Assignment 10: Airport Environmental Impacts

Part 2 of Final Project

Due: May 10, 2015 (via email and PDF)
Final Exam Time is May 11 at 1:05 PM in CEECL
Requirements for this assignment are: a) Slide presentation and b) 10+ page report with your findings.

Problem 1

Table 1 illustrates the typical aircraft fleet mix operating at ORD Airport in the typical day. This aircraft mix will be used to estimate the noise contours and the capacity of the airport. In the typical day of the year 2014, the airport handled **2,640 operations daily**. Half of them arrivals and the other half departures. Recent airport data suggests 135 departures and 135 arrivals occur at night between 10 PM and 7:00 AM in the morning. The simplified fleet mix operating at the airport is shown in Table 1. The table also shows the average stage length (miles flown) by each departure.

Table 1. ORD Fleet Mix and INM Aircraft to be Used in the Study.

Aircraft	% Fleet Mix in 2014	INM Aircraft to Use	Wake Class	Average Stage Length Flown (statute miles)
Embraer 145	35	E145	Large	335
B737 (600-900)	11	737700	Large	1260
747-8/A380	4	747400	Super-heavy	5200
B767	5	767CF6	Heavy	3656
A320 (318-321)	10	A320-232	Large	1170
CRJ (200-900)	28	CL601	Large	359
B777 (200-300)	7	777300	Heavy	6534
Total	100			

Using the arrival-arrival and departure-departure separation matrices shown in Tables 2 and 3, determine the saturation capacity of the airport for West Flow operations. Assume the ROT values at the airport for 4 wake classes are: 52 (small), 56 (large), 63 (Heavy) and 73 (Superheavy) seconds. For both IFR and VFR conditions, the airport operates arrivals and departures as shown in Figure 1. The approach speeds (in knots) derived from radar data are: 127 (small), 138 (large), 152 (Heavy) and 152 (Superheavy). The airport has the following technical parameters: a) in-trail delivery error of 14 seconds, b) departure-arrival separation for both VMC and IMC conditions is 2 nautical miles, c) probability of violation is 5%. Arriving aircraft are “vectored” by ATC to the final approach fix located 7 miles from the runway threshold.

Table 2. Arrival-Arrival Separation Matrix. VFR Conditions.

Minimum Separation Matrix (nm)		Arrivals-Arrivals			
		Trailing Aircraft (Header Columns)			
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	2.5	2.5	2.5	2.5	2.5
Large	4	3	2.5	2.5	2.5
B757	5	4	3	3	2.5
Heavy	6	5	4	4	4
Superheavy	10	10	10	10	10

Table 3. Departure-Departure Separation Matrix. VFR Conditions.

Departure-Departure Separation Matrix (seconds)					
		Trailing Aircraft (Header Columns)			
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	60	60	60	60	60
Large	90	60	60	60	60
B757	120	120	60	60	60
Heavy	120	120	120	120	90
Superheavy	150	120	120	120	120

a) Plot the complete Pareto capacity diagram for VFR conditions at the airport. Label appropriately.

Problem 2

Perform a noise study for the ORD airport considering the fleet mix shown presented in Table 1. The arrival and departure flow patterns are shown in Figure 1. Assume that the distribution of arrivals is that shown in Figure 1. The words PA stand for Percent Arrivals and PD for percent departures. Assign aircraft classes randomly the arrival and departure streams. Consider the number of arrivals and departures performed during the day and night time as described in the previous section.

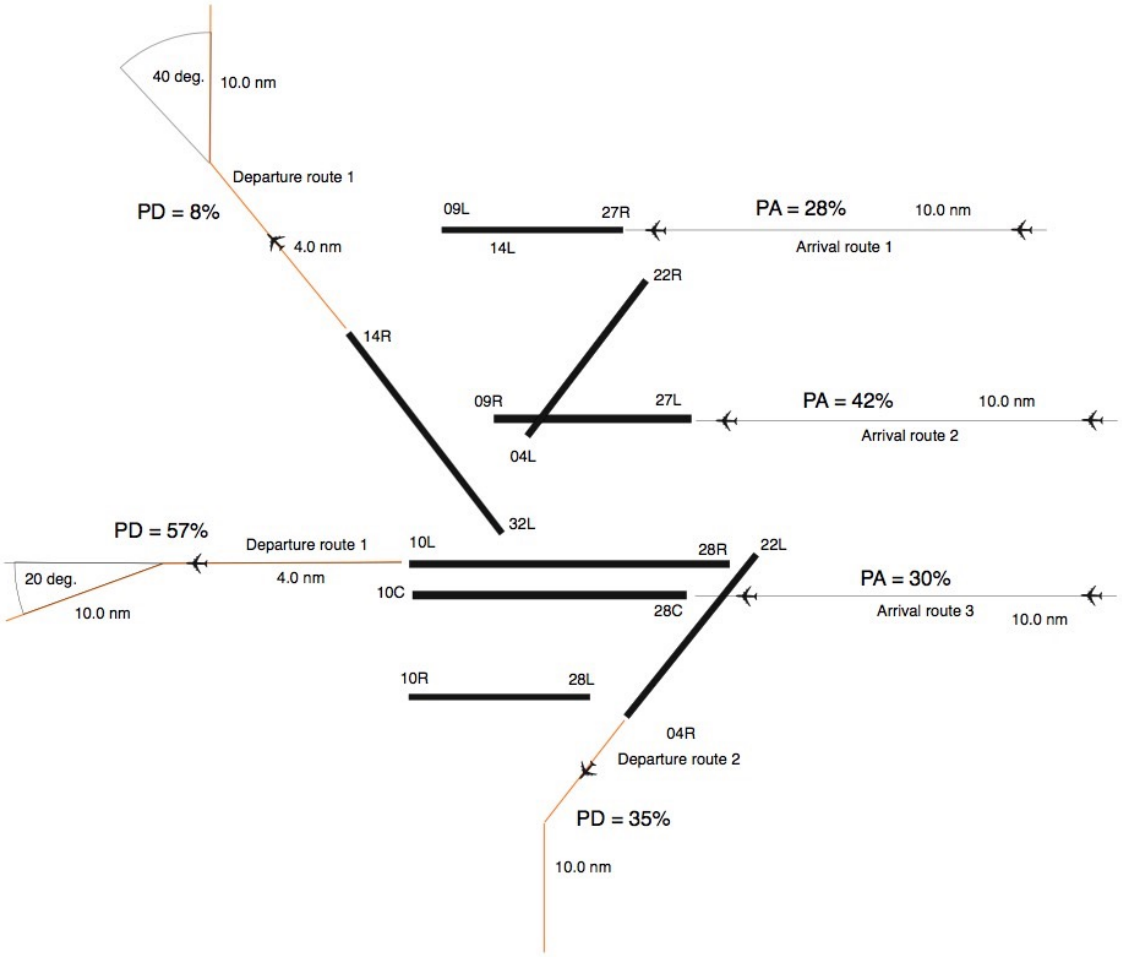

Figure 1. Simplified Arrival and Departure Patterns to ORD during West Flow Operations.

a) Find the noise contours around the airport from 55-80 LDN. Plot using your CAD and INM skills. Export the noise contours to a DXF file and then read the file using Autocad or equivalent application.

b) Estimate the area under the 55 and 65 LDN contours.

c) Suggest improvements to reduce the noise at this airport.

Bonus: Export the contours to Google Earth and superimpose the contours exported as an Image Overlay (or layer) of the Google Earth satellite picture.