AE4424 Network Scheduling

TU Delft, Faculty of Aerospace Engineering

Assignment 2

Deadline: 13 - 04 -2017

Problem 1: Itinerary-based Fleet Assignment Problem

Consider again the airline from Assignment 1 (Problem 2) that is operating from Argentina. The airline flies to 34 national and international destinations, using two hub airports - one in Aeroparque Jorge Newbery (AEP) and the other in Ministro Pistarini International Airport (EZE), both located in Buenos Aires metropolitan area.
The flight number, the departure times and the direct operating costs for each flight in the schedule are given in this first sheet of a new Excel file uploaded in blackboard. Operating costs values of 'NA' imply that the flight can not be operated by the associated aircraft type. The second sheet presents a set of passenger itineraries, indicating the origin and destination, the demand and the fare for each itinerary. In addition, the flight or the set of flights used in each itinerary is provided in the same sheet. The third sheet presents the passenger itinerary recapture information, presenting the recapture rates among different itineraries. Consider a recapture rate equal to zero for the itinerary pairs not presented in this third sheet. Finally, the fourth sheet describe the aircraft fleet of the airline. The airline operates a fleet of Airbus 330 (A330) and 340 (A340), and Boeing's 737-700 (B737) and 737-800 (B738). The flights between both hub airports, AEP and EZE, are operated using buses which connect both airports in the same city by road. Per flight in the schedule, the airline provides 4 buses of 54 seats.
The objective of the airline is to best allocate the fleet to all flights scheduled, in order to minimize direct operating costs and passengers assignment costs. The airline is considering spill costs and recapture opportunities.

Questions

1. Develop an algorithm to read the flight schedule information provided and to convert it into a set of nodes and arcs that would represent the time-space network to be used to solve the fleet allocation problem. Present the pseudo-code and explain the outputs of the algorithm, indicating how many ground arcs do you have for the A330 aircraft type,.
2. Solve the optimization problem. Provide the following information:
   - initial and final number of variables and constraints
   - number of iterations run until convergence
   - objective function value evolution and final value
   - number of columns and rows added per iteration
   - list the flights operated by the A340's
   - list of itineraries with passengers spilled and the amount of passengers spilled
   - total computational time (excluding input upload but including time-space networks computation)
3. Based on your previous solution, describe the strategy you would suggest to the airline's revenue management department in order to best explore the estimated demand per itinerary.
4. The airline is considering to replace one B737 by a new Boeing 787 MAX 8 with 186 seats. Assume that the new aircraft has operating costs similar to the ones currently in the fleet and neglect investment costs. Without solving again the model, indicate if this would be good to reduce operating and spilling costs and explain in which route would you assign the new aircraft. Justify you answer.

Problem 2: Aircraft Rotation and Crew Scheduling

Consider now only the flights operated by the B737-700 and B737-800 aircraft.

1. Develop an algorithm to produce a set of feasible single-days pairings (i.e., duties) for the cockpit crew with base at AEP. The pairings should respect the following requirements:
   - pairing should start and end at the base airport;
   - no more than 4 flights per duty;
   - a minimum of 45 minutes between flights;
   - a maximum of 3 hours of idle time between flights;
   - a maximum of 8 hours of duty (not including brief and debrief times).

   Present the pseudo-code of the algorithm and a set of pairings that would allow the operation of all flights.

Report submission

- Motivate all your choices, comment on results and be critical towards your results.
- If possible, use figures and tables to present your results and support your conclusions. Note that the report shall not contain any computer code.
- Submit your files through Blackboard (assignment folder in the course webpage) at the latest on Friday 13 April, 23.59 hrs.
- You need to submit the following files (all as separated files):
  - o the report in pdf format with a maximum of 10 pages plus cover (font equivalent to Times New Roman – 12 pt, line spacing 1.15 and standard margins), describing your approach and the results for each of the questions in detail (note: group number, names and student IDs should be stated in the cover);
  - o the set of script files used in the implementation of the models and solution techniques used to solve the questions (make sure these files have a good structure and are well commented in order to be clear how you implemented your models and solution techniques);
  - o one copy of the log page indicating which activities were performed by each member of the group.

General information

- The assignment should be handed in via Brightspace. **All files should be uploaded separately** - compiled files will not be considered.
- The grade of the assignment will reflect the quality of the report, the description of the work and the results obtained, according to what is described in the report.
- If you fail to meet the deadline, 0.5 points will be deducted from your grade for each day after the deadline.
- If you fail to obtain a grade of 6.0 or higher you will fail the assignment. In that case, you will get a chance to redo your work and pass the assignment. Your final grade cannot become higher than 6.0 in that case.
- The reports and the script files will be checked for plagiarism (including reports and scripts from last years). In the case plagiarism or any other fraud situations are identified, the group(s) in case will fail the assignment and the situation will be reported to the Board of Examiners (according to TU Delft regulations).

Table 1: Log Table - Use this table to register the contribution of each student [note: use percentages of 0; 25; 50; 75; 100 %]

Problem	Question	Points	Task	Student_____	Student_____
1	1	2.5	Implementation (70%) Reporting (30%)		
	2	3.0	Implementation (70%) Reporting (30%)		
	3	1.0	Analysis (70%) Reporting (30%)		
	4	1.5	Analysis (70%) Reporting (30%)		
2	1	2.0	Algorithm design (30%) Implementation (40%) Reporting (30%)		