PURDUE DATA MINE CORPORATE PARTNERS SANDIA FLIGHT COVID FLIGHT INVESTIGATIONS

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Abstract

The goal of the COVID team is to determine how COVID-19 has affected flights in the United States, so that the industry might be better prepared for a similar event in the future. There are four groups that are each investigating a different side of how COVID has affected flights.

Background

- On March 11, 2020, the WHO declared the COVID-19 outbreak to be a pandemic. Over the course of the pandemic, air travel across the world has drastically changed. Travel bans and other precautions were taken to prevent the spread of the disease, which had direct impacts on air travel.
- We chose to study these impacts, hoping to find insights into how the pandemic affected air travel and what actions could be taken to be better prepared to deal with future pandemics.
- For our research, we used flight data from January 2019 through October 2020.
- Our main tool used to conduct these studies was a Python library called Tracktable, used for trajectory analysis and visualization.

Flight Density Evolution

- We were interested in the pandemic's effect on where planes flew & how often they flew.
- We decided that a 2D histogram would be the best way to breakdown the data into useable chunks.
- A latitude/longitude block is broken into 25 partitions and colored based on the number of points in that partition.
- After importing a day's worth of trajectory data, we use Tracktable to generate a 2D histogram.
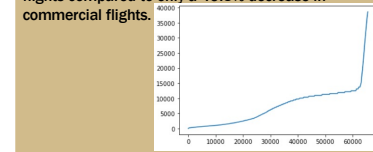- This density table is then plotted above a map of the US, using a logarithmic scale.

top: densities on 04/04/2019
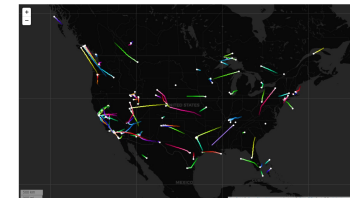*bottom: densities on 04/04/2020*
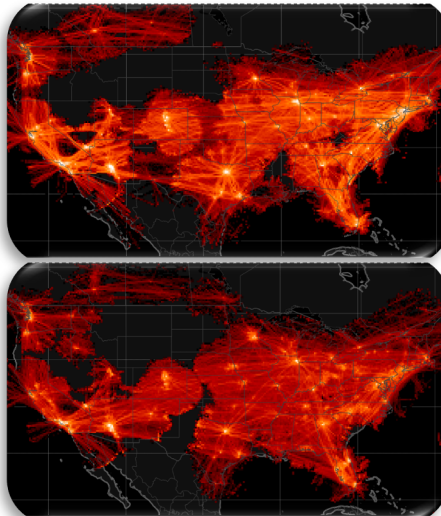
Comparison of Commercial vs Private Flight Trajectories

To distinguish between commercial and private flights, we took the maximum altitude of each flight. Once we took all the maximums, we were able to discover any flight flying over 13,000 ft was a commercial flight and any flight under was a private flight. We then rendered the trajectories for flights that under 13,000 feet and over 13,000 feet separately.

The average duration of a flight before the pandemic was 0.73 hours however it was 0.77 hours during. This means there were less short (private) flights compared to longer (commercial) flights. There was also a 62.5% decrease in private flights compared to only a 49.5% decrease in commercial flights.

Less than 13,000 feet

More than 13,000 feet

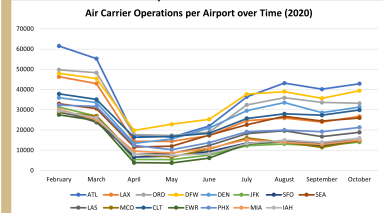|	% total (2019)	% total (2020)	% decrease 2019 - 2020	average duration (2019)	average duration (2020)
Private	95.56%	94.11%	62.52%	0.73 hours	0.75 hours
Commercial	4.44%	5.89%	23.92%	1.01 hours	1.49 hours
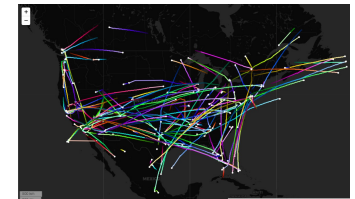
Relationship Between Flight Densities and COVID-19 Spread

Our research looked at both the flight data and COVID-19 data for the areas around the 15 busiest airport in the US. Using this data, we hoped to find a correlation between flight traffic density and COVID-19 case density in these specific areas.

* The line plot displays the monthly air carrier operations per airport from Feb-Oct of 2020.
* The data was collected using FAA's Air Traffic Activity System (ATADS).
* There is a clear drop-off in flights from March to April, which is in line with the time that COVID-19 was declared a pandemic on March 11, 2020.
* Although the 4th most popular airport in 2019, DFW had the most air carrier operations between April and July of 2020, which is a good reflection of how COVID-19 protocols were handled in that area.

https://aspm.faa.gov/opsnet/sys/Airport.asp
https://github.com/CSSEGISandData/COVID-19/tree/master/csse_covid_19_data

COVID-19
- **Gather from various states live COVID data**
- **Contains state, county, confirmed and active cases**

This map shows the sum of confirmed cases of airport counties and those that are adjacent to them.
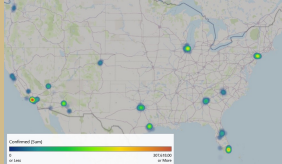
* The bar graph below shows the ratio of confirmed COVID-19 cases divided by total air carrier operations by airport/city from Feb-Oct 2020.
* The airport/city with the highest COVID cases per aircraft operation is Miami at 1.31, while the lowest is Denver at 0.08.
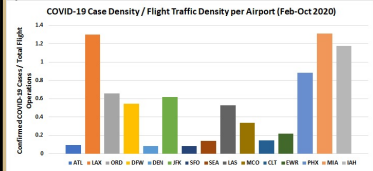

Length of Flights Before and During the Pandemic

How did the lengths of flights change as a result of the pandemic?
- We compared data from a selection of dates both before and during the pandemic
- We used Tracktable to find distance and duration of each trajectory

We chose to analyze holiday flight traffic for a few dates in 2019 and compare them to the corresponding dates from 2020.
After loading the necessary data, we used Tracktable to group data points into trajectories and find the distance and duration of each one. These histograms show the distribution of flight lengths on the given dates.
We also calculated the total number of flights per day, as well as the average flight distance, for every day in our dataset. We plotted the results in a line graph.
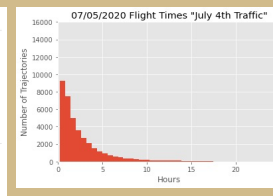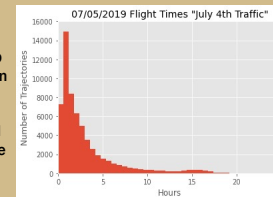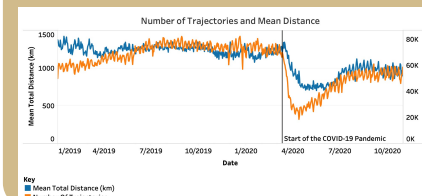
Conclusions and Future Goals

- Flight densities decreased overall
- The flight traffic density of the 15 airports does not determine the effects of COVID-19 case density for that area
- Airports/cities with high ratio of COVID cases to flight traffic likely had less effective travel restrictions during the pandemic
- Private flights had greater decrease in volume than commercial flights
- Length of flights and number of trajectories both decreased when the pandemic first began.
- Future goals include:
  - Exporting data tables from heatmap and changing density calculation to be duration focused.
  - Use a larger set of airports based on the found ratio to look at trends that helped prevent the spread & the ones that didn't
  - When comparing commercial & private flights, analyze more features than just volume and flight duration.
  - Find specific examples of longer flight routes affected by COVID-19

Acknowledgements