

Assignment 2: Air Transportation

Date Due: September 12, 2012

Instructor: Trani

Problem 1

Suppose we are conducting an analysis of flight operations for Newark 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/>).

Before doing this problem please read the presentation entitled "Aviation System Performance Metrics (ASPM) Overview" posted at the ASPM Complete web site (see Figure 1).



Figure 1. Aviation System Performance Metrics (ASPM) Presentations Window.

For two days: July 20 and July 25, 2012 do the following:

- Extract the hourly and quarterly hour operations at the airport considering all types of operations.
- Plot the flight demand at EWR against time and comment on the pattern observed.
- Estimate the delays at the airport using the ASPM data.
- Find the taxi-in and taxi-out times at AT in the two-day period.
- Repeat steps (a-d) for Denver International Airport. Comment on the differences observed at these two airports.

A sample screen shot of the FAA ASPM site is shown in Figure 2. Note that you will required to log on to the site using the instructions provided in class # 2.

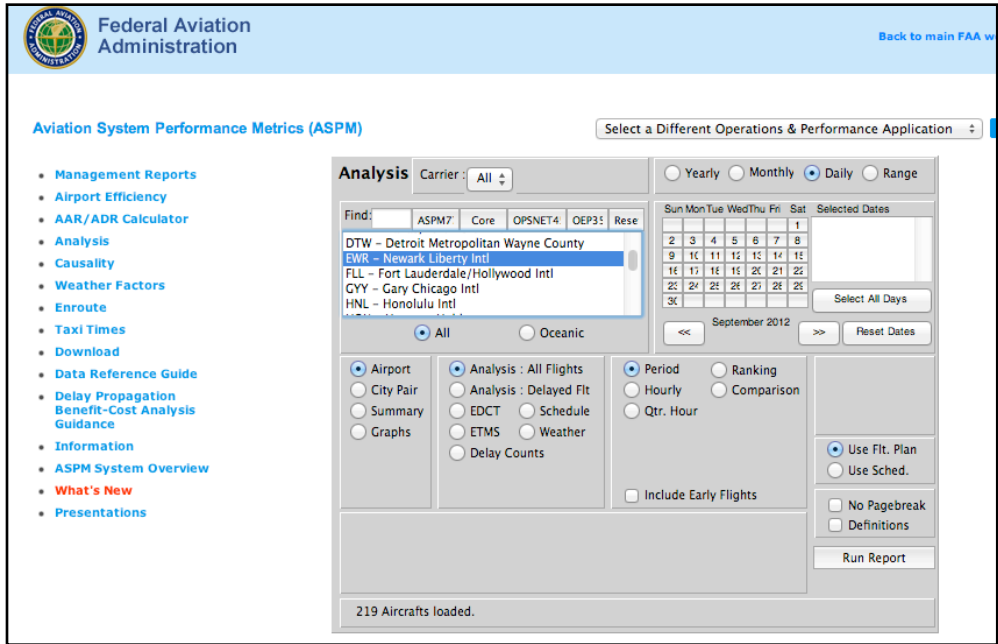


Figure 2. ASPM Analysis Java Interface.

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? Explain where is ADS-B available today.

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 CDTI technology in visual approaches?
- b) How did the authors evaluated the capacity gains of CDTI in visual approach conditions?
- c) Explain how ADS-B and CDTI technologies can help increase the Oceanic capacity - specifically in the North Atlantic Organized Track System (OTS).

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 $C_{l_{max}}$ (dimensionless) is 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:

`function [approachSpeed, stallSpeed] = speedCalculator(mass, cIMax, wingArea, density)`

- a) Run the function for an aircraft with the following parameters: $S = 190$ square meters, $C_{l_{max}} = 1.3$ (clean wing - no flaps), $m = 100,000$ 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 10,000 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 40,000 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 required to land the aircraft at 85 metric tons at an airport located at sea level conditions.

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 American Airlines climbs out of LGA enroute to Miami. The pilot reports to Air Traffic Control an indicated airspeed of 280 knots while climbing through 20,000 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 0.83 at Flight Level 370 (or 37000 feet above sea level) over the North Atlantic track system. The atmosphere is 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 370?
- c) A small very light jet descends to the Reagan Airport. As the aircraft passes 10,000 feet the ATC controller advises the pilot to reduce its indicated airspeed to 230 knots. If the aircraft has a tailwind of 20 knots, how fast is this aircraft moving with respect to the ground?