# Air Transportation Systems Field Exam
January 2016

Note: You have 60 minutes to prepare for this examination. The preparation is closed book, but you can bring any notes that you generate during the preparation period to use in the oral exam. The oral examination will be 45 minutes long.

Make any assumptions that you believe are reasonable, but be sure to state them while answering the questions.

GOOD LUCK!

PART A: AIRPORT OPERATIONS

Consider an airport with two independent parallel runways and one intersecting runway, as shown below:
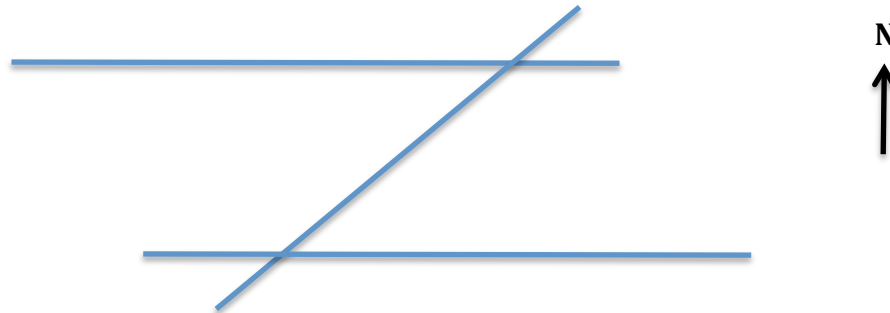
1. Describe the major factors that can cause the capacity of this airport (measured in operations per hour) to vary from day to day, even from one hour to the next. For each factor identified, explain how it affects the capacity of the airport.

2. How can this variability affect airline operations at this airport? Discuss briefly the trade-offs an airline's scheduling department must make in its efforts to anticipate this operational variability.

3. Under some conditions, the single intersecting runway is the only runway in use, for both departures and arrivals. Assume that the capacity of this runway is 40 arrivals per hour and that the demand is, on average, 36 arrivals per hour (and no departures) over a period of several consecutive hours of the day. Discuss how you would model such a system (and what assumptions you might make) in order to estimate the likely level of delay at this airport for arrivals.

PART B: FLEET PLANNING

A large network legacy carrier is considering the acquisition of a 20 new aircraft of a type different from the aircraft in its current fleet. These new aircraft will replace 20 existing aircraft in the airline's fleet, and will have effectively the same seating capacity. In this question, we will consider the various factors involved in this decision, from the point of view of the airline.

1. Focusing on the components of Aircraft Operating Costs (AOC) only, discuss the trade-offs the airline will have to make in evaluating whether it makes economic sense to replace the existing fleet with the new aircraft type. Specifically, for each of the components of AOC, explain the expected cost effects of operating the new aircraft.

2. Two of the most important technical and performance characteristics of a given aircraft type are its *payload* and *range*. Define these two terms, and then use a diagram to explain the relationship between payload and range for a single aircraft type. Explain briefly why these two characteristics are important to airline route planning and fleet assignment.

PART C: AIRCRAFT CONFIGURATION

An airline has been operating its existing fleet of A320 aircraft on US domestic routes feeding its international connecting hub. These aircraft currently are configured with 24 Premium Cabin (P) seats and 126 Economy Cabin (Y) seats (150 total), with the following additional historical data provided for the past year of operations:

	P-cabin	Y-cabin
Number of seats	24	126
Mean Load	12.0	113.4
Standard deviation	4.8	20.1
Average Load Factor	50%	90%

The airline is considering a cabin re-configuration of this aircraft fleet to 12 Premium and 150 Economy seats (162 total).

1. Assuming independent Gaussian demand distributions for each cabin, describe the specific steps required to estimate the mean and standard deviation of unconstrained demand for the Economy (Y) cabin, given the above information.

2. The airline has made the following estimates of unconstrained demand by cabin, based on the principles of spill modeling:

	P-cabin	Y-cabin
Mean unconstrained demand	12.0	125.9
k-factor	0.40	0.25
Average fare	$600	$300

(i) Based on these estimates (above) describe qualitatively your expectations with respect to the probability of full flights and expected spill per flight under the baseline cabin configuration.

(ii) Describe how the airline can estimate the expected revenue impact of switching to the new cabin configuration, given the above information. Specifically, what calculations and steps are required to produce an estimate of the overall change in revenue from the configuration change? Use sketch graphs to illustrate conceptually the required calculations.

(iii) Discuss briefly the use of average fares in the valuation of incremental passengers in the above analysis. How should these revenue values be adjusted to account for differential pricing and revenue management in both cabins? What impact would the modified fare assumptions have on the estimates of revenue change above?