

Assignment 6: Air Traffic, and Runway Operations

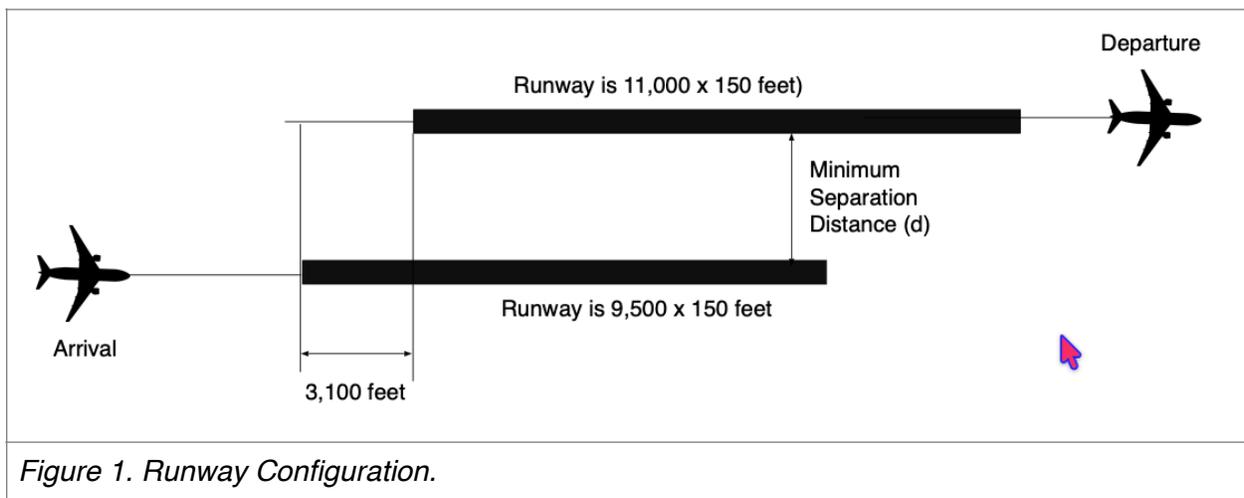
Date Due: April 2, 2026

Instructor: Trani

Problem 1 Basic ATC and Runway Separations

Answer briefly the following ATC-related questions.

- A Boeing 737-700 cruises at Mach 0.78 at FL 400 above Washington DC. Name the ATC service that oversees the flight.
- Find the true airspeed of aircraft in part (a).
- Indicate if the flight in part (a) is flying to the East or to the West. Comment on your answer.
- Briefly explain why flights above FL 410 are separated by 2,000 feet.
- Over the ocean, explain how pilots communicate with Air Traffic Control.
- Suggest the minimum separation distance (d) between two parallel runways to serve operations on parallel runways similar to Figure 1 allowing independent arrival and departure operations in IMC conditions.



- If the airport in Figure 1 operates on a Westerly flow configuration (flights operating to the West), find the distance (d) needed to conduct independent arrival and departure operations in IMC conditions.
- Use Google Earth and the FAA airport diagram to familiarize yourself with the runway configuration at Phoenix International Airport. Can runways 25R and 26 be operated independently for simultaneous instrument departures? Comment on the rule used.
- Can the Dallas-Fort Worth airport operate three simultaneous arrivals in East flow and IMC conditions? Name the runways selected in such operations.

Problem 2 Oceanic Operations

Read the paper “A Metaheuristic Optimization Algorithm for Flight Assignment to the North Atlantic Organized Track System” (<https://doi-org.ezproxy.lib.vt.edu/10.2514/6.2021-2364>). You can also watch the presentation associated with the paper at: <https://arc-aiaa-org.ezproxy.lib.vt.edu/doi/10.2514/6.2021-2364>.

- A) Summarize the possible benefits of using the metaheuristic optimization approach described in the paper.
- B) Explain some of the obstacles to adopting an optimization-based approach to assign traffic in the North Atlantic Organized Track System (OTS).
- C) Explain the tools used to estimate fuel benefits in the Atlantic.
- D) What aircraft performance model was used to support the analysis?

Problem 3 Runway Capacity

Figure 2 illustrates the configuration of the runways at the airport. Runways 9L and 9R serve different aircraft fleet mix.

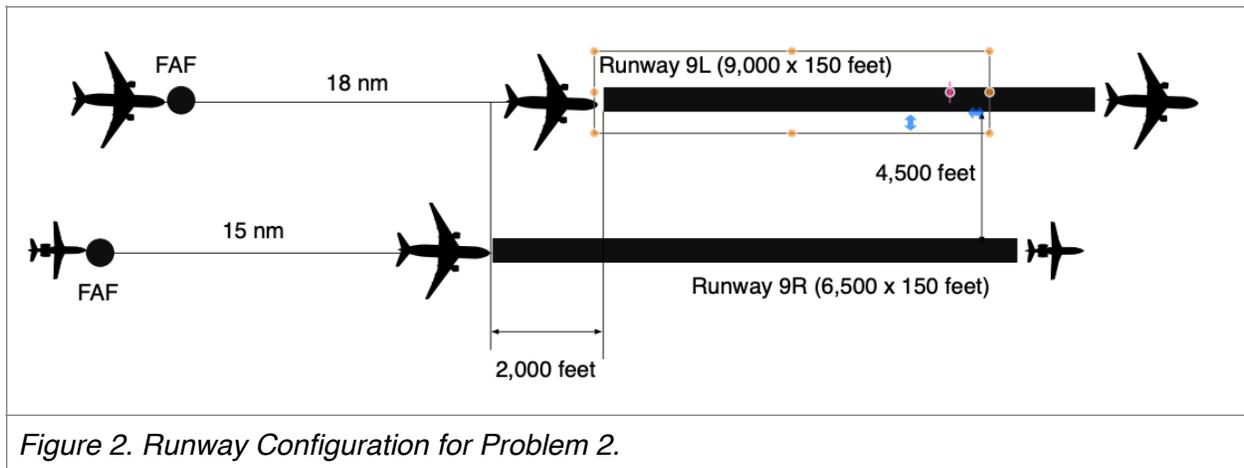


Figure 2. Runway Configuration for Problem 2.

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 21 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) 2.4 nautical miles minimum separation between an arrival and a departure. The 2.4 nm arrival-departure separation includes a small 0.4 nm buffer over the minimum value used in the US. Use the 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	6	59	155
E	18	57	152
F	76	55	136
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
F	54	53	140
H	23	50	125
I	23	48	116
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 (includes 10-second departure buffers).

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

- a) Estimate the IMC arrivals-only capacities for runways 9L and 9R at the airport.
- b) Estimate the IMC departures-only capacities for the airport
- d) Show the complete Pareto diagram (arrivals and departures on both runways) for the airport under IMC conditions.
- e) 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 4 Runway Capacity

Figure 3 shows the runway configuration for Problem 3. Use the technical separation parameters similar to those of Problem 3. 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.

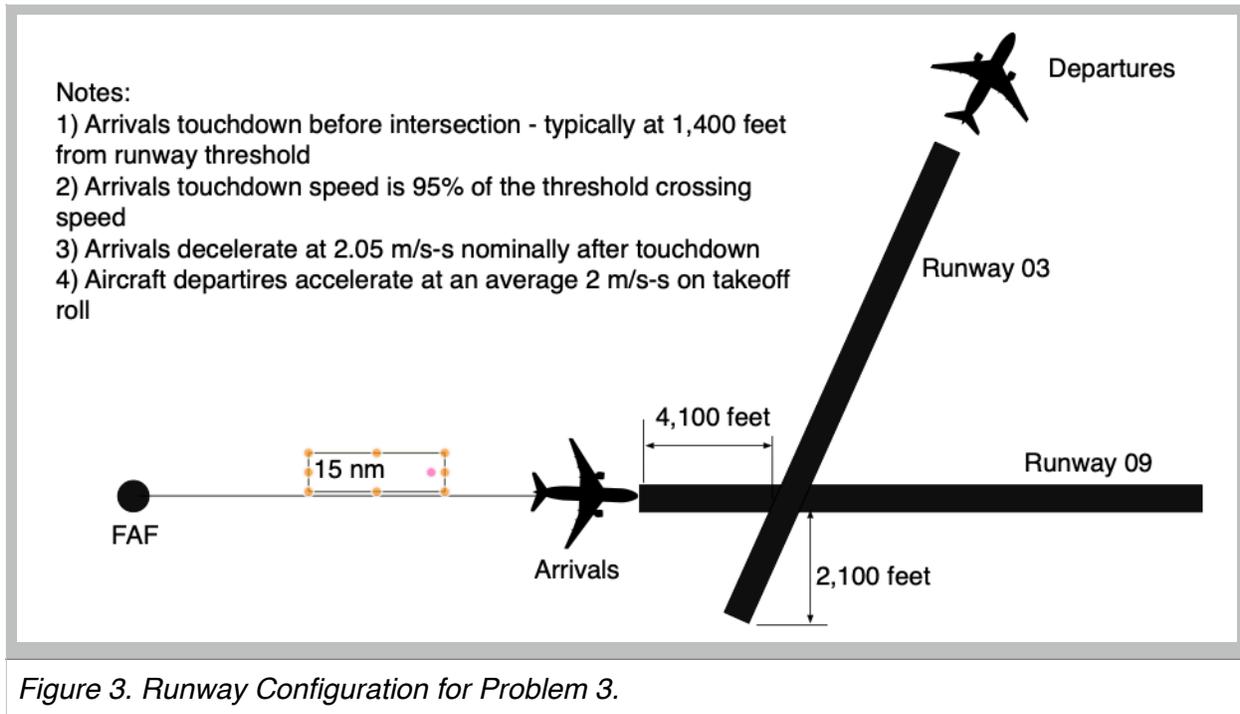


Table 4. Operational Parameters and Fleet Mix for Problem 3.

Aircraft CWT Group	Percent Mix (%)	Runway Occupancy Time (s)	Average Approach Speed (knots) from FAF to Runway Threshold
F	59	59	140
G	20	57	131
H	21	53	125
Totals	100		

- a) Estimate the IMC arrival and departure capacities for the two-runway system. Show me the procedure to estimate departures on runway 03.

Assume the minimum distance between an arrival on runway 9 and a departure that crossed the intersection of runway 3 is 2 nm.

- b) Draw the IMC Arrival-Departure diagram for the configuration shown in Figure 3.

- c) If the airport ATC decided to operate additional departures on runway 09, estimate the new departure capacity with 100% arrival priority on runway 09 and 100% departures on runway 03