CEE 5614: Analysis of Air Transportation Systems Fall 2020

Quiz 2 (Open Notes)

Date Due: November 30, 2020 Instructor: Trani

Problem 1

Figure 1 shows the baseline runway configuration for an airport to be studied in this problem. Assume IMC conditions in the solution to the problem. According to the departing aircraft acceleration is 2.1 m/s^2. The airport has a PRM radar at the facility. For this analysis we use the following technical parameters: a) in-trail delivery error of 16 seconds under IMC conditions, b) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to both Final Approach Fixes (FAF) as shown in Figure 1. The minimum separation matrix for the airport is similar to that on page 43 of the Aircraft Classification handout (http://128.173.204.63/courses/cee4674/cee4674_pub/Aircraft%20Classifications_rfs.pdf). Considering the average ROT values the a minimum radar separation used is 3.0 nm. In your analysis assume that all arrivals to runway 9 touchdown prior to the intersection point with runway 5L. Tables 1 and 2 show the technical parameters for this airport and the typical departure-departure separations.

Table 1. Runway Operational Parameters and Fleet Mix for the Airport. RECAT Groups.

Aircraft RECAT Group	Percent Mix (%)	Average Runway Occupancy Time (s)	Typical Approach Speed (knots) from Final Approach Fix
B	3	61.3	152
C	5	59.7	149
D	50	48.2	142
E	40	44.3	135
F	2	43.1	123
Totals	100		

Table 2. Departure-Departure Separations with Buffers Included. Columns 2-7 are the Following Aircraft. First Column Presents the Lead Aircraft. Values in are seconds (the values include departure buffers).

Aircraft	B	C	D	E	F
B	125	125	135	135	135
C	125	130	130	130	130
D	70	70	70	70	70
E	70	70	70	70	70

Aircraft	B	C	D	E	F
F	70	70	70	70	70

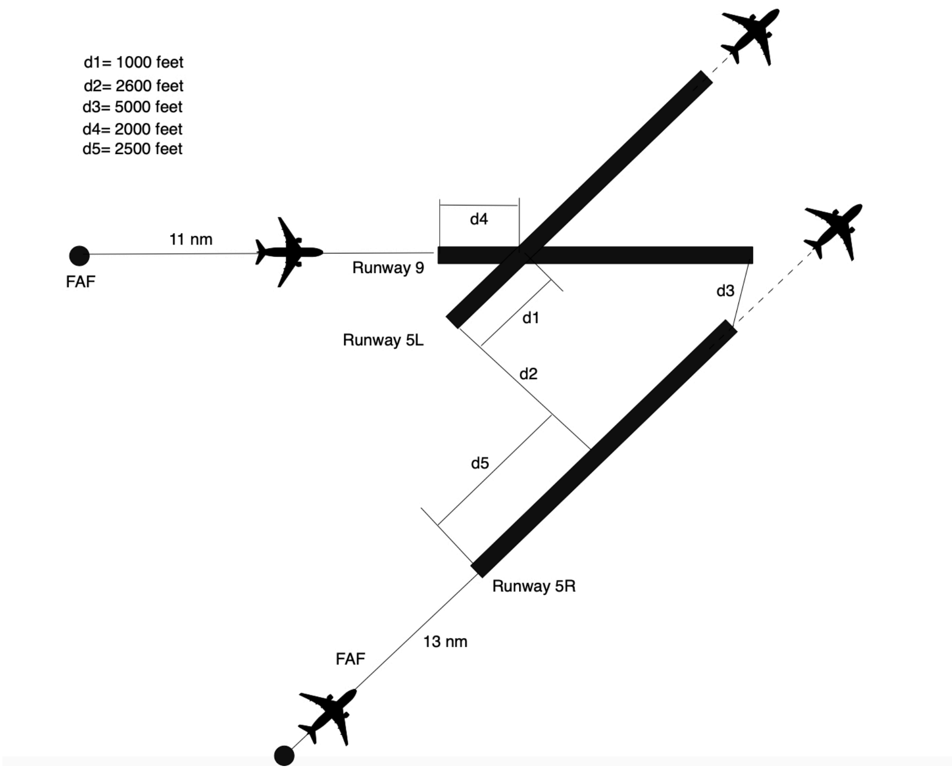

Figure 1. Runway Configuration for Problem 1.

a) Read the FAA Order 7110.110B entitled "Dependent Converging Instrument Approaches (DCIA) with Converging Runway Display Aid (CRDA)" and available at: FAA_Order_JO_7110.110B_Dependent_Converging_Instrument_Approaches_(DCIA)_with_Converging_Runway_Display_Aid_(CRDA).pdf. This document provides details on the use of Converging Runway Display Aid (CRDA).

b) Can runways 9 and 5L be operated independently for arrivals in IMC conditions? State the applicable rule(s).

c) Find the arrivals-only capacity of the airport under IMC conditions using runways 9 and 5R. Clearly state all your assumptions. Use all the ATC rules learned in class to solve the problem.

d) Can runways 5R and 5L be operated independently for departures in IMC conditions? State the applicable rule(s).

e) Find the departures-only capacity of the airport under IMC conditions using runways 5R and 5L.

f) Find two additional points (your choice) along the Pareto frontier to estimate the complete arrival-departure saturation capacity diagram. Explain the logic of selecting the two new data points.

g) Draw the Pareto diagram for the complete airport under IMC conditions.

h) Estimate the possible departures-only capacity gains with all the runways used for departures.

Problem 2

Use the data for the transport aircraft similar to the Boeing 787-8 (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing787_class.m) to answer the following questions. Assume ISA conditions.

a) Plan a flight plan using Skyvector to travel between Washington Dulles International Airport and Buenos Aires , Argentina (EZE). For this flight start the airline dispatch such the following parameters:

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OEW = 117,700;                  % Operating empty mass (kg)
Fuel mass = 60,000;             % Fuel mass (kg)
Payload = 32,500;               % Payload (kg)
Cruise Mach = 0.83              % dimensionless
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b) Find the initial cruise altitude at the TOC using a 500 ft/min climb capability suggested in class. Select the initial altitude **consistent** with the ATC hemispherical rules discussed in class.

c) Find two possible step climb altitudes to improve the fuel economy of the flight as fuel is used. Assume ATC can grant the new altitudes at intervals of 2,000 feet (i.e., hemispherical rules). For this problem, assume the pilot wants to keep a 500 ft/min climb capability at the new altitudes selected. Clearly state the distance from the origin airport for each one of the two step-climbs and the time between step climbs for this flight.

d) Find the total fuel used in the flight from IAD to EZE. Consider the changes in altitude in part (c).