

Assignment 3: Aircraft Performance Calculations

Date Due: February 17, 2020

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Problem 1

A new low-cost airline is evaluating two aircraft to operate flights from DCA Airport in Washington. The following table shows the aircraft proposed by airline executives to operate from DCA. The critical stage lengths the airline would like to fly with the selected aircraft are: a) DCA-PHX and b) DCA-MIA.

Table 1. Aircraft Considered in the Airline Evaluation.

Aircraft Considered
Boeing 737-8 Max with CFM LEAP-1B28 engines. Aircraft maximum design takeoff weight is 181,000 lb. 162 seats in a two-class layout.
Boeing 737-800 (with winglets) powered by two CFM56-7B24/-7B26/-7B27 engines at 26,000 LB SLST)). Aircraft maximum design takeoff weight is 174,200 lb. The aircraft has 160 seats in a two-class layout.

The design airport temperature used should be the average of the daily high temperatures 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 Boeing documents for airport design (http://128.173.204.63/courses/cee5614/sites_ce_5614.html#Aircraft_Data).

- a) Find the average stage length to be flown between each one of the critical OD airport pairs. 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 operating the critical route. Determine if DCA has enough runway length to support these flights.
- c) Estimate the average fuel per passenger assuming a load factor of 0.85 (85% of the seats used) for both routes. Can the airline achieve good fuel savings using the new Boeing 737-8 Max compared to the standard Boeing 737-800?
- d) Using the Payload-Range diagram of each aircraft, and using the longest flight of the two routes, find the Specific Air Range (SAR) parameter for each aircraft. Comment on the SAR values calculated.
- e) Considering various factors which aircraft is the best for this airline? Explain.

Problem 2

Use the data for the transport aircraft similar to the Boeing 737-800 (http://128.173.204.63/courses/cee5614/cee5614_pub/Boeing737800Jet_class.m) to answer the following questions.

- a) Calculate total drag produced by the aircraft at the following cruise altitudes: FL340 and FL370 meters while cruising at Mach 0.77. Assume straight and level flight conditions and the mass of the vehicle is 74,000 kg. Assume atmospheric conditions to be ISA.
- b) Estimate the fuel consumption for each flight condition given in part (a).

c) Plot the drag vs altitude and comment on the observed trend.

c) Find the Lift-to-drag ratio (L/D) for the aircraft while in cruise at FL340 meters and 295 knots indicated airspeed. Repeat the calculation for the same altitude but different IAS values (250, 275, and 320 knots). Plot and comment on what would be the optimum speed to achieve the highest L/D ratio.

d) Find the optimal (L/D * M) value (M here is the true mach number) for this aircraft cruising at FL340 meters. This factor L/D * M drives the condition for maximum range for a turbofan engined aircraft.

Problem 3

a) An airline is evaluating operations out of Mexico City Airport in (airport elevation is 7,300 feet above mean sea level conditions). The airline is evaluating the Boeing 787-8 and its sibling, the Boeing 787-9 to fly from Mexico to various European countries including Paris (CDG). In this analysis consider the runway length available at Mexico City (use the link provided in our web page to the World Airport data). Assume ISA+15 deg. C conditions from Mexico City (MMMX). The airline is considering a dual class Boeing 787 configuration.

For the aircraft in question investigate the following:

a) Can the aircraft operate the route MMMX-CDG with a full passenger load? State the numbers to justify your answer.

b) Can the aircraft operate the route MMMX-YUL (Montreal) with a full passenger load?

c) Find the maximum freight capacity for the MMMX-YUL route above with full passenger load. State all your assumptions.

d) What version of the Boeing 787 is best suited for this airline? Explain.