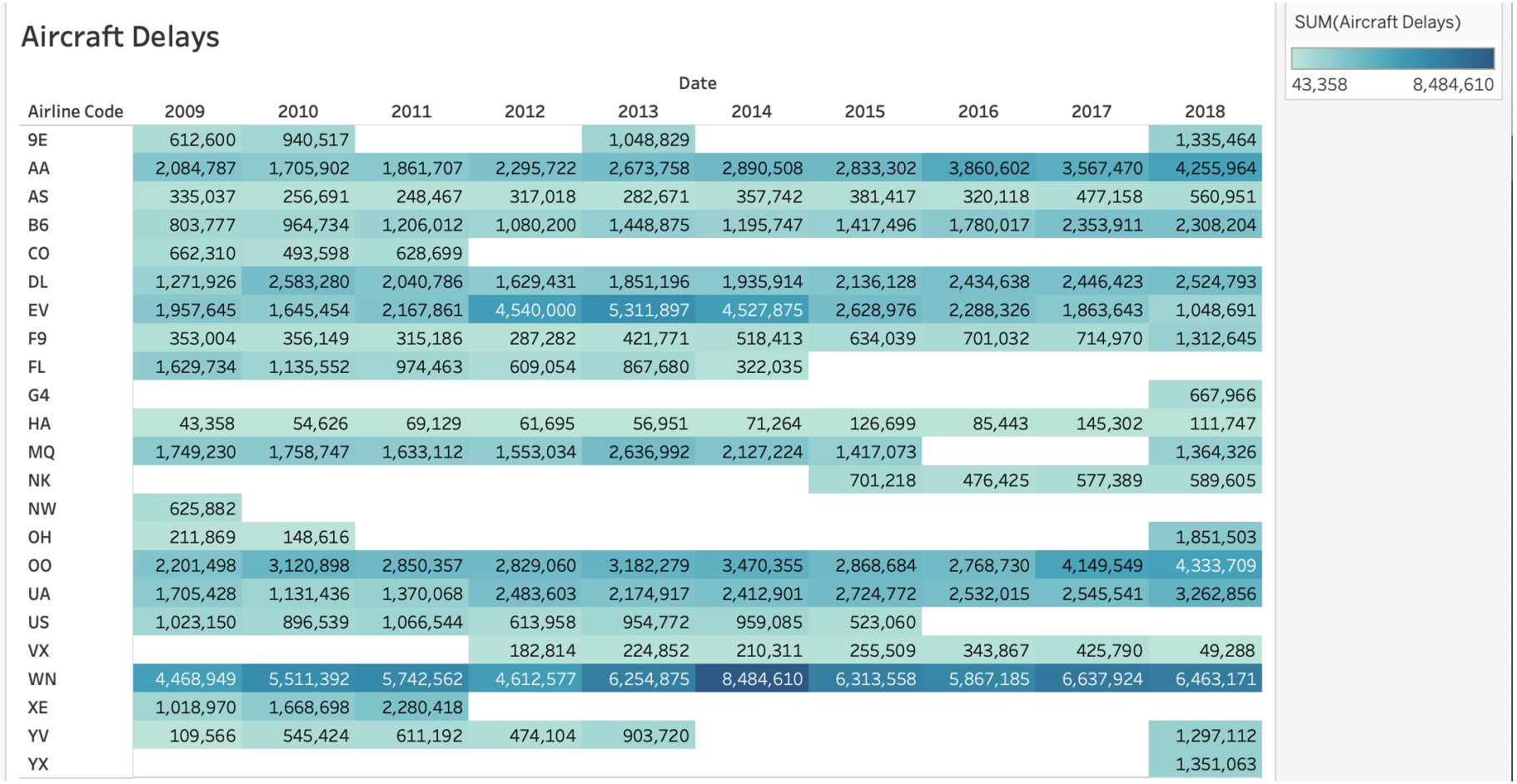
https://www.kaggle.com/datasets/sherrytp/airline-delay-analysis

7.7 GB of Data

Github – Link to tutorial documents and resources


Flowchart - Data Analysis
Download Data from Kaggle
Uploaded the CSV files into HDFS using gitbash
Create tables using Beeline
Analyze data using Tableau
Analysis of charts (Bar, Line, Treemap, Geo and Temporal Spatial

Aircraft Delays



Aircraft Delays

Airline Code	Date 2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
9E	612,600	940,517			1,048,829					1,335,464
AA	2,084,787	1,705,902	1,861,707	2,295,722	2,673,758	2,890,508	2,833,302	3,860,602	3,567,470	4,255,964
AS	335,037	256,691	248,467	317,018	282,671	357,742	381,417	320,118	477,158	560,951
B6	803,777	964,734	1,206,012	1,080,200	1,448,875	1,195,747	1,417,496	1,780,017	2,353,911	2,308,204
CO	662,310	493,598	628,699							
DL	1,271,926	2,583,280	2,040,786	1,629,431	1,851,196	1,935,914	2,136,128	2,434,638	2,446,423	2,524,793
EV	1,957,645	1,645,454	2,167,861	4,540,000	5,311,897	4,527,875	2,628,976	2,288,326	1,863,643	1,048,691
F9	353,004	356,149	315,186	287,282	421,771	518,413	634,039	701,032	714,970	1,312,645
FL	1,629,734	1,135,552	974,463	609,054	867,680	322,035				
G4										667,966
HA	43,358	54,626	69,129	61,695	56,951	71,264	126,699	85,443	145,302	111,747
MQ	1,749,230	1,758,747	1,633,112	1,553,034	2,636,992	2,127,224	1,417,073			1,364,326
NK							701,218	476,425	577,389	589,605
NW	625,882									
OH	211,869	148,616								1,851,503
OO	2,201,498	3,120,898	2,850,357	2,829,060	3,182,279	3,470,355	2,868,684	2,768,730	4,149,549	4,333,709
UA	1,705,428	1,131,436	1,370,068	2,483,603	2,174,917	2,412,901	2,724,772	2,532,015	2,545,541	3,262,856
US	1,023,150	896,539	1,066,544	613,958	954,772	959,085	523,060			
VX				182,814	224,852	210,311	255,509	343,867	425,790	49,288
WN	4,468,949	5,511,392	5,742,562	4,612,577	6,254,875	8,484,610	6,313,558	5,867,185	6,637,924	6,463,171
XE	1,018,970	1,668,698	2,280,418							
YV	109,566	545,424	611,192	474,104	903,720					1,297,112
YX										1,351,063

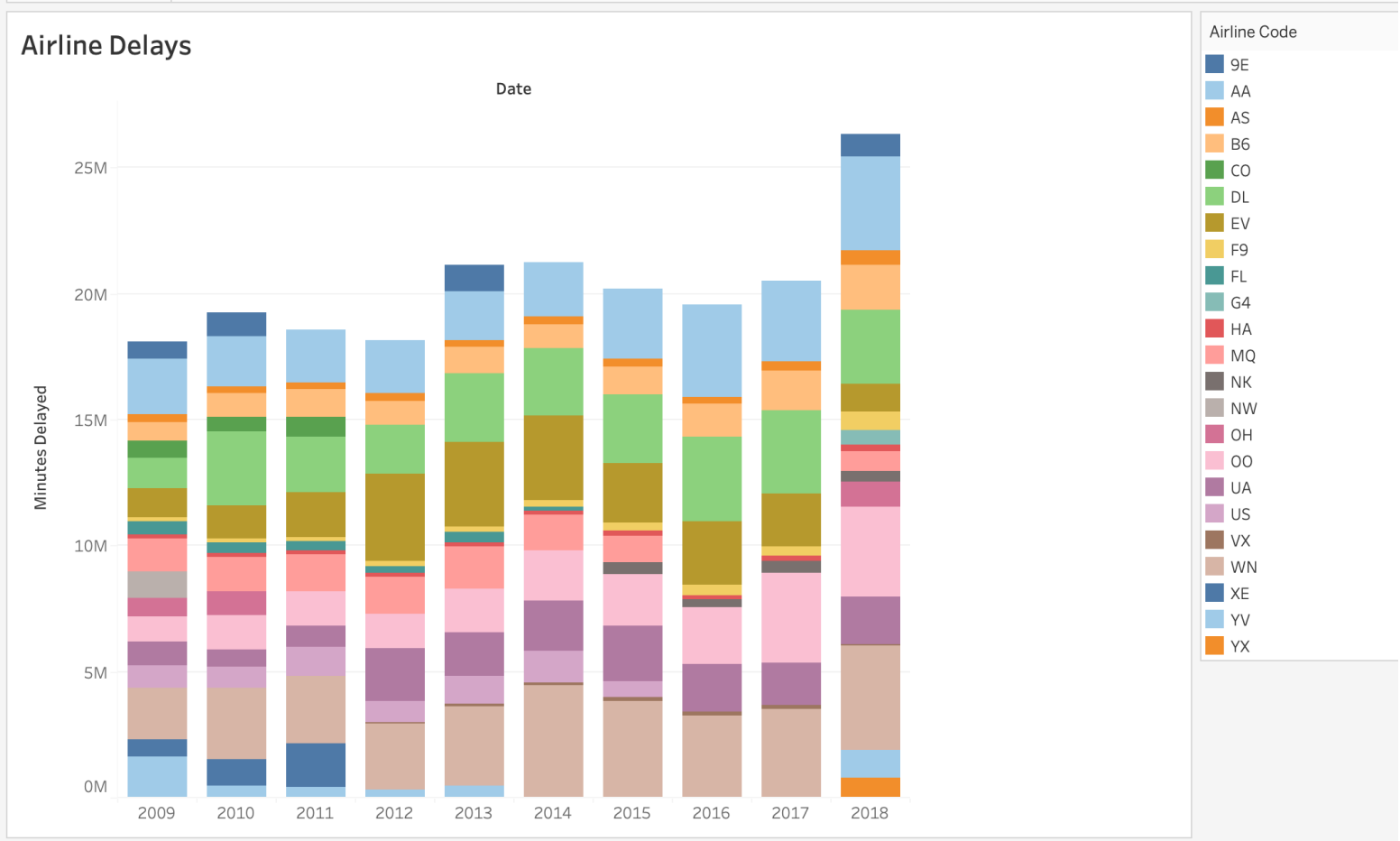
SUM(Aircraft Delays)

43,358 8,484,610

Aircraft Delay Analysis

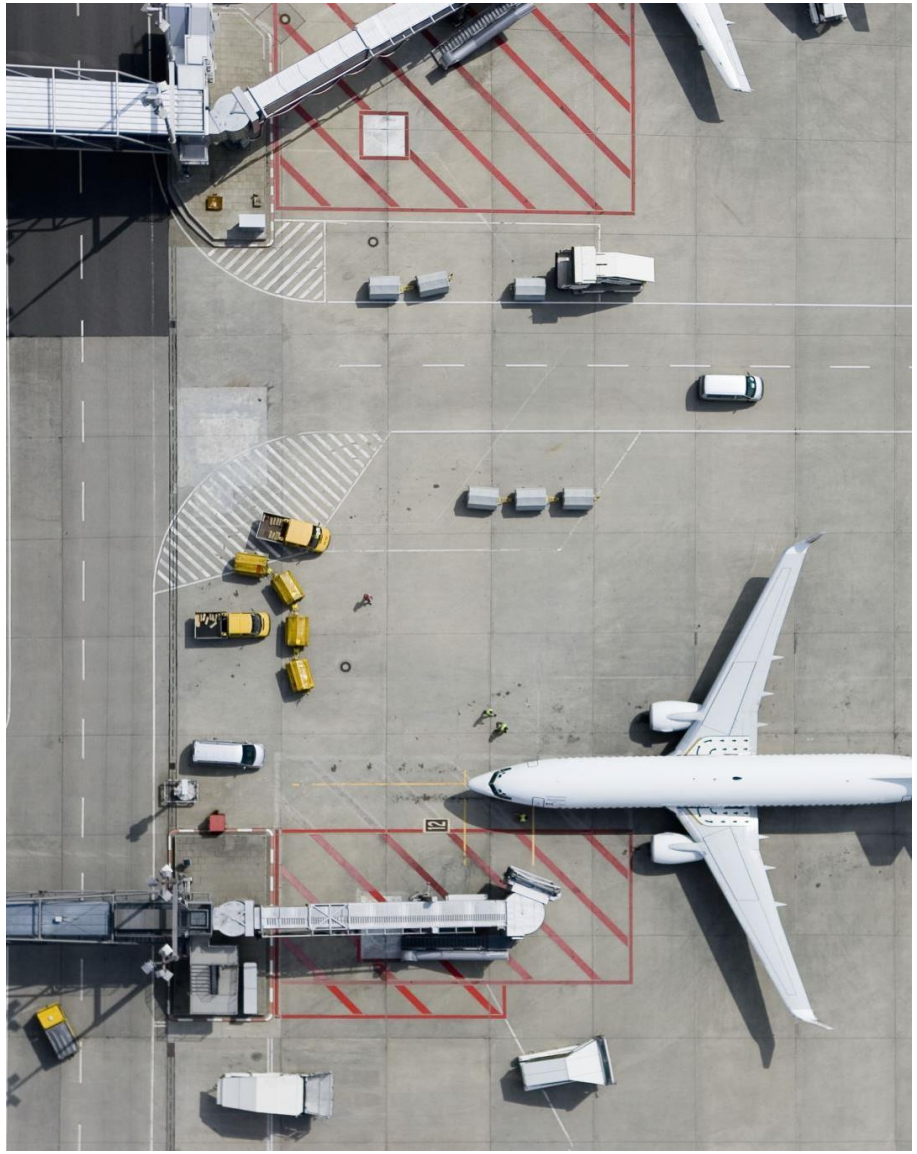
- The heat map allows the viewer to see the most aircraft delays that are a direct corrrelation to airline delays in a given year by any airline
- Hawaiian Airlines experienced the least amount of aircraft delays in 2009 with just over 43k, while also having the least amount on average over the 9-year span
- Southwest Airlines experienced the most aircraft delays in 2014 with a little bit over 8.4 million

Airline Delays



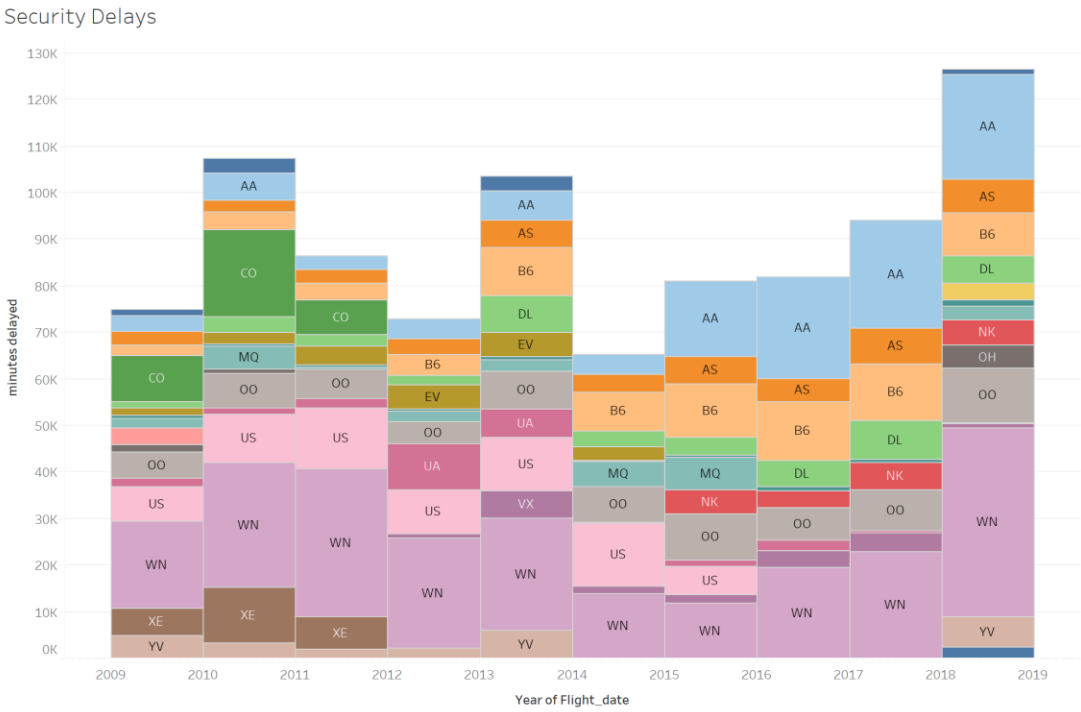
Airline Delays Analysis

- This portion of the analysis is secluded to the airline causing their own delays
- From the data, 2018 had the most airline induced delays with over 28 million, which is over 21% more than the next closest year in 2014 with just over 22 million delays
- Of the top 10 rated airlines, Southwest Airlines experienced the airline induced delays over that 9-year span every single year

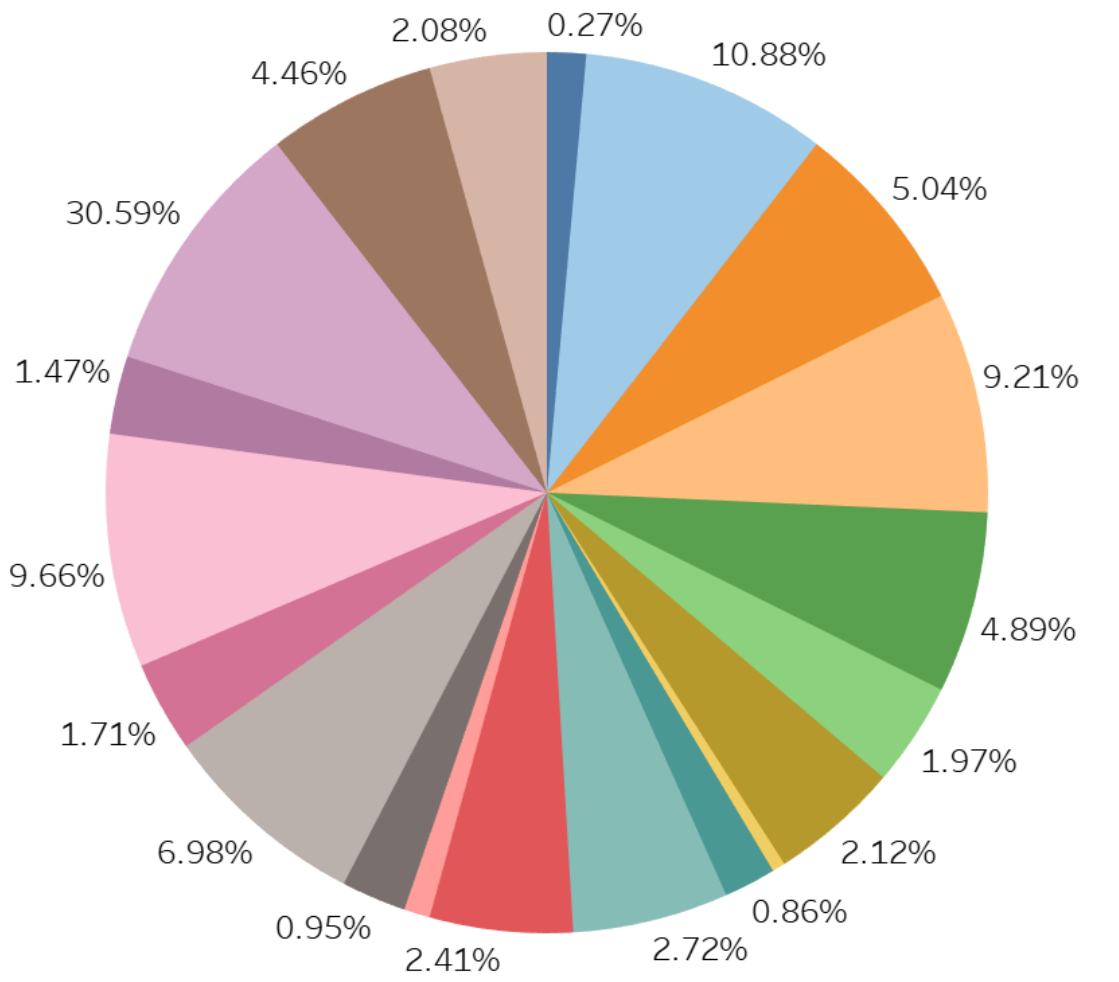


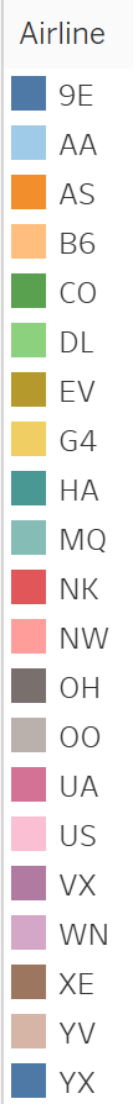
Security Delays by Minute

- Security Delays are the least impactful of all the major delay types
  - Showing significantly less total minutes delay overall versus the others
- WN airline leading in security delays from 2009-2018.
- Peaking 40,498 delays in 2018.
- American Airlines comes in second
- Spiked in 2019 over shutdown protests over withheld pay in numerous airlines



Security Totals
- Total count



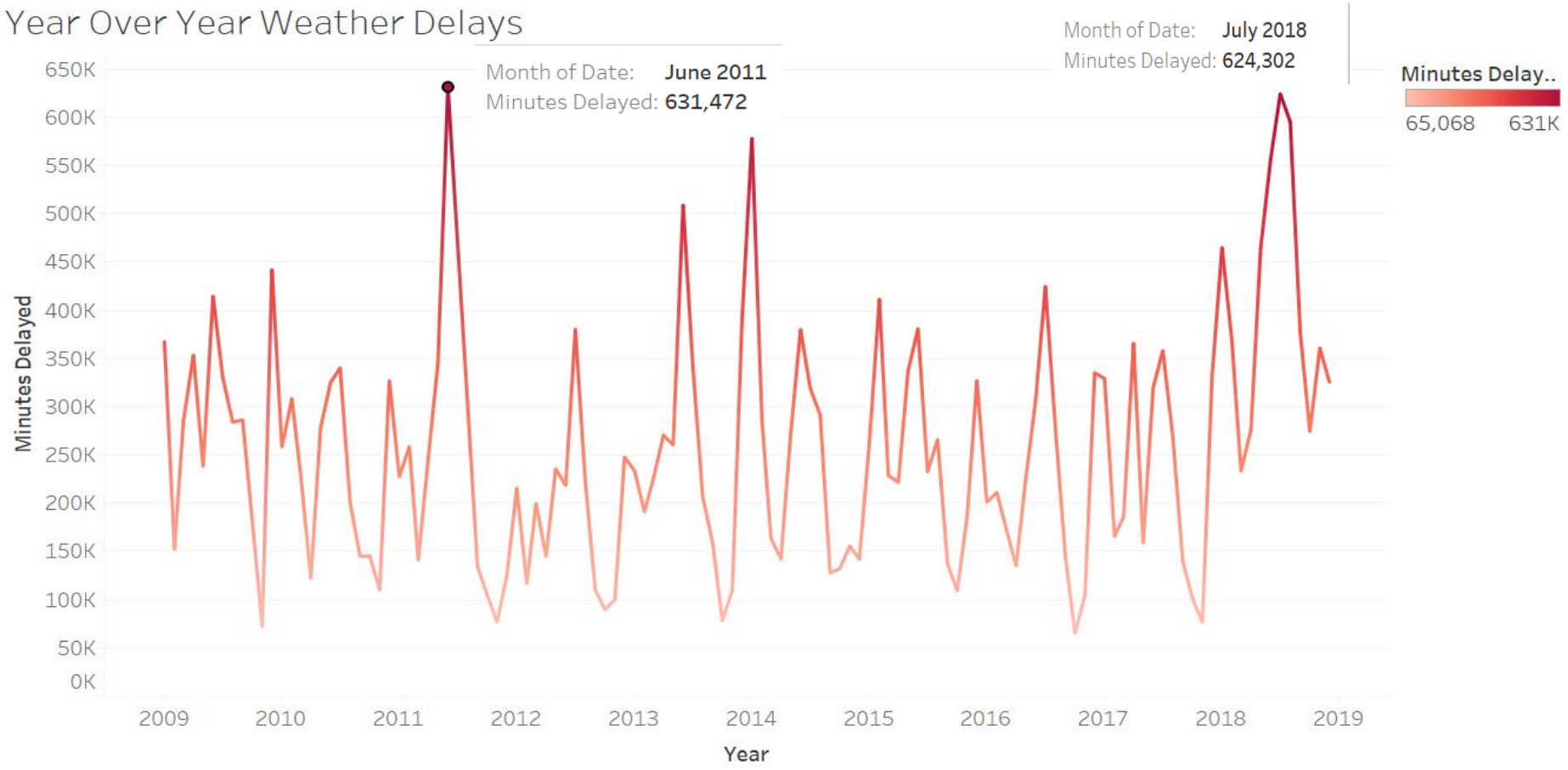


-Total counts of security delays

-30% are by Southwest Airlines, but still maintain good customer satisfaction

-These are caused by increased security measures, technical issues, and as staffing shortages

Weather Delay



Weather Delay Analysis

June 2011

Tornadoes: Above-average tornadoes impacted major hubs in the Midwest and Southeast.

Heat Waves: Affected air traffic through operational and safety constraints.

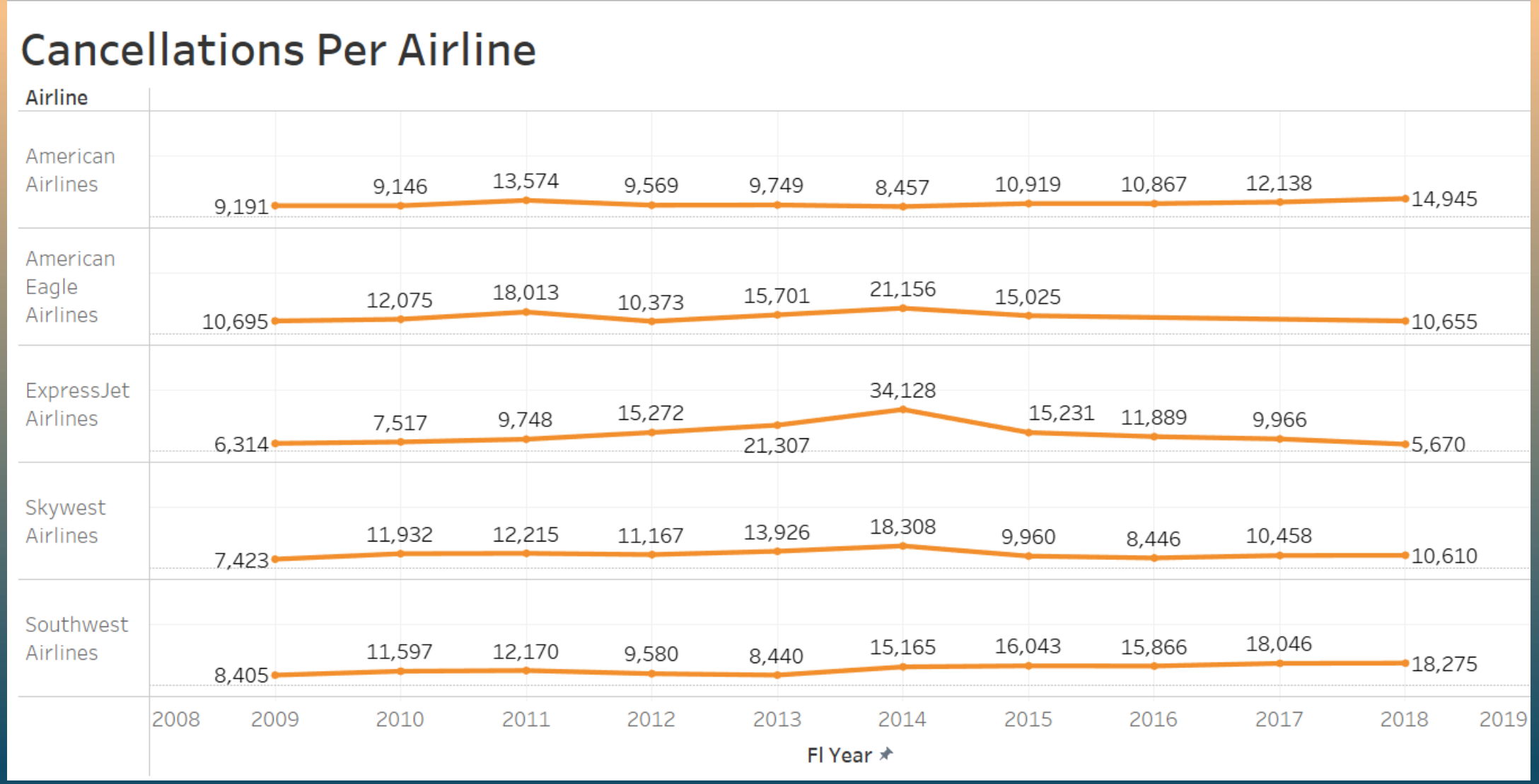
Thunderstorms: Caused frequent shutdowns and delays at key airports.

July 2018

Heat Waves: Record-breaking temperatures impacted operations and maintenance.

Wildfires: Reduced visibility and air quality, disrupting flights particularly in the western U.S.

Thunderstorms & Severe Weather: Led to significant delays in busy airspace.



Cancellations Per Airline

Top 5

Cancellations

- In 2014, there was a notable surge in flight cancellations across various airlines and airports.
  - **We can correlate this to a Weather Events**
- In 2014, a severe weather phenomenon known as the Polar Vortex swept across the United States.
  - In 2011, Passengers also faced travel disruptions in due to Hurricane Irene and it affecting various regions along the East Coast

Cancellations Per Airport

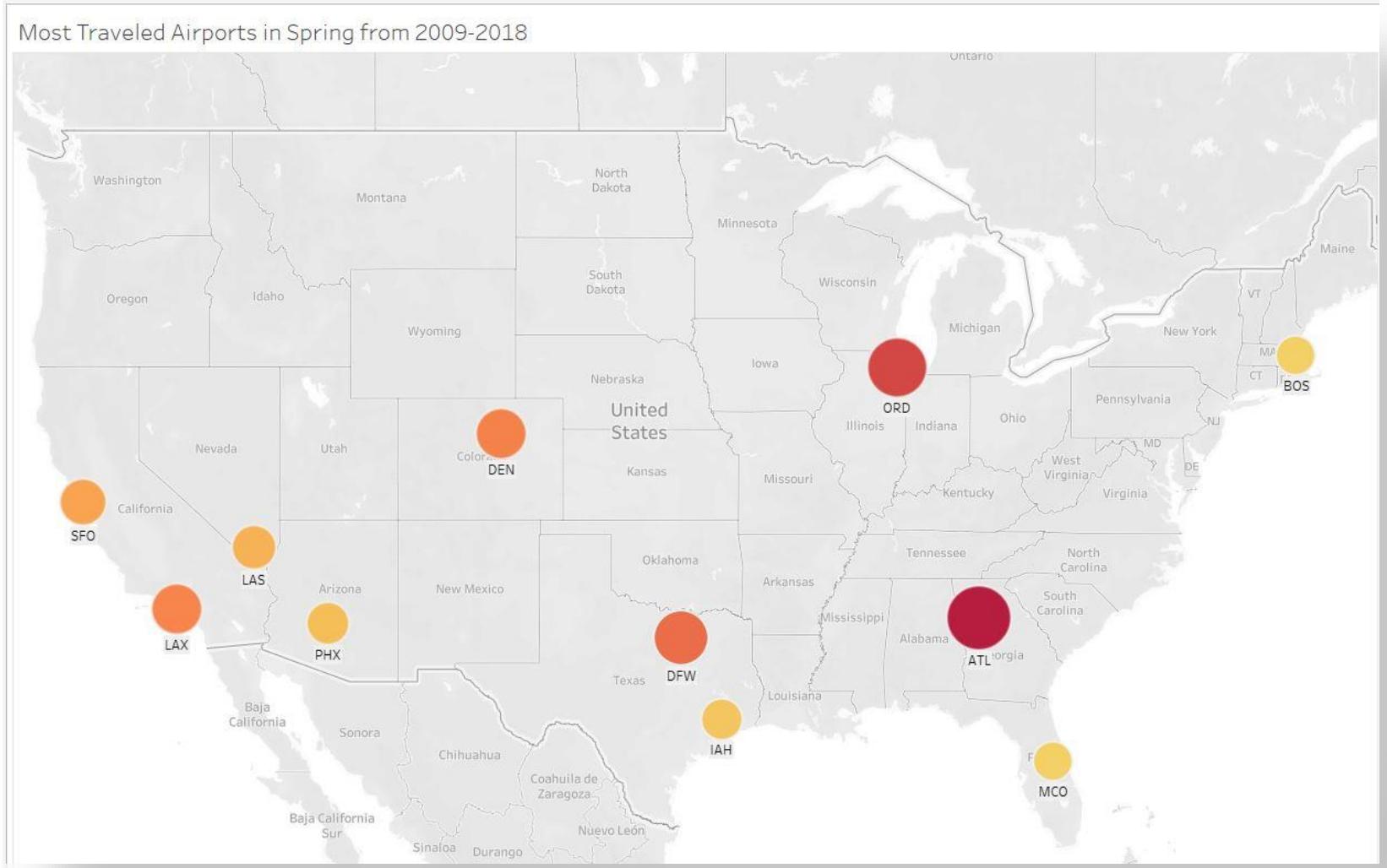
Top 5

Airport Correlations

- Factors such as these weather events and operational challenges can cause air traffic congestion.
- The data shows that these conditions disrupted air travel operations, leading to widespread flight cancellations and delays.

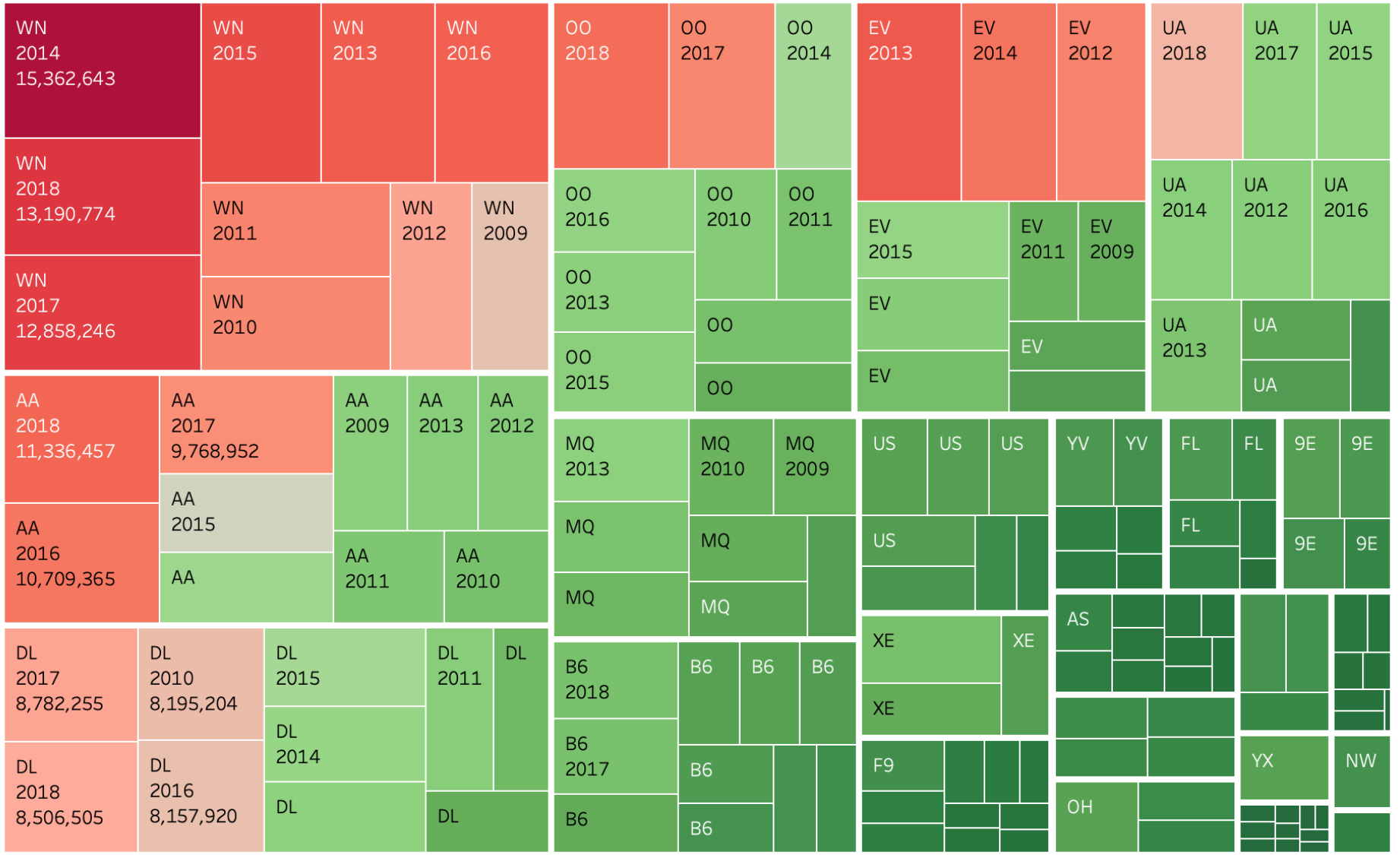
Flight Patterns

Airports with the Heaviest Traffic During the Spring



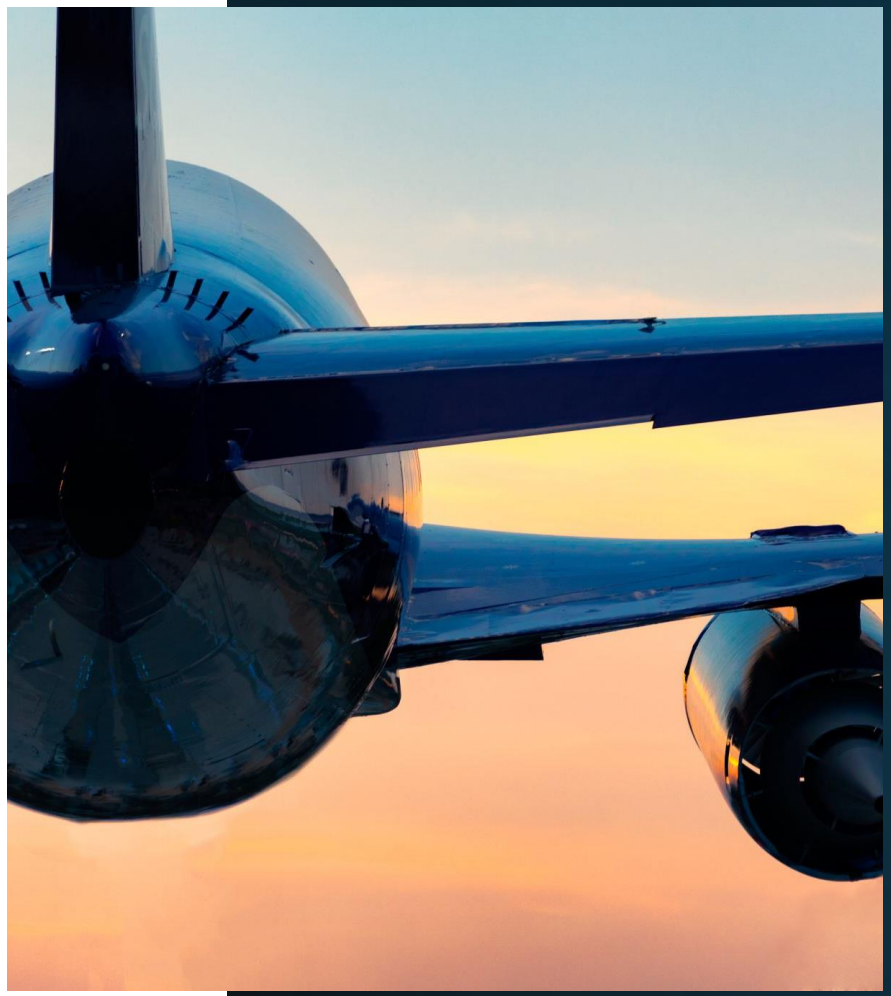
In 2023 Los Angeles, San Fransisco, Denver, Dallas, and O'Hare International Airports were included in lists of the top 10 worst airports to travel through in the United States. Despite being the busiest airport in the world, the Atlanta International Airport has consistently been ranked as one of the best airports to pass through.

Total Minutes Delayed - Airline



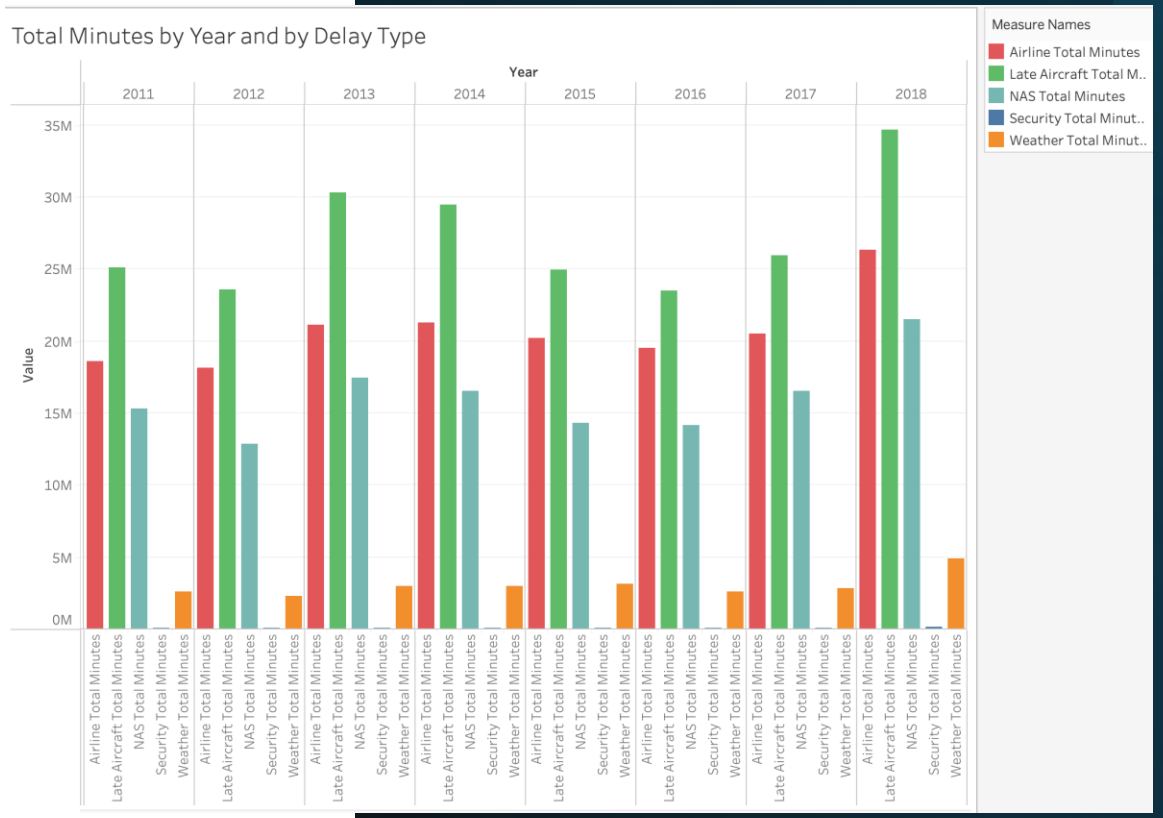
Total Minutes Delayed by Airline per Year

- Southwest is the airline with the most minutes delayed over the years from 2009-2018
- Of the major airlines, American Airlines and Delta Airlines rank in the top 3 of total minutes delayed.
    - Other factors that can attribute to this is the sheer number of flights each airline flies each year
- If arriving on time, or just leaving at your scheduled time is important, you may want to avoid the top 5 airlines listed on the tree map



Total Minutes Delayed by Type

- From 2011-2018, late aircrafts dominated the total minutes delayed per year by a significant margin.
  - In large part because other delays can have a major impact on aircrafts being late.
  - If an aircraft is delayed at take off for any reason, it is safe to assume that there is a possibility that the next flight that plan must make after landing at its destination will be delayed
- We can also see that security delays are seldom the reason why a flight is delayed, with totals never surpassing even the 500k minutes mark.



Conclusion

- ✓ - There are too many flights happening every day in the world, let alone every year
- ✓ - In 2018, for Late Aircraft delays, we clocked in over 64 years of delay time
  - ✓ Multiple flights happening at the same time globally
- ✓ Airlines cause the most delays of the what we have explored today
  - ✓ As we have heard in recent news, it is due to negligence by the Airlines and the manufacturer's in maintaining their aircrafts

FIN

Resources

- *Airlines set records for first half of 2012 in On-Time performance, fewest cancellations and tarmac delays, lowest mishandled baggage rate*. (n.d.). Bureau of Transportation Statistics. https://www.bts.gov/content/airlines-set-records-first-half-2012-time-performance-fewest-cancellations-and-tarmac-delays
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- NASA. (n.d.). *The 2013-2014 polar vortex adds data points to the books - NASA science*. NASA. https://science.nasa.gov/earth/extreme-weather-events/the-2013-2014-polar-vortex-adds-data-points-to-the-books/
- Los Angeles Times. (2011, August 27). *Airlines cancel nearly 5,000 flights because of Hurricane Irene*. Los Angeles Times. https://www.latimes.com/travel/la-xpm-2011-aug-27-la-me-0827-flights-cancel-20110828-story.html