

## Assignment 1: Air Transportation

### Solution

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### Problem 1

Familiarize yourself with the Great Circle Mapper application (<http://www.gcmap.com/>). Plan two trips from Cleveland airport as follows: 1) CLE to DCA and 2) CLE to LAX.

- Extract the great circle distance for these flights.
- CLE-DCA - 270 nautical miles, CLE-LAX - 1784 nautical miles

b) Now use the Flightaware web application (<http://flightaware.com/>) and extract flight information for two flights flown between those cities in the past 10 day (your choice).

Varies from day to day. However, the detour factor for short flight is more than for longer flights.

c) Compare the actual distances filed in the pilot's flight plan (these are typically stated as "Planned" in [flightaware.com](http://flightaware.com))

Detour factors for short flights vary from 11 to 19% (detour factor is the additional distance compared to the great circle distance) versus the great circle distances. Comment on the detour factor observed for each of the flights.

d) State the cruise flight levels (i.e., altitude in feet / 100) for the flights selected in part(b) and comment on the altitudes flown. Comment on the altitudes used for Westbound versus Eastbound flights.

#### Rule from FAR Part 91

On magnetic course of zero degrees through 179 degrees, any odd flight level, at 2,000-foot intervals beginning at and including flight level 290 (such as flight level 290, 310, 330, 350, 370, 390, 410);

Eastbound flight levels are always odd. Examples are FL 310, 330, 350, 370, 390, etc.

Westbound flight levels are even numbers. Examples are FL 320, 340, 360, 380, 400, etc.

### Problem 2

Use airport and airline passenger data available at the BTS site.

a) Use the Aviation Database T-100 Domestic Market to extract the number of **passengers enplaned** at Cleveland Hopkins International Airport (CLE) and Atlanta Jackson International Airport (ATL) airports in the past 3 years. Make a plot and comment on the results observed. The T-100 database is available at the BTS web site ([www.transtats.bts.gov](http://www.transtats.bts.gov)).

ATL airport had 40.16 million enplanements in 2022 (incomplete data). In 2020 the airport had 23.4 million enplanements.

CLE airport had 4.15 million enplanements in 2022 (incomplete data). In 2020 the airport had 2.4 million enplanements.

b) Show the effect of Covid (years 2020-2022) in the number of flights at CLE and ATL. Comment on possible reasons for differences observed.

Both airports had significant loss of passenger traffic due to Covid-19.

### Problem 3

BTS airline fares and enplanement data.

- Use the Aviation Database **T-100 Domestic Segment** to extract the number of **enplaned passengers** and **seats offered** at the Los Angeles International Airport (LAX) in years 2016 - 2021. Make a plot (or a bar chart) and comment on the results observed.
- Plot the on-time performance of flights at LAX in the same period. Comment on the on-time performance during Covid.

LAX had 76% on-time performance in 2017. In 2020, with reduced demand, the on-time performance improve to 86%.

- Air fares are critical in the estimation of aviation demand. Use the BTS site to estimate average fares in the US for the period 2112-2021. Comment on the possible explanation about the decrease in air fares over time.

Adjusted for inflation, airfares continue to decrease with time. In 2010, the average fare was \$441. In 2020, the average fare was \$329. Some reasons are higher competition of low cost carriers in the US., slight increase in flight distance (cheaper fare per mile).

**Problem 4**

Fuel consumption and Greenhouse gases.

- a) Plot the fuel cost paid by (in \$/gallon) of the US commercial airlines with scheduled service (more than \$20 million in revenue per year) for years 2010-2022. The fuel consumption data can be found at the BTS web site (<https://www.transtats.bts.gov/fuel.asp>). Comment on the observed trends.

The price of jet-A fuel varies from \$2.20 per gallon in 2010 to \$3.4 per gallon in 2022. During 2020, the price of jet-A fuel dropped significantly.

- b) Plot the fuel consumption (in gallons) of the US commercial airlines with scheduled service (more than \$20 million in revenue per year) for years 2010-2022. The fuel consumption data can be found at the BTS web site (<https://www.transtats.bts.gov/fuel.asp>).

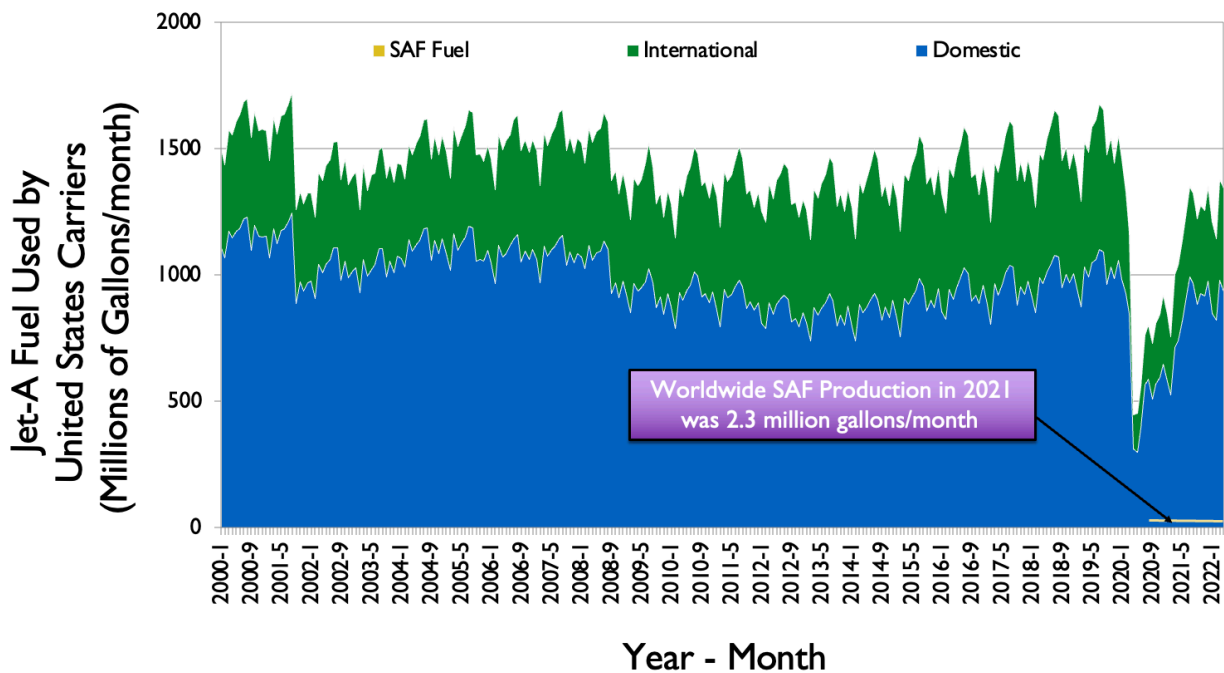


Figure 3. Fuel Consumption in the US. Source of Data: BTS Data.