

Assignment 3: Air Transportation Systems Analysis

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Problem 1

An airline is evaluating two aircraft to operate flights from . The following table shows two two aircraft proposed by airline executives to operate from La Guardia airport (LGA). The critical stage lengths the airline would like to fly with the selected aircraft are: a) LGA-DEN and b) LGA-IAH.

Table 1. Aircraft Considered in the Airline Evaluation.

| Aircraft Considered |
|---|
| Boeing 737-500 with CFM56-3B-1 engines at 18,500 lb. sea level static thrust) engines. Aircraft maximum design taxi weight is 134,000 lb. with 122 seats in a one-class layout. |
| Boeing 737-600 (no winglets) powered by two CFM56-7B22 engines at 22,000 lb. sea level static thrust). Aircraft maximum design taxi weight is 144,000 lb. The aircraft has 150 seats in a one-class layout. |

The airline would like to request your services to help them select among the two aircraft to start operations from LGA. The design airport temperature used should be the average of the maximum temperatures of the hottest month of the year. You can query these averages for any airport at:

<http://www.weather.com/weather/wxclimatology/monthly/graph/LGA:9>

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).

- 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.
- Find the runway length needed for each one of the aircraft operating the two routes. Determine if DCA has enough runway length to support these flights in the critical day (i.e., average maximum temperature of the hottest month of the year).
- Estimate the average fuel per passenger assuming a load factor of 0.85 (85% of the seats used) for both routes.
- Considering various factors which aircraft is the best for this airline? Explain.

Problem 2

a) A Latin American airline is evaluating purchasing three Boeing 777 aircraft to operate long-range passenger services between: a) Mexico City (ICAO code MMMX or IATA code MEX) and European and South American cities. Mexico City is located on a high plateau at 7,321 feet above mean sea level conditions. The city pairs to be operated have a minimum stage length of 3,800 nm and a maximum of 6,050 nm. The airline requires a minimum of 250 seats in a three class cabin layout. Boeing is offering both the Boeing 777-200LR and the Boeing 777-300ER to the airline. The airline would like to carry an extra 10 metric tons of freight under the fuselage to generate additional revenue in the long routes. In your analysis, use the great circle mapper application and add 6% to the route distance to account for Air Traffic and weather detours. Also consider the runway length available at MMMX.

For each of the two aircraft investigate the following:

- b) Find the maximum freight capacity the aircraft could carry in both the 3,800 nm and the 6,050 nm routes if all seats are occupied? State all your assumptions.
- c) Suggest the best aircraft for this application. Comment on the factors considered in your analysis.

Problem 3

A Middle East airline operates Airbus A380-800 from JFK airport to Dubai. The airline has several A380s in the fleet all powered by the Rolls-Royce Trent 900 engines. If the airline has a version of the A380 with 490 seats and the aircraft has a maximum ramp weight of 562 000 kg, find:

- a) The maximum departure weight from LAX (limited by runway length). State the runway length at JFK.
- b) Find the runway length if the airline typically operates with a load factor of 0.86 and carries an extra 20 tons of belly cargo under the fuselage.

Problem 4

Reading of Chapter 3 in Whitford's book.

- a) In a Figure shown on page 55, the author compares the relative improvements in maximum lift coefficients for various wing flap configurations. In your own words, what is the value of achieving high values of CL_{max} ? How does this affects takeoff and landing runway length used?
- b) Describe the benefits of using supercritical wings in modern commercial transport aircraft.
- c) Describe the benefits of using winglets in modern commercial transport aircraft. Using data from Boeing in the article (http://www.boeing.com/commercial/aeromagazine/articles/qtr_03_09/article_03_1.html) describe how much fuel savings are possible in cruise using winglets.