Assignment 4: Air Transportation Systems Analysis

Date Due: October 17, 2011 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 activities that happened in the NAS on December 20, 2008. The header and a few flights are illustrated in Table 1.

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

Examine operations in the NAS performed using wide-body transport aircraft represented by the Boeing 767 family (models B762, B763, B764 and B767) and Airbus A330 family represented by the following models: A330, A332, and A333.

a) Find cruise flight levels assigned to all modern wide-body aircraft stated above and establish a possible correlation between cruise flight level and distance flown. Plot and find the best fit model. Explain the trends observed.

b) For the aircraft fund in Part (a), create a histogram representing the stage length flown by the aircraft vs frequency of operations flying a given range of distances. I suggest you partition the range of distances into 15-30 bins.

c) Compare the histogram of distance flown by wide bodies and compare to that of the Boeing 777 family (B772, B77W and B773). Comment on the difference observed.

Problem 2

Use the large twin-engine transport aircraft performance file provided in the Matlab files for CEE 5614 (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing777_class_2006.m) to answer the following questions.

An airline wants to fly the route ATL-LFPG (Paris) with the aircraft. The route is 3,878 nm in Great Circle Distance (see Figure 1). We can add 5% to account for route deviations. The aircraft takeoff weight is projected to be 290,000 kgs. with 140,000 OEW, 90,000 kg. of fuel and 60,000 kg of payload. The aircraft is expected to climb to FL 330 directly and fly at Mach 0.82 at that altitude for 3 hours until the aircraft reaches the entry point of the North Atlantic Organized Track system (NAT) near Gander, New Foundland. **Read about the NAT at: http://en.wikipedia.org/wiki/North_Atlantic_Tracks.** At the NAT entry point the pilot requests FL 360 and Mach 0.82 and continues at that altitude until reaching the Top of Descent Point (TOD) North of Paris.

a) Calculate the fuel savings to the airline if the aircraft receives an approved flight plan with the step climb before entering the NAT. The worse scenario is the aircraft crosses the Atlantic at 33,000 feet.

c) Estimate fuel savings if a higher altitude is provided by Gander Oceanic Center. Comment on the method to select the altitude.

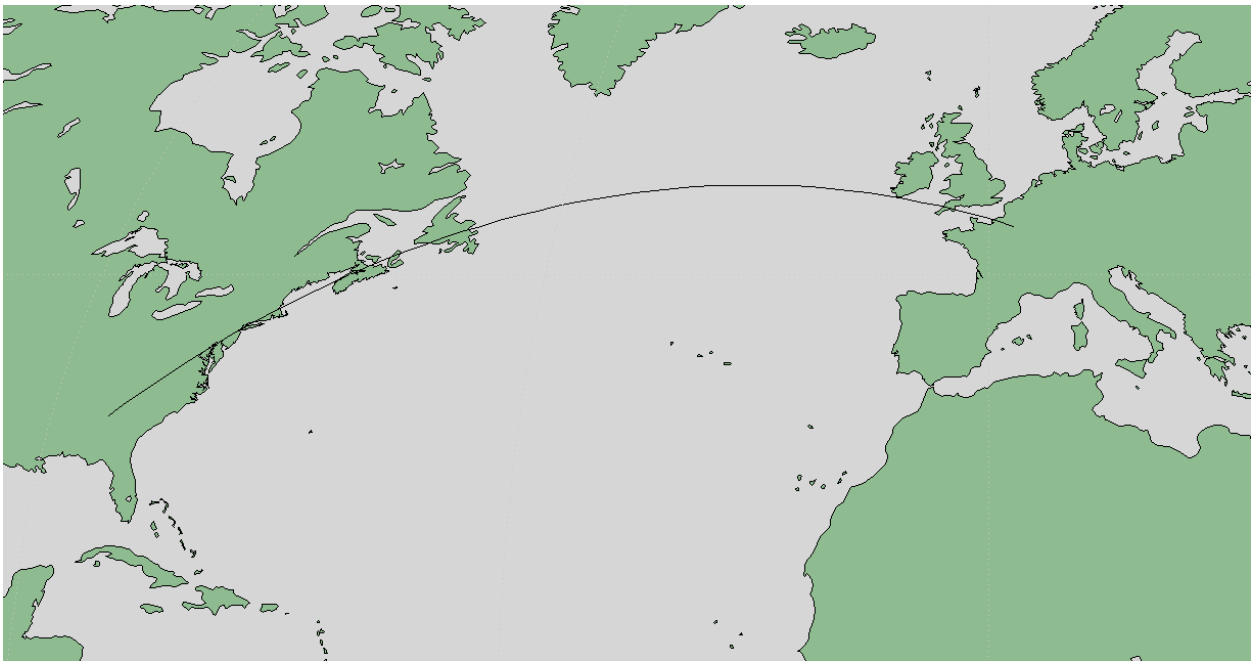

Figure 1. ATL-LFPG (Paris) Route.

Problem 3

For the aircraft climb and maneuvering example solved in class (http://128.173.204.63/courses/cee5614/cee5614_pub/aircraft_maneuvering_performance.pdf), find the maximum takeoff weight for the very large capacity aircraft to legally depart the airport and clear the 1,500 meter hill by 1,250 feet.

Assume the aircraft fully retracts the landing gear at 100 meters of altitude and the climb speed is 200 knots in the initial climb for the first 10 miles after engine failure.