Assignment 7: Runway Capacity

Problem 1

Figure 1 illustrates the configuration of the runways at the airport. Runways 9L and 9R serve different aircraft fleet mix.
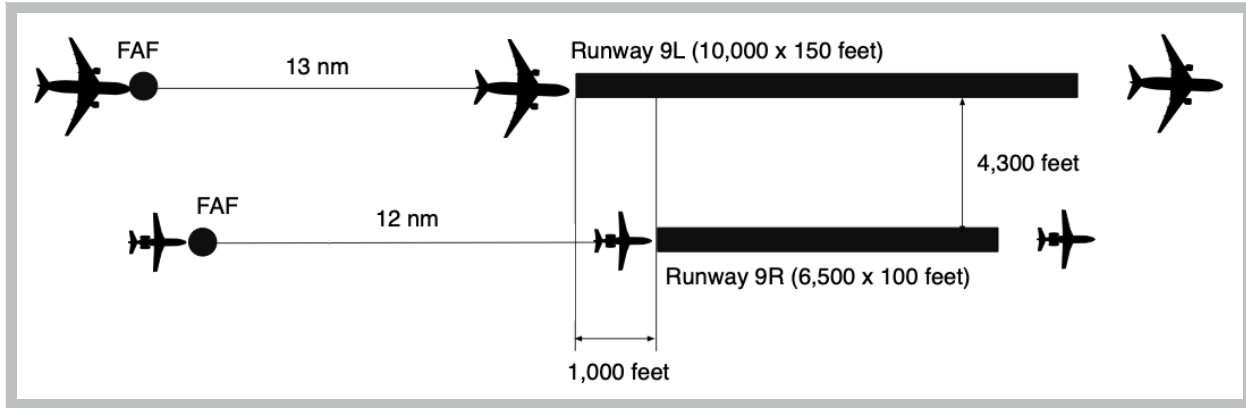

Figure 1. Runway Configuration for Problem 1.

Assume IMC conditions in the solution to the problem. The airport operates an East flow configuration with arrivals and departures using both runways. Tables 1 and 2 show the airport fleet mix for runways 9L and 9R, respectively. For this analysis we use the following technical parameters: a) in-trail delivery error of 15 seconds under IMC conditions, b) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to the Final Approach Fix (FAF) for each runway, and c) two miles minimum separation between an arrival and a departure. Use the minimum arrival-arrival separations for on-approach operations described in the consolidated wake vortex separation document (or notes). Table 3 shows the departure-departure separation matrix employed.

*Table 1. **Runway 9L** Operational Parameters and Fleet Mix. CWT Groups.*

Aircraft CWT Group	Percent Mix (%)	Runway Occupancy Time (s)	Average Approach Speed (knots) from FAF
B	4	62	151
E	7	60	142
F	89	59	135
Totals	100		

Table 2. **Runway 9R** *Operational Parameters and Fleet Mix . CWT Groups.*

Aircraft CWT Group	Percent Mix (%)	Runway Occupancy Time (s)	Average Approach Speed (knots) from FAF
G	7	47	132
H	26	49	124
I	67	50	115
Totals	100		

Table 3. **Departure-Departure Separations** *with* **Buffers Included**. *Columns 2-6 are the Following Aircraft. First Column Presents the Lead Aircraft. Values in are seconds (including departure buffers).*

Lead Aircraft (Below)	Following Aircraft					
	B	E	F	G	H	I
B	130	130	130	135	140	140
E	95	120	130	130	130	130
F	70	70	70	70	70	90
G	70	70	70	70	70	70
H	70	70	70	70	70	70
I	65	65	65	65	65	65

a) Estimate the IMC arrival runway capacities for runways 9L and 9R at the airport.
b) Estimate the IMC departure runway capacities for the airport (assuming both runways can be used for departures).
c) Comment on the effect of fleet mix and separation requirements on the individual runway capacities at the airport.
d) Use the new FAA/MITRE Corporation buffers and estimate the VMC runway capacity.
e) Show the complete Pareto diagram (arrivals and departures) for the airport under IMC conditions.
f) Show the complete Pareto diagram (arrivals and departures) for the airport under VMC conditions.
g) Comment on the differences in runway capacity between runways 9L and 9R.

Note: You can employ the Excel spreadsheet provided. However, you must show me some sample calculations.

Problem 2

Figure 2 shows the runway configuration for Problem 2. Use the technical separation parameters similar to those of Problem 1. Table 4 shows the fleet mix and ROT parameters of the airport. Use the departure-departure separations of Table 3 which include the departure-departure buffers.
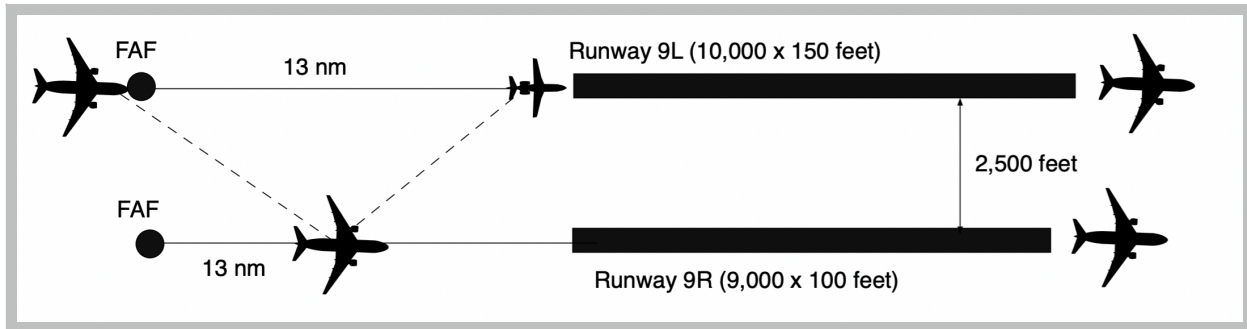

Figure 2. Runway Configuration for Problem 2.

Table 4. Operational Parameters and Fleet Mix for Problem 2.

Aircraft CWT Group	Percent Mix (%)	Runway Occupancy Time (s)	Average Approach Speed (knots) from FAF
B	5	62	151
F	62	59	135
G	12	53	130
H	21	51	125
Totals	100		

a) Estimate the IMC arrival runway capacities for the primary and secondary runways. Show the procedure to estimate the arrivals on the secondary runway.
b) Find the departures-only saturation capacity of the airport under IMC conditions.
c) Draw the complete Arrival-Departure diagram for the configuration shown in Figure 2.
d) If the airport ATC authority decided to operate runway 9L for departures (exclusive) and runway 9R for arrivals (exclusive), draw the IMC arrival-departure diagram (Pareto). Compare to part (c).

Problem 3

a) Use the Landing Events developed at the Air Transportation Systems Laboratory to estimate the runway occupancy times for Cessna Latitude (C68A) landing at BWI runway 33R.
b) Compare the runway occupancy times observed at IAD for the same aircraft with part (a).
c) Find the typical approach speeds of an Airbus A320neo (A20N) operating at Charlotte (NC).