Assignment 8: Runway Throughput and Capacity

Date Due: November 6, 2020 (via Canvas) Instructor: Trani

Problem 1

Review the runway configuration of San Diego International Airport. Assume IMC conditions in the solution to the problem. The airport operates on a West flow configuration with arrivals and departures using runway 27. The airport fleet mix is shown in Table 1. Assume 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 18 seconds under IMC conditions, b) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to the final approach fix located 10 miles from the runway threshold. The minimum separation matrix for SAN is shown on page 43 of the Aircraft Classification handout (http://128.173.204.63/courses/cee4674/cee4674_pub/Aircraft%20Classifications_rfs.pdf). SAN has good runway exits and hence minimum radar separation is 2.5 nm (empty cells on page 43 of the handout).

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

Aircraft RECAT Group	Percent Mix (%)	Runway Occupancy Time (s)	Typical Approach Speed (knots) from FAF
A	0	N/A	N/A
B	4	62	151
C	7	60	146
D	69	58	142
E	15	54	138
F	5	51	127
Totals	100		

Table 4. Departure-Departure Separations with Buffers Included. Columns 2-7 are the Following Aircraft. First Column Presents the Lead Aircraft. Values in are seconds (including departure buffers).

Aircraft	A	B	C	D	E	F
A	125	125	130	130	130	180
B	75	130	130	130	130	130
C	65	65	90	120	120	120

Aircraft	A	B	C	D	E	F
D	65	65	65	65	65	65
E	65	65	65	65	65	65
F	65	65	65	65	65	65

a) Estimate the IMC arrival runway capacity for SAN.
b) Estimate the IMC departure runway capacity for SAN.
c) Show the complete Pareto diagram (arrivals and departures) for SAN airport under IMC conditions.

Problem 2

Review the runway configuration of Chicago O'Hare International Airport from previous assignment. Assume IMC conditions in the solution to the problem. The airport operates on a West flow configuration with arrivals to runways 27R, 27L, 28C and departures from runways 28R and 22L. The airport fleet mix is shown in Table 1. Assume the departing aircraft acceleration is 2.1 m/s^2. Consider the interactions between arrivals on runway 28C and departures on runway 22L. The airport has a PRM radar at the facility. In the analysis consider the ATC human factor time lag and engine spool-up time (8 seconds). For this analysis we use the following technical parameters: a) in-trail delivery error of 18 seconds under IMC conditions, b) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to the final approach fix located 8.5 miles from the runway threshold. Assume the fleet mix for all the runways is the same (to simplify the problem). The minimum separation matrix for ORD is shown on page 43 of the Aircraft Classification handout (http://128.173.204.63/courses/cee4674/cee4674_pub/Aircraft%20Classifications_rfs.pdf). ORD has good runway exits and hence minimum radar separation is 2.5 nm (empty cells on page 43 of the handout).

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

Aircraft RECAT Group	Percent Mix (%)	Runway Occupancy Time (s)	Typical Approach Speed (knots) from FAF
A	0	N/A	N/A
B	10	61	152
C	8	57	146
D	41	58	142
E	36	54	138
F	5	51	127
Totals	100		

Table 4. Departure-Departure Separations with Buffers Included. Columns 2-7 are the Following Aircraft. First Column Presents the Lead Aircraft. Values in are seconds (including departure buffers).

Aircraft	A	B	C	D	E	F
A	125	125	130	130	130	180
B	75	130	130	130	130	130
C	65	65	90	120	120	120
D	65	65	65	65	65	65
E	65	65	65	65	65	65
F	65	65	65	65	65	65

a) Estimate the runway capacities (arrivals and departures) for ORD today.

b) If a new runway is available on the North side of the airport (called runway 9C-27C and 1,200 feet North of existing runway 27L), estimate the capacity benefit to the airport. Shown in detail your analysis to account for the dependency between operations on runways 22L and 28C for today's configuration and for the future configuration.

c) Show the complete (i.e., all runways combined) Pareto diagram (arrivals and departures) for two ORD configurations under IMC conditions.