1.206J/16.77J/ESD.215J Airline Schedule Planning

Problem Set #2

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Due date: Monday, April 7th, 2003

Part I: Implementing FAM

You are working as the chief scheduler for this newly formed airline, Cheapo airlines ("the cheapest airline in the sky" ®). Cheapo can lease up to **2** Boeing 737-500 and **2** Airbus A320. The relevant data for each of these aircraft types are as follow:

Aircraft type	Seats	Turn Time
Boeing 737-500	108	25 minutes
Airbus A320	144	35 minutes

Cheapo airlines flies between three airports: A, B and C. The relevant data for each flight leg is contained in the following schedule table:

Flight Number	Origin	Destination	Departure	Arrival
301	A	B	8:30AM	10:15AM
102	C	B	9:00AM	10:30AM
101	B	C	11:00AM	12:30PM
302	B	A	2:00PM	3:45PM
201	C	A	2:15PM	3:15PM
202	A	C	4:30PM	5:30PM

1. Draw the daily timeline network from each aircraft type and compute the number of variables.

2. Draw the daily timeline network with maximal feasible node consolidation and compute the number of variables.
3. Write the integer programming constraints for the node-consolidated network.

You are given the following data:

Flight Number	Number of passengers	Average fare	Operating cost	
			737	A320
301	130	$143.85	$10,500	$13,500
102	140	$142.86	$9,000	$13,000
101	140	$144	$9,000	$13,000
302	130	$142	$10,500	$13,500
201	120	$100	$6,000	$9,000
202	100	$100	$6,000	$9,000

4. Assume for now that all the passengers are locals (they fly on one flight only): Calculate the objective coefficients of the basic Fleet Assignment Model (FAM), which minimizes the profitability (sum of the operating costs and the spill costs), and find the optimal solution using OPL Studio.
5. In reality, some passengers are connecting in airport B. The passenger itinerary matrix is given below:

#	From	To	Itinerary		Number of passengers	Fare
1	A	B	301		90	$150
2	A	C	301	101	40	$130
3	C	B	102		90	$150
4	C	A	102	302	50	$130
5	B	C	101		100	$150
6	B	A	302		80	$150
7	C	A	201		120	$100
8	A	C	202		100	$100

6. Solve the Itinerary Fleet Assignment Model (IFAM) with no recapture using OPL Studio.
7. Compare and comment on the profitability of FAM and IFAM fleet assignment solutions.
8. Assume that you are given the additional information that 20% of the passenger originally scheduled on flights 102 and 302 (itinerary 2) but who are spilled, accept to be re-accommodated on flight 120 (itinerary 8). Can you tell, using only the LP solver if this itinerary might improve the fleet assignment solution found in question 6?

Part II: Side Constraint Modeling

9. Write the Fleet Assignment Model mathematically for the general case, and clearly define your variables, parameters and sets.

How would you model the following constraints?

10. *Station exclusion*: Due to restrictions, fleet type f cannot fly into airport j.
11. *Noise restriction*: Due to municipal laws, no more than 30% of departures out of airport j can be of fleet type f or g.
12. *Crew*: The number of flying hours of fleet f cannot exceed the maximum number of available crew hours, C(f).
13. *Require through*: A required through flight corresponds to connecting flight legs with the same flight number (which is interesting for marketing purposes). This means that both flight legs (say i_1 and i_2) must be of the same fleet type. How would you model this?
14. *Two-service maintenance*: The two-service maintenance for fleet f are at airport: j, k and m. At least n aircraft of fleet type f must overnight at one of these airports.