CEE 5614: Analysis of Air Transportation Systems Fall 2015

Assignment 9: Runway Capacity and Delay Analysis

Date Due: November 16, 2015 Instructor: Trani

Problem 1

Before embarking on a very expensive and ambitious runway reconfiguration project (see Figure 2), the Chicago O'Hare International Airport had a departure saturation capacity of 25 departures per 15-minute period (see red line in Figure 1) in IMC conditions. The airport is a major hub for United and American Airlines and back in the peak days of 2004 had a departure demand as shown in the blue line of Figure 1. The departure saturation capacity was estimated using 2 independent runways for departures.

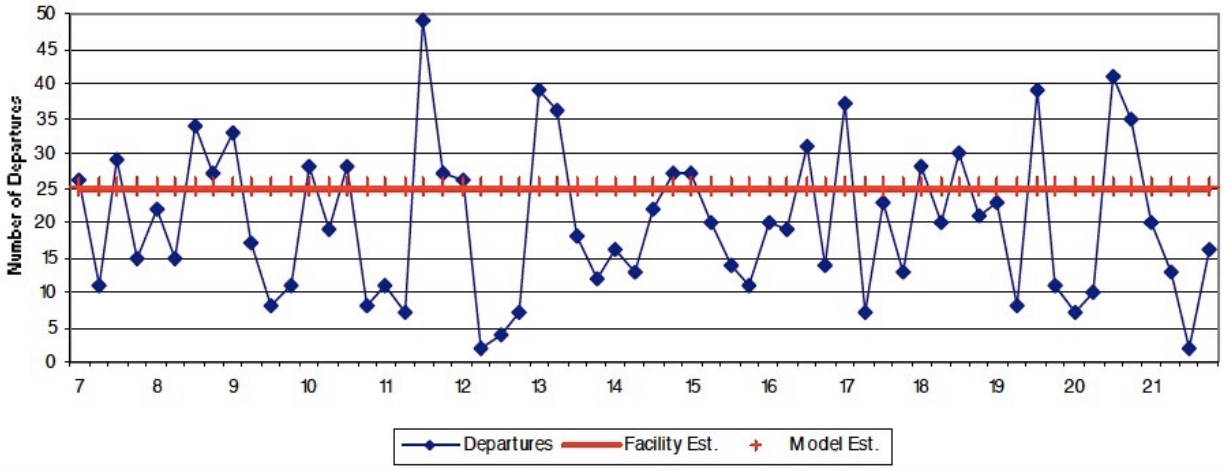

Figure 1. IMC Departure Saturation Capacity (red line) and Scheduled Departure Profile for ORD Airport. Source: FAA Airport Capacity Benchmarks (2004).

a) Convert the graph shown to numerical values of departure demand over time.

b) Estimate the aircraft departure queues that were likely to be experienced for the conditions shown in Figure 1 (called baseline).

c) Estimate the average delay per departure at ORD using an unsteady deterministic queueing model.

d) This past month of October (2015), ORD opened a new runway (see Figure 2). The departure capacity per hour increases to 140 departures per hour using 3 independent runways . Estimate the new delays at the airport. Assume the demand function remains the same. This is a good assumption because ORD had its largest annual demand in the year 2004 and the FAA expects a slow worth in the next 10 years (see FAA Terminal Area Forecast). Is the additional runway justified in terms of reducing departure delays?

Problem 2

a) Calculate the annual benefits of the reconfiguration project at ORD in terms of departure delay savings. Assume the average cost of one hour of delay to the airlines at DFW is $3,500 per hour per aircraft. Also consider the value of time for passengers. According to FAA/DOT data, the value of time for a passenger traveling long distance is $32/hr. The average seating capacity of aircraft operating at ORD is 115 seats and the average load factor for airlines using ORD is 80%.

b) An estimated cost of adding the new runway at ORD is $1400 million dollars. Use your knowledge of engineering economics to explain how would you do an economic analysis for the new runway investment. The construction of the runway was funded through bonds at an interest rate of 4% per year. Hint: Review the use of Net Present Value or Benefit/Cost ratio techniques.

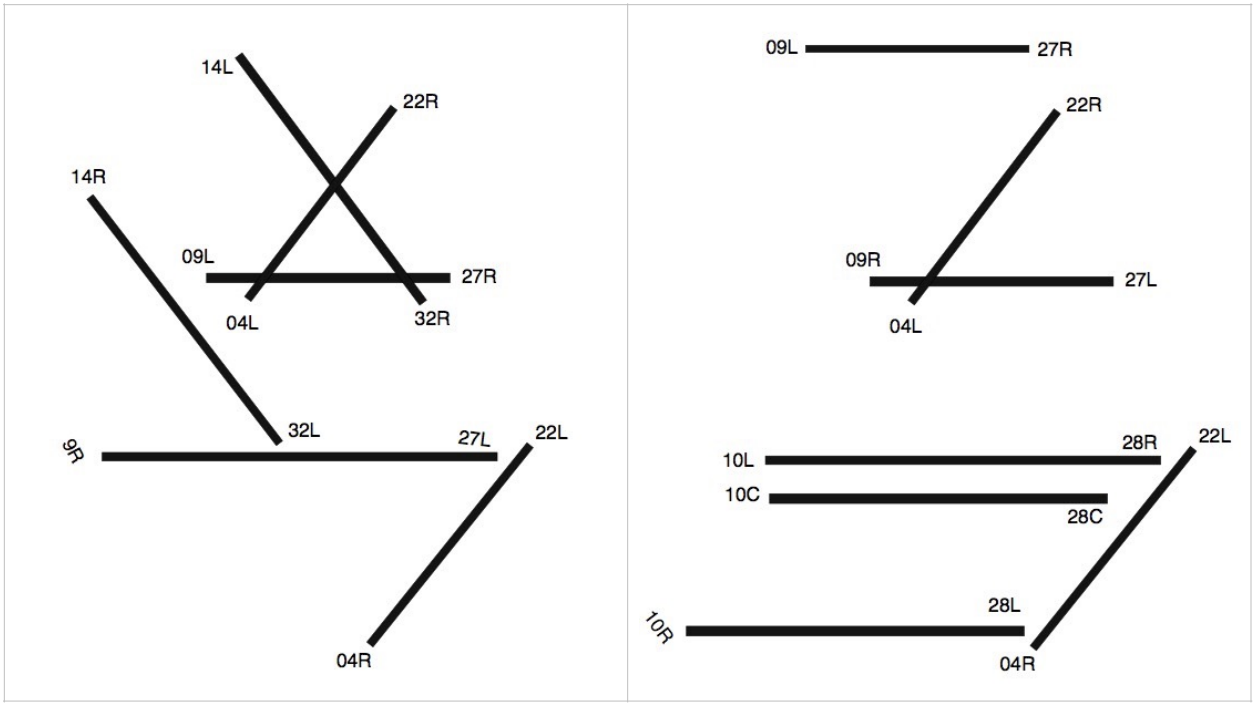

Figure 2. ORD Airport Layouts. Left-Hand side is the Original Runway Configuration. Right-hand Side is the Reconfigured Airfield as of Fall 2015. Runway 32L (not shown) is not used much due to the new CRO rules.