Assignment 2: Air Transportation

Date Due: September 6, 2011 by Close of Business Day (via Email) Instructor: Trani

Problem 1

Suppose we are conducting an analysis of flight operations for Atlanta International Airport. We would like to use the FAA Aviation System Performance Metrics database (ASPM). A link to ASPM can be found on our web site (http://aspm.faa.gov/eurl.axd/215b24959b3b0343923e2ce188ab5d03/). For two days: July 15 and July 16, 2011 do the following:

a) Extract the hourly operations at the airport considering all types of operations.

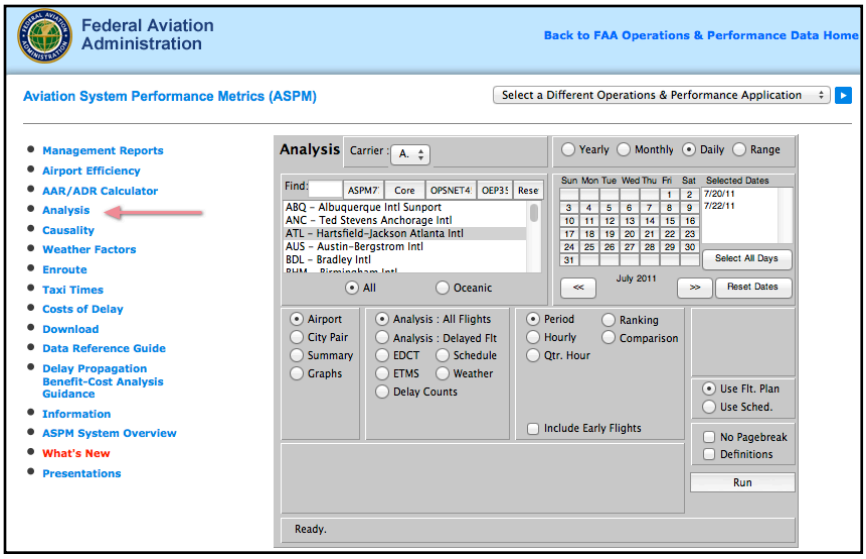
b) Plot the flight demand at ATL against time and comment on the pattern observed.

c) Estimate the delays at the airport using the ASPM data.

d) Find the taxi-in and taxi-out times at AT in the two-day period.

e) Repeat steps (a-d) for LaGuardia airport. Comment on the differences observed at these two airports.

A sample screen shot of the FAA ASPM site is shown below.



Problem2

Read an article about the ADS-B system (http://en.wikipedia.org/wiki/Automatic_dependent_surveillance-broadcast)

a) State the advantages of this system for surveillance

b) What are the FAA implementation plans for ADS-B?

Read the Paper: Potential ADS-B/CDTI Capabilities for Near-Term Deployment, by Mundra et al. (http://www.atmseminar.org/seminarContent/seminar1/papers/p_023_ASSP.pdf) and comment on the following issues:

a) What are the benefits of using ADS-B/CDTI in terminal area operations?

b) What capacity benefits are possible using the dual technology according to the paper?

Problem 3

The minimum flight speed of an aircraft is called the stalling speed (V_{stall}) and is given by the formula:

$$V_{stall} = \sqrt{\frac{2mg}{\rho S C_{l\max}}}$$

where: m is the aircraft mass (in kilograms), g is the gravity constant (9.81 m/s-s), S is the aircraft wing area (square meters), ρ is the air density (kg/cubic meter) and $C_{l\max}$ i(dimensionless) s the maximum lift coefficient (a parameter determined by the aerodynamic capability of the aircraft). According to Federal Aviation Regulations (FAR Part 121), the approach speed of an aircraft should be 1.3 times the stalling speed.

Create a simple Matlab function to estimate the stalling and approach speeds of an aircraft. The function should take 4 parameters (aircraft mass, maximum lift coefficient, wing area and air density) and should output two parameters: stalling speed, and approach speed. Suggested names of variables for the function are shown below:

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function [approachSpeed, stallSpeed] = speedCalculator(mass,clMax,wingArea,density)
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a) Run the function for an aircraft with the following parameters: S=350 square meters, $C_{l\max}$ = 1.3 (clean wing - no flaps) , m = 200,000 kg and g = 9.81 m/s-s and sea level atmospheric conditions. Find the values of atmospheric density on pages 14 and 15 of the aircraft performance notes 1 (http://128.173.204.63/courses/cee5614/cee5614_pub/Aircraft_perf_notes1.pdf)

b) Repeat the analysis for altitudes ranging from sea level to 12,000 meters (every 1000 meters).

c) Plot the results and comment on the trends observed.

d) What is the stalling speed if the aircraft flies at 35,000 feet above mean sea level?

e) Suppose that for the aircraft in question, the maximum lift coefficient is 2.5 with full flaps down (I.e., landing configuration) . Find the approach speed require to land the aircraft at 180 metric tons.

Problem 4

Use the Matlab computer program ISAM.m (available in the Matlab files section of our web site - http://128.173.204.63/courses/cee5614/matlab_files_cee5614.html) to answer the following questions:

a) A Boeing 737-800 of Delta Airlines climbs out of Atlanta enroute to Miami. The pilot reports to Air Traffic Control an indicated airspeed of 300 knots while climbing through 18,000 feet. Find the true airspeed (in knots) of the aircraft and the typical outside temperature in the standard day (ISA conditions).

b) A Boeing 777-200LR cruises at Mach 0.84 at Flight Level 360 (or 36000 feet above sea level) over the Pacific under standard day conditions. Find the true airspeed of this aircraft. What is the value of the atmospheric density and the speed of sound at Flight Level 360?

c) A new RNP departure procedure - a type of departure procedure used at airports, calls for a very precise climb speed profile schedule for the aircraft. The pilot programs the following values in the aircraft Flight Management System (FMS):

Altitude (ft)	Indicated Airspeed (knots)	Aircraft Configuration
100	155	Flaps 15
1000	180	Flaps 15
2000	200	Flaps 2

Altitude (ft)	Indicated Airspeed (knots)	Aircraft Configuration
4000	250	Flaps 0 (clean wing)
10000	250	Clean
20000	285	Clean
30000	300	Clean

a) Calculate and plot the values of true airspeed vs. altitude for this profile (use Matlab or Excel)

b) Calculate and plot the values of true Mach Number during the climb profile.

c) Comment on the observed trends.