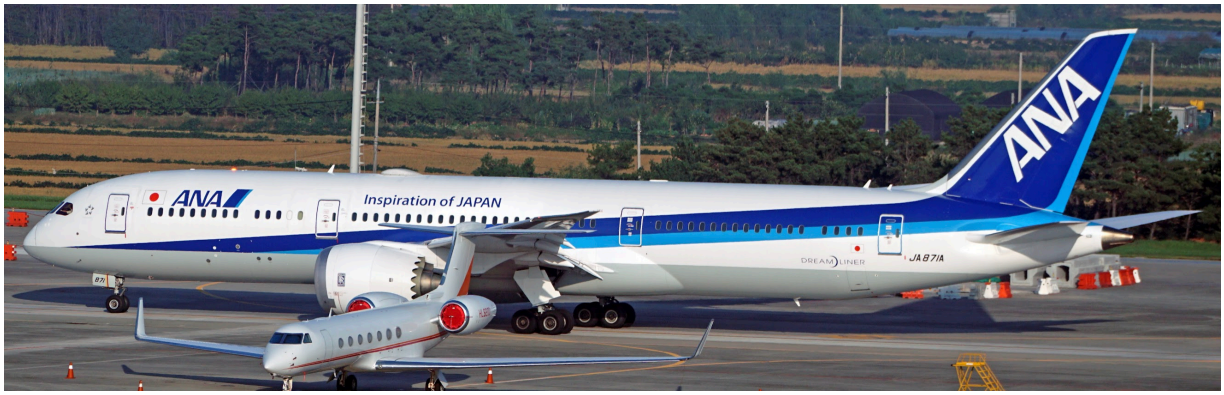
Assignment 3: Aircraft Performance Calculations

Date Due: February 12, 2023 Instructor: TraniProblem 2

An airline is evaluating two aircraft to operate flights from Colorado Springs Airport (COS) Airport. The following table shows the aircraft proposed by Boeing. The airline would like to fly with the selected aircraft to Narita International Airport in Japan (NRT). In your analysis use the latest version of the Boeing documents.

Table 1. Boeing 787-9 and Boeing 787-10 Considered in the Airline Evaluation.

Aircraft Considered
Boeing 787-9 with High-Thrust Rolls-Royce engines (see picture below). The aircraft has a maximum design takeoff weight of 561,500 lb. With 290 seats in a two-class layout. See other characteristics in the Boeing documents for airport planning and design.

Boeing 787-10 with High-Thrust Rolls-Royce engines. Aircraft maximum design takeoff weight is 560,000 lb. 330 seats in a two-class layout. See other characteristics in the Boeing documents for airport planning and design.

Use the Climate Explorer website (https://crt-climate-explorer.nemac.org/climate_graphs) to find the mean maximum temperature of the hottest month of the year. More detailed information about the airport can be found at the AIRNAV database available on the web at: http://www.airnav.com/airports/ or visit the airport site.

a) Find if the proposed route can be flown with both aircraft considered. In your analysis use the Great Circle Flight Path mapper link provided in our interesting web sites. Add 6% to the distances calculated to account for real Air Traffic route conditions and to account for possible weather deviations from the optimal Great Circle flight path.

b) Find the runway length needed for each one of the aircraft flying the COS-NRT route. Determine if Colorado Springs has enough runway length to support flights with all seats full.

c) Repeat part (b) assuming a load factor of 0.85 (85% of the seats used).

d) If the aircraft carries 85% of the seats full, can the flight carry additional belly cargo as payload from the existing longest runway at COS?

e) Using the Payload-Range diagram of each aircraft, to find the fuel needed to fly the route. Find the Specific Air Range (SAR) parameter for each aircraft. Comment on the SAR values calculated.

f) Considering various factors such as payload, fuel economy, and potential of additional belly cargo, which aircraft is the best for this airline? Explain.

Problem 2

A new low-cost airline is evaluating The Airbus A220-300 to operate flights from a variety of airports including Roanoke-Blacksburg Regional (ROA). The airline would like your help to evaluate the A220-300 with the Pratt and Whitney PW1524G or with the lower thrust PW1521G.

Table 2. Aircraft Considered in the Airline Evaluation.

Aircraft Considered in the Analysis
Airbus A220-300 140 seat configuration. Maximum takeoff weight is 149,000 lbs.


The design airport temperature used should be the average of the maximum daily temperatures of the hottest month of the year. Use the Climate Explorer website (https://crt-climate-explorer.nemac.org/climate_graphs) to find the mean maximum temperature of the hottest month of the year. More detailed information about the airport can be found at the AIRNAV database available on the web at: http://www.airnav.com/airports/ or visit the airport site.

In your analysis use the latest version of the Airbus A220-300 documents for airport design (http://128.173.204.63/courses/cee5614/sites_ce_5614.html#Aircraft_Data).

a) Find the maximum range that the airline can fly from ROA airport either at maximum takeoff weight or limited by runway length. Evaluate the departure conditions for both engines and the usual airport design temperature conditions.

b) Does ROA have enough runway to support maximum takeoff weight departure operations?

c) Estimate the average fuel per passenger on a 1,200 nm (includes detour factor) for the aircraft.

d) Find the SAR for the same 1,200 nm trip.

e) Considering the runway length and the environmental conditions at ROA airport which aircraft engine would you recommend?

Problem 3

Use the data for the large twin-aisle transport aircraft similar to the Boeing 777-200 (http://128.173.204.63/cee5614/cee5614_pub/B777_class.m) to answer the following questions.

a) Calculate total drag produced by the aircraft during a climb profile with an Indicated Airspeed of 270 knots at 3,400 meters above mean sea level conditions. Assume atmospheric conditions to be ISA. The aircraft weight is 320,000 kgs.

b) Repeat the process when the aircraft is climbing at 9,500 meters and an indicated Mach number of 0.78.

c) Estimate the instantaneous fuel consumption for each flight condition given in parts (a) and (b).

d) Comment on the observed trends.

Problem 4

Use the SARLAT tool described in class to answer the following:

Use the Small Aircraft Runway Length Analysis Tool (SARLAT) to **design a runway** at a new airport located 3,800 feet above mean sea level conditions. The average of the maximum daily temperature of the hottest month of the year is 80 degrees Fahrenheit. Table 3 shows the representative aircraft at the airport. To obtain the SARLAT tool follow the links in the class notes.

a) Find the required runway length needed to satisfy the runway performance requirements of the fleet mix in Table 1. For the critical aircraft, list the following runway lengths: 1) dry runway takeoff distance, 2) wet runway takeoff distance, 3) dry landing distance, and 4) wet landing distance. Use the default “useful load” parameters included in SARLAT (100% for piston aircraft and 90% for turboprop and jet-powered aircraft).

b) The FAA Airport Improvement Program (AIP) pays for a **dry takeoff runway** and a **wet landing runway**. Find the runway length that the FAA AIP Program may approve. State the critical aircraft and the condition used (i.e., takeoff or landing).

c) If the airport client wants to pay additionally for a runway that satisfies wet takeoff conditions, estimate the runway length needed. State the critical aircraft used in the design.

d) Show the SARLAT bar chart of runway length requirements for each individual aircraft for your solution.

Table 3. Aircraft Fleet Mix for Problem 4.

Aircraft Type	Aircraft	Useful Load (%)	Picture
Piston	Cirrus SR22	100	
Piston	Cessna 421C	100	

Aircraft Type	Aircraft	Useful Load (%)	Picture
Jet	Cessna CitationJet 1	90	
Jet	Phenom 300	90	

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