

Assignment 7: Airport Capacity

Date Due: July 4, 2016

Problem #1

Estimate the saturation capacity of the airport assigned to the group under Instrument Meteorological Conditions (IMC). Your airport has a standard airport surveillance radar (ASR) which tracks aircraft up to 60 miles from the airport site. The radar has a scan rate of 4.5 seconds or better. Tables 1 and 2 show the typical ATC separations used by ICAO at the airport under IMC conditions. Three or four aircraft groups operate at your airport. The airport has the following technical parameters: a) in-trail delivery error of 20 seconds (because there is a radar at the site), b) departure-arrival separation for both VMC and IMC conditions is 3 nautical miles (more conservative in China than the US), c) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to the final approach fix located 10 miles from the runway threshold. Arrivals follow in-trail after crossing the final approach fix. The airport aircraft mix is to be determined from the analysis done in day one of the short course. Typical runway occupancy times and approach speeds are shown in Table 1 for four ICAO groups.

You are allowed to modify the spreadsheet provided in class to solve the problem. Show me sample calculations for both opening and closing cases.

- a) Calculate the fleet mix for your airport for either 3 or 4 groups of aircraft operating at the airport (some airports may only have 3 groups). Use the table provided in this assignment to match aircraft at your airport with the wake groups needed to do capacity analysis Table 3).
- b) Calculate the arrival-departure saturation capacity diagram (Pareto diagram) under IMC conditions (show all your work). Include one point to estimate the departure capacity with 100% arrival priority under mixed runway operations.

Use the following runway configurations: a) Chengdu - one arrival and one departure runway; b) Hong Kong - one arrival and one departure runway; Beijing - two arrivals and one departure runway; Pudong - two arrivals and two departure runways.

Table 1. Airport Information and Fleet Mix.

Parameter	Small	Large	Heavy	Superheavy
ROT (s)	45	55	61	75
Approach Speed (knots)	121	137	150	150

Table 2. ICAO Minimum arrival-arrival separations under IMC conditions. Values in are nautical miles. Values Shown Do Not Include Air Traffic Buffers.

Minimum Separation Matrix (nm)	Arrivals-Arrivals				
	Trailing Aircraft (Header Columns)				
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	3	3	3	3	3
Large	4	3	3	3	3
B757	5	4	3	3	3
Heavy	6	5	4	3	3
Superheavy	8	8	8	8	8

Table 3. Minimum departure-departure separations under IMC conditions recorded in the US. Values in are seconds. For capacity computations in China increase the values by 15%.

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

Table 4. Aircraft Operated in China and Wake Groups.

Aircraft	Count of LocDepTimeDec	Wake Class (ICAO)
Airbus A310 Passenger	8	Heavy
Airbus A319	1604	Large
Airbus A320	4345	Large
Airbus A321	1686	Large
Airbus A330	272	Heavy
Airbus A330-200	257	Heavy
Airbus A330-300	571	Heavy
Airbus A340-300	42	Heavy
Airbus A340-600	2	Heavy
Airbus A380-800 Passenger	16	Superheavy
Antonov An148-100	1	Large
ATR 72	1	Large
ATR42 /ATR72	74	Large
Boeing (douglas) MD-83	27	Large
Boeing (douglas) MD-90	52	Large
Boeing 737 Passenger	1976	Large
Boeing 737-300 Passenger	132	Large
Boeing 737-500 Passenger	1	Large
Boeing 737-600 Passenger	27	Large
Boeing 737-700 Passenger	342	Large
Boeing 737-800 (winglets) Passenger	98	Large
Boeing 737-800 Passenger	4378	Large
Boeing 737-900 (winglets) Passenger	14	Large
Boeing 737-900 Passenger	52	Large
Boeing 747 (Passenger)	19	Heavy
Boeing 747-400 (Mixed Configuration)	5	Heavy
Boeing 747-400 (Passenger)	84	Heavy

Aircraft	Count of LocDepTimeDec	Wake Class (ICAO)
Boeing 747SP Passenger	1	Heavy
Boeing 757 (Passenger)	3	Heavy
Boeing 757-200 Passenger	60	Heavy
Boeing 767 Passenger	49	Heavy
Boeing 767-300 (winglets) Passenger	1	Heavy
Boeing 767-300 Passenger	63	Heavy
Boeing 767-400 Passenger	1	Heavy
Boeing 777 Passenger	33	Heavy
Boeing 777-200/200ER Passenger	86	Heavy
Boeing 777-200LR	8	Heavy
Boeing 777-300 Passenger	85	Heavy
Boeing 777-300ER Passenger	108	Heavy
Boeing 787	54	Heavy
Boeing 787-8	21	Heavy
Boeing 787-9	14	Heavy
Canadair Regional Jet 200	7	Large
Canadair Regional Jet 700	23	Large
Canadair Regional Jet 900	231	Large
Embraer 190	693	Large
Embraer RJ 135/140/145	76	Large
Fokker 50	3	Large
Sukhoi Superjet 100-95	1	Large
Tupolev TU-204 /tu-214	3	Large
Xian Yunshuji Ma-60	46	Large