Assignment 4: Air Transportation Systems Analysis

Date Due: September 23, 2012 Instructor: Trani

Problem 1

The National Airspace System is a complex system with thousands of commercial flights each day. The file nasOperations_2011.xls contains a sample of the flights that happened one day in the NAS in the year 2011. The header and a few flights are illustrated in Table 1. The Excel file contains a tab that explains each one of the columns of data (see Data Dictionary Tab).

Table 1. Sample NAS Flights File.

Flight ID	Aircraft Type	Type of Aircaft	Origin Airport	Destination Airport	Cruise Flight Level (feet/100)	Cruise Speed (knots)	Departure Time (hrs)	Arrival Time (hrs)	Distance Flown (nm)
BSK641	B738	J	MUHA	MIA	230	346	1.70	3.40	235.17
CSDKC	GLF5	J	OMA	DAL	190	337	13.83	16.15	586.62
EJA931	C750	J	FLL	APF	60	249	23.50	0.12	100.82
TSU132	CVLT	T	MDSD	BQN	150	279	23.63	0.40	166.49
ABX2217	B762	J	MIA	SPIM	340	471	22.78	4.55	2621.49
ABX2250	DC86	J	NGU	MUGM	320	450	12.13	15.20	1178.55
ABX2251	DC86	J	MUGM	NGU	380	453	17.18	20.77	1178.55
ABX38	B762	J	ZBAA	ANC	390	462	19.28	3.25	3950.40
AIP511	B190	T	HNL	MUE	130	219	11.30	12.32	171.82
AIP512	B190	T	MUE	HNL	120	219	12.63	13.65	171.82

a) Examine operations in the NAS performed by the new generation of Boeing 737 family aircraft (models B737, B738 and B739 in column 2). Make a histogram of cruise flight levels assigned to the aircraft stated above and observe if there is any correlation between cruise altitude and distance flown. Explain the trends observed.

b) b) For the aircraft fund in Part (a), create a histogram representing the stage length flown by the aircraft vs frequency of operations.

c) Compare daily operations of Southwest Airlines (flight ID starts with SWA) Boeing 737 and those of United Airlines (flight ID starts with UAL) in the NAS. Contrast the distribution of the stage lengths flown (i.e., distance flown) and the cruise flight levels and filed cruise speeds used.

d) Filter all Boeing 777 aircraft in the data set (models B772 and B773 in column 2) and explain the types of routes flown by these aircraft compared to the analysis done in part (a). Does the B777 flies faster (statistically speaking) than the Boeing 737? Explain.

Problem 2

a) For the new generation long-range transport aircraft provided in the class web site (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing787_class.m), estimate the rate of climb and true airspeed for each one of the following climb conditions.

Flight Condition (altitude above sea level) in meters	Indicated Airspeed (knots)
1000	220
4000	270
8000	300
10000	310

In this solution calculate all the aerodynamic parameters using the parabolic drag model discussed in class. For each data point your calculations should include: a) lift coefficient, b) drag coefficient, c) drag, d) thrust generated and e) rate of climb.

Note: If you employ a spreadsheet or Matlab approach show me a sample calculation by hand. You can certainly do this problem by hand as well.

b) Using the rate of climb values estimated in part (a), estimate the time to climb from 1,000 meters to a cruise altitude of 10,000 meters.

Problem 3

a) For the new generation long-range transport aircraft provided in the class web site (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing787_class.m), estimate climb profile (distance vs. altitude) using the unrestrictedClimbAnalysis.m Matlab script. Run the program at the aircraft MTOW.

b) How many metric tons of fuel does the aircraft burns in the climb profile to 35,000 feet.

c) What distance is covered during the climb to 35,000 feet?

d) Repeat the process (parts a-c) for ISA + 30 degree conditions. You control the temperature profile changing line 44 of UnrestrictedClimbAnalysis.m. Using a deltaTemp value of 30 degree (positive) the computer program will use ISA + 30 degrees of temperature. Comment on the differences observed.

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deltaTemp = 0;              % ISA + deltaTemp conditions for analysis (deg. Kelvin)
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