Abstract

In recent times, data wrangling and visualization techniques are widely used on pre-processed datasets in an effort to identify patterns and trends. I decided to focus on airline and airport data over a period of 18 years to identify and understand flight path demand trends, before the pandemic and during the pandemic. After conducting a thorough analysis using several R functions, we have recommended strategic business decisions for airlines based on airport growth during and before the pandemic.

Motivation

The United States Department of Transportation's Bureau of Labor Statistics has expansive public data on airlines, airports, flight paths, and passenger numbers. Conducting a thorough analysis of this data can provide airlines with insights that can be used to make strategic business decisions. Our objective was to take flight path data on 9 major airports and use several R functions to clean, analyze, and visualize the data. We formed strategic recommendations to optimize airlines' flight paths in order to maximize profit and increase the market share of flights at airports showing signs of growth.

Data

This dataset contains data on 14 U.S. and foreign airline companies as well as several airports within the United States. The dataset contains information on several variables from October 2002 to November 2020. The variables include passengers, flights, net income, operating revenue, and more. There is data on each of these variables separated by month as well as domestic or international flights. We randomly selected 10 major airports where most flights occur within the United States and downloaded the passenger and flight data for each. The airports included were Portland, Salt Lake City, Honolulu, Denver, Houston, Orlando, Minneapolis, Detroit, Baltimore, and Philadelphia.

Statistics

By using the subset command to omit the month value Total and Phoenix airline, I was able to find measures of variability (mean, std dev, min, 25th pct, median, 75th pct, max) within the conditions we set. This will result in the domestic flights having a lower measure for every measure, the most notable being the mean drastically decreasing by about 180,000 flights and median flights decreasing by 4,000. By filtering Phoenix's major airport as well as only taking into account flights after 2017, we can see that demand for domestic air travel has greatly decreased compared to years prior.

Analysis

By visualizing our data, we drew several conclusions about airlines' history since 2002 as well as their response to the COVID-19 Pandemic in 2020. When analyzing the flight counts for all airlines in the below line graph (Figure 1), we identified a few trends that would be beneficial in formulating our strategy recommendations. Outside of the Phoenix airport, we can see clearly that Denver not only has the highest flight count of these airports but also has had a significant increase in flights in the last five years. Between 2015 and 2019, Denver International saw a 28% increase in total flights. There was also a proportional increase in flight paths to Orlando and Philadelphia in accordance with the increase in total airline flights to those airports, showing us

that major airlines have experience with quickly negotiating deals with airports as soon as they notice increased demand. Figure 1 also demonstrates the airline's growing commitment to Hawaii over the past 13 years. Honolulu has become one of the most in-demand destinations, as evidenced by the steep increase in flights from there between 2007 and 2013. Another interesting finding was that airline flights significantly decreased going in and out of Salt Lake City in the past few years even though there were incremental increases in the number of flights from all airlines to that airport. Figure 2 shows airline response to cutting flights was uneven with a percentage decrease in all major flights. Meanwhile, airlines chose to change course and decrease their presence there despite the relatively steady, and sometimes rising, overall demand at that airport shown in Figure 1.

Figure 1:

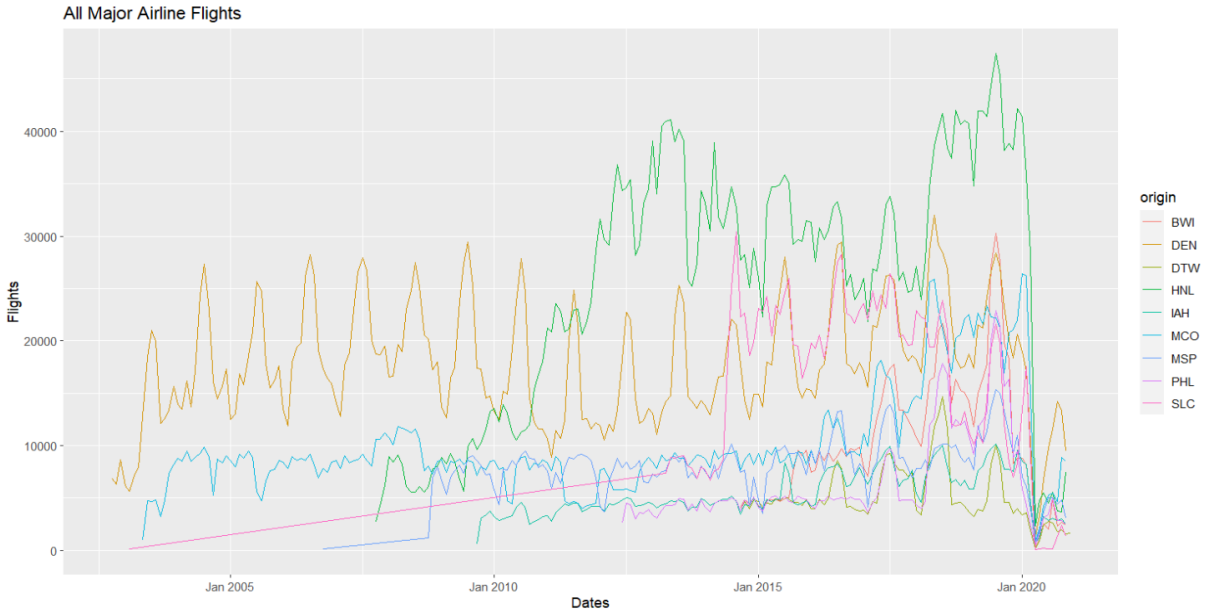
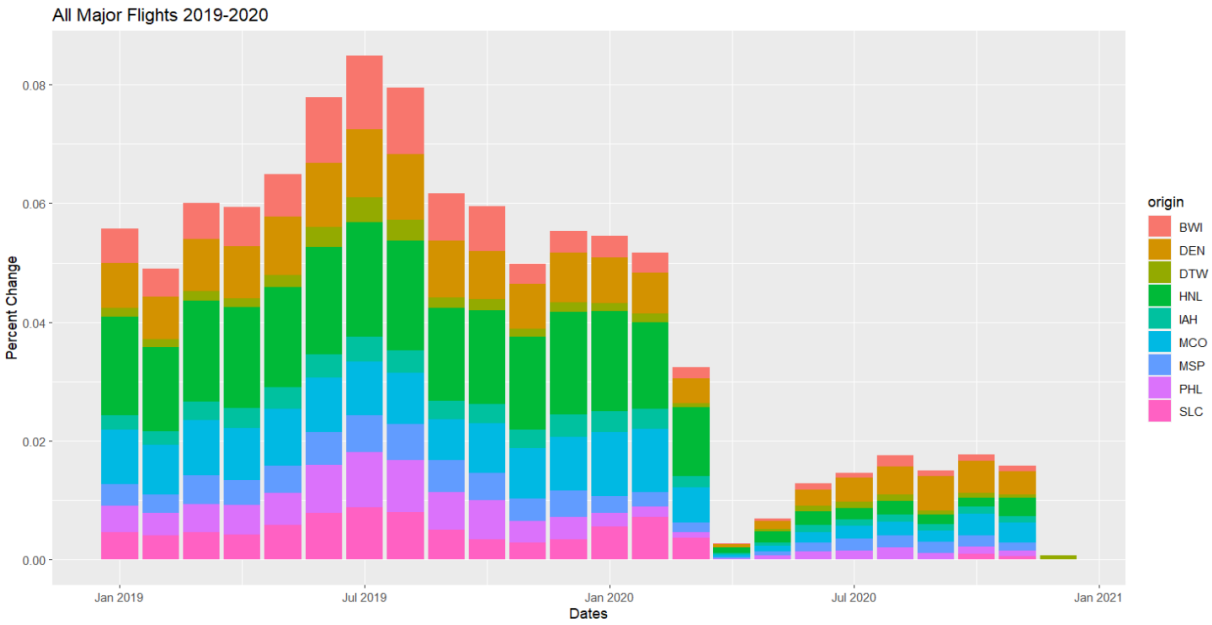


Figure 2:



The pandemic effectively shut down travel for nearly nine months in 2020 as safety regulations were put in place that barred interstate travel, and people canceled plans out of fear of contracting the virus. The travel industry responded by downsizing significantly, laying off employees, and reducing their output in order to cut costs. The last year of Figure 1 shows a huge dip in the number of flights and passengers in 2020.

Conclusion

After conducting our analysis and visualizing all of our data, we decided to focus on creating three actionable recommendations we could give to airlines based on flight path demand that would optimize their flight paths to maximize profits and increase market share. The increase in flights to Denver is likely due to the fact that Denver's rate of growth has skyrocketed, as several companies have established themselves in the city and its suburbs, bringing tens of thousands of new residents there every year. We recommend that airlines increase flights from surrounding states to Denver and vice versa as our results show a considerable increase in passengers in the last five years. When analyzing Houston passenger trends, we recommend airlines increase flight paths to and from Houston as it saw the second smallest percentage decline post-COVID, meaning more people are willing to travel here even amid a pandemic. Houston is a growing city in a state with more lax covid restrictions, so there will be benefits to increasing flights both during and after the pandemic. Airlines seem to have elected to decrease flights in and out of Salt Lake City, but SLC has seen a healthy incremental increase each year leading up to COVID. Salt Lake City is another western city that has seen astronomical increases in housing prices and corporate activity in the past few years. During COVID, there has been a mass migration of Californians moving to cheaper Western states, meaning there will be more traffic in and out of SLC. Considering its proximity to most airlines' regional presence will give them an advantage in taking a large portion of this market share.