CEE 5614: Analysis of Air Transportation Systems Fall 2013

Assignment 9: Delay Analysis and Monte Carlo Simulation

Date Due: December 4, 2013 Instructor: Trani

Problem 1

A single runway airport in the West Coast of the United States has a saturation capacity diagram as shown in Figure 1. The figure shows a 6th order polynomial to approximate the values of arrivals and departures. The equation of the polynomial is given in Figure 1.

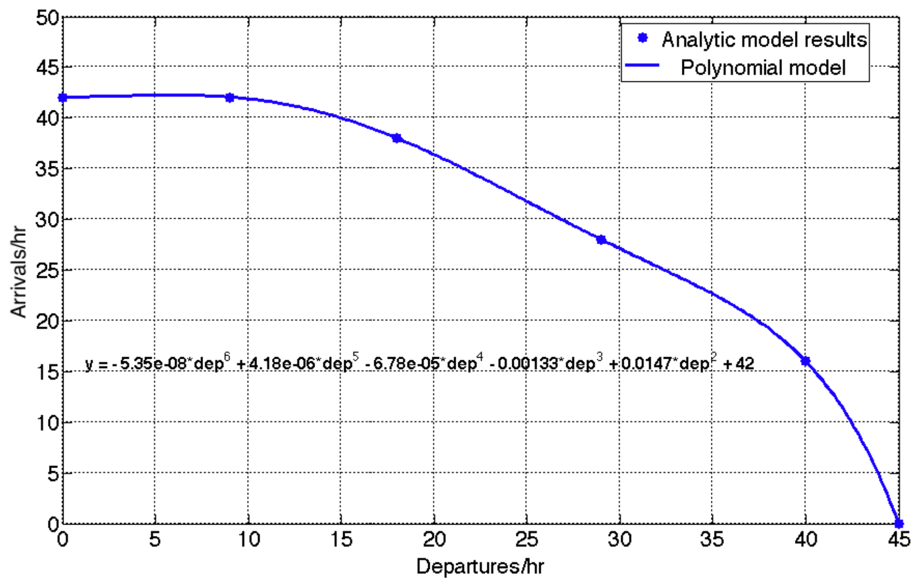

Figure 1. Pareto Diagram for Problem 1.

a) Estimate the average delays to both arrivals and departures at the airport if the daily demand function is as shown in Table 1. Explain where in the Pareto diagram should Air Traffic Control manager operate the single runway airport.

b) Estimate the maximum number of aircraft waiting for departure at the departure queue of the runway.

Table 1. Flight Demand for Problem 1

Time Period	Arrival/hr	Departures /hr
0-4	3	5
4-7	12	10
7-10	46	14
10-16	23	42
16-20	18	25
20-24	8	13

Problem 2

Data is collected at an airport for two aircraft is shown in Table 2.

Table 2. Observed Normal Distributions for Two Aircraft in the Fleet Mix. Values in parenthesis are the mean and the standard deviation of each parameter.

Parameter	Aircraft 1 Distribution	Aircraft 2 (Distribution)
Touchdown distance (m)	*dt*=(315,112)	dt=(213,90)
Approach speed (m/s)	Vapp = (64.2,3.7)	Vapp = (55,3.1)
Free roll time (seconds)	tr = (1.9,0.5)	tr = (2.0, 0.10)
Deceleration rate (m/s-s)	aMean[1] = (2.3,0.3)	aMean = (2.4,0.29)
Exit Speed (m/s)	Vexit = (10.5,2.8)	Vexit = (9.9, 2.9)
Turnoff time (s)	toff = (9.6,2.25)	toff = (10.1, 2.8)

1 - deceleration rate is negative in the equations on page 49 so here we show the values as positive.

a) Using Matlab, the kinematic equations of motion shown on page 49 of the notes (http://128.173.204.63/courses/cee5614/cee5614_pub/FAA_modeling_and_sim.pdf) and the distributions shown above, estimate the “natural distribution” of runway occupancy times (ROT) and landing distances for the complete population of aircraft. Assume each aircraft represents 50% of the population operating at the airport (i.e., only two aircraft operating at the airport).

b) Plot a histogram of the natural distribution of landing distances. Repeat for ROT times.

c) Where would you locate 3 runway exits if the airport has a single runway? State the distances from the threshold of your suggested runway exits.