

## Assignment 1: Analysis of Air Transportation Systems

Date Due: January 29, 2026

Instructor: Trani

### Problem 1

Familiarize yourself with the Great Circle Route (GCD) Mapper application (<http://www.gcmap.com/>). Plan two trips from Charlotte Douglas Airport (CLT) airport as follows: 1) CLT to MIA and 2) CLT to LAX.

- Extract the great circle distance for these flights.
- Now use the Flightaware web application (<http://flightaware.com>) and extract flight information for two random flights flown between those cities in the past five days (just pick one day of the last five days) using the Airbus A321neo aircraft (see Figure 1). The aircraft four-letter code designator for FAA/ICAO is **A21N**.



Figure 1. Airbus A321neo (A21N) landing at Atlanta Hartsfield International Airport (A. Trani).

c) Compare the actual distances filed in the pilot's flight plan (see the Flight Details box provided in Flightaware) versus the great circle distance calculated by the mapper. The flight plan distances are labeled as "Planned" in Flightaware.com. Comment on the detour factor observed for each of the flights. The detour factor is the ratio of the distance flown and the great circle distance calculated by the mapper.

d) State the altitudes **filed** by the pilot and cruise speed filed in the flight plan for the flights selected in part(b) and comment on the altitudes and speed flown. Are they different for the two trips?

### Problem 2

Learn to use the 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 on US carriers departing (called enplaned passengers)** Charlotte Douglas (CLT) and San Francisco International Airport (SFO) airports in the past 6 years (2019-2024). 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)). **Note:** You can use the quick access Airport Snapshot data to look for yearly or monthly data for an airport as well.

b) Explain the effect of Covid (years 2020-2022) in the number of flights at the airports in question. Comment if the passenger traffic at the airports has recovered compared to 2019.

c) Comment on the on-time performance for both arrivals and departures at the airport in the past five years.

d) What percentage of flights were cancelled at SFO and CLT in 2024?

Air Carriers : T-100 Domestic Market (U.S. Carriers)				
Sum : On-Flight Market Passengers Enplaned by Origin for 2024				
<a href="#">Format results for printing</a> <a href="#">Download results</a> <span style="float: right;"><a href="#">Databases</a> <a href="#">Data Tables</a> <a href="#">Table Contents</a></span>				
Filter Categories	Filter Variables	Filter Statistics	Filter Years	
Origin	Passengers	Sum	2024	
Latest available 2025 data is October				
<b>Note:</b> US Airways and America West started to report combined on-time data in January 2006 and combined traffic and financial data in October 2007 following their 2005 merger announcement. Delta and Northwest began reporting jointly in January 2010 following their 2008 merger announcement. Continental Micronesia was combined into Continental Airlines in December 2010 and joint reporting began in January 2011. Atlantic Southeast and ExpressJet began reporting jointly in January 2012. United and Continental began reporting jointly in January 2012 following their 2010 merger announcement. Endeavor (9E) operated as Pinnacle prior to August 2013. Envoy (MQ) operated as American Eagle prior to April 2014. Southwest (WN) and AirTran (FL) began reporting jointly in January 2015 following their 2011 merger announcement. Alaska (AS) and Virgin America (VX) began reporting jointly in April 2018 following their 2017 merger announcement.				
<a href="#">Recalculate</a>				
<a href="#">&lt;&lt;Prev</a> Rows : 201 - 400 of 1313 <a href="#">Next&gt;&gt;</a>				
Code	Description	Summary		
BYH	Blytheville, AR: Arkansas International	0		
BZN	Bozeman, MT: Bozeman Yellowstone International	1,321,649		
C01	Camarillo, CA: Camarillo Airport	27		
CAE	Columbia, SC: Columbia Metropolitan	651,388		
...	...	...		

Figure 2. T-100 Domestic Market Table Interface with Passengers Enplaned (at Origin Airport).

## Problem 3

BTS airline fares and seats offered data.

- Use the Aviation Database **T-100 Domestic Segment** to extract the number of **enplaned passengers** and **seats offered** at Charlotte Douglas (CLT) and San Francisco International Airport (SFO) airports in the past 6 years. Make a plot (or a bar chart) and comment on the results observed.
- Find the load factor (i.e., ratio of the number of passengers enplaned and the seats offered) by year at each airport.
- Comment on the load factors estimated in part (b).

Air Carriers : T-100 Domestic Segment (U.S. Carriers)				
Sum : Available Seats by Origin for 2024				
<a href="#">Format results for printing</a> <a href="#">Download results</a> <span style="float: right;"><a href="#">Data Tables</a> <a href="#">Table Contents</a></span>				
Filter Categories	Filter Variables	Filter Statistics	Filter Years	
Origin	Seats	Sum	2024	
Latest available 2025 data is October				
<b>Note:</b> US Airways and America West started to report combined on-time data in January 2006 and combined traffic and financial data in October 2007 following their 2005 merger announcement. Delta and Northwest began reporting jointly in January 2010 following their 2008 merger announcement. Continental Micronesia was combined into Continental Airlines in December 2010 and joint reporting began in January 2011. Atlantic Southeast and ExpressJet began reporting jointly in January 2012. United and Continental began reporting jointly in January 2012 following their 2010 merger announcement. Endeavor (9E) operated as Pinnacle prior to August 2013. Envoy (MQ) operated as American Eagle prior to April 2014. Southwest (WN) and AirTran (FL) began reporting jointly in January 2015 following their 2011 merger announcement. Alaska (AS) and Virgin America (VX) began reporting jointly in April 2018 following their 2017 merger announcement.				
<a href="#">Recalculate</a>				
<a href="#">&lt;&lt;Prev</a> Rows : 1 - 200 of 1332 <a href="#">Next&gt;&gt;</a>				
Code	Description	Summary		
01A	Afognak Lake, AK: Afognak Lake Airport	30		
05A	Little Squaw, AK: Little Squaw Airport	9		
06A	Kizhuyak, AK: Kizhuyak Bay	401		
...	...	...		

Figure 3. T-100 Domestic Segment Table Interface with Seats Offered (at Origin Airport).

## Problem 4

Familiarization with airfare data. Air fares are critical in the estimation of aviation demand.

- a) Use the BTS site to estimate average fares in the US over time. Use the air fare releases by BTS (<https://www.bts.gov/content/annual-us-domestic-average-itinerary-fare-current-and-constant-dollars>).
- b) Make a plot of airfares (inflation-adjusted) over time.
- c) Comment on the trends observed. Is flying cheaper than in 1995?
- d) Find the fares between between Atlanta and New York in the latest report of average airfare at airports in metropolitan areas (see below).

Figure 4. Ar Fare BTS Interface (<https://www.bts.gov/air-fares>).

## Problem 5

Fuel consumption and Greenhouse gases.

- a) Collect the data and 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 2019-2024. The fuel consumption data can be found at the BTS web site (<https://www.transtats.bts.gov/fuel.asp>). Comment on the observed trends.
- b) Plot the domestic fuel consumption (in gallons) of the US commercial airlines with scheduled service (more than \$20 million in revenue per year) for years 2019-2024. The fuel consumption data can be found at the BTS web site (<https://www.transtats.bts.gov/fuel.asp>).
- c) Estimate the Greenhouse Gases (GHG) produced by US commercial airlines in 2024 knowing that a pound of Jet-A fuel produces 3.125 pounds of CO<sub>2</sub>. Compare the Greenhouse emissions of 2024 and the first year of Covid (2020).
- d) Overall, what was the reduction in GHG during Covid?