Assignment 2

AE4423 – Airline Planning & Optimization 2019/2020

Introduction

It is time to plan the operations of your airline. In this 2nd assignment, you have to design the flight schedule and the aircraft routings for your operations, in order to maximize the profits.

Consider the network given in the 1st assignment with 20 airports, the demand matrix (consider it as being daily demand) and the location of your hub airport. The cost and revenue information provided in the 1st assignment is still valid for this new assignment.

Read the assignment carefully (including the appendices) to extract all information required to adapt the model presented in the lecture!

Aircraft Routing Problem

Timetable development & aircraft routing

With the input data available in the Excel file supplied with the assignment and the Appendix, determine the flight schedule and aircraft routing for one day (24-hour period). That is, you have to determine which aircraft to fly a specific route as well as the departure time of each flight. The objective is to maximize the profit within one day.

To achieve this goal, you need to:

1. Apply the dynamic programming framework presented during the lectures to solve the problem.
2. Setup a **computer model** (e.g., in Python or Matlab) according to the model written on paper. You should not use any commercial solver.
    - Write in your assignment the pseudo-code of your computer model.
3. Determine the optimal routing of each aircraft and corresponding departure times, assuming:
    - the data in the Excel file and the Appendix from this assignment;
    - the airport and the 2014 demand information (consider it as being your 2019 daily demand) provided for Assignment 1;
    - the cost and revenue formulas and parameters used during Assignment 1;
    - the fleet information from Assignment 1 – consider leasing costs per day (i.e., weekly costs divided by 7 days).

Note: don't use your results from Assignment 1. This should be an independent assignment. Also, do not compare the results from both assignments. They are not meant to match.

General information

- **Motivate your choices, comment on results, and be critical towards results!**
- Describe the dynamic programming model, your assumptions, results and KPIs in detail in a comprehensive report of **no more than 10 pages A4** (excluding cover but including appendixes; font equivalent to Times New Roman – 12 pt, line spacing 1.15 and standard margins). **Note that the report shall not contain any computer code.**
- Use **figures** and **tables** to present your results and KPIs and support your conclusions.
- Submit your report and model script file(s) through **BrightSpace** (assignment folder in our course webpage) at the **latest on Monday 13 December, 18.00 hrs**. Don't forget to include the group number, names and student IDs in the report (and script file(s)). Do **NOT** submit input (Excel) files. Files submitted by email will not be considered.
- **If you fail to meet the deadline**, 0.5 points will be deducted from your grade for **each day** after the deadline. No excuses will be accepted! Make sure that you work as a group and save the latest versions of your work in multiple places.
- All files uploaded in BrightSpace should be uploaded as **individual files** (i.e., not compressed as '.zip', '.tar',…) to be subjected to **Turnitin check**. **If compressed files are uploaded**, 1.0 points will be deducted from your grade.
- **If you fail to obtain a grade of 5.5 or higher you will fail the assignment.** In that case, you will get a chance to improve your work and pass the assignment. Your final grade cannot become higher than 6.0 in that case.
- You should include a separate overview of the **workload distribution** of each group member. Indicate (in percentages) each member's contribution to the three categories **modelling framework (30%)**, **programming (50%)** and **reporting (20%)**. Based on this overview you will receive an individualized grade for the assignment. For an example of the format see Appendix E.
- **An assessment matrix** will be available to clarify the grading process.

Appendices

A. Aircraft routes to consider

Your airline will only consider to add aircraft routes that:

- Are profitable – i.e., you do not have to use all aircraft in your fleet;
- Have a minimum of 6 hours of block time per day;
- Respect range and runway constraints.

B. Demand management

1. The demand per hour can be computed by multiplying the daily demand (demand matrix given for Assignment 1) by the hour-coefficients given in the Excel attached to this assignment. You should use the following formula:

$$Dem(t)_{i,j} = Dem_{i,j}^{2014} \times Coef(t)_i$$

Where

- $Dem(t)_{i,j}$ is the demand for hour t in the route i,j
- $Dem_{i,j}^{2014}$ is the demand per week given for 2014 between the airports i and j
- $Coef(t)_i$ is the coefficient for hour t given in the Excel file.

Note:

- the demand is given per route and they already consider the connection of passengers at the hub;
- demand for a given hour of the day will be available at any (departure) time within that hour.

2. When you fly at hour t, you can assume that you can capture the demand you estimated for hours t, t-1, t+1 and t-2. After adding an aircraft route to your solution, you should remove the demand you transported. To do this, remove demand from t, t-1, t+1 and t-2, sequential, until the aircraft is full or no more demand is available.

C. Other considerations

Consider the following elements:

- Besides the flight time and the TAT, assume that
  - the aircraft takes 15 min extra for take-off and get to cruise position;
  - the aircraft takes 15 min extra for approaching the destination airport and landing.
- Divide your scheduling horizon (24 hours) into time stages of 6 minutes. That is, each hour will be divided into 10-time stage, where, e.g., 5.4 = 5h24min.

E. Individual workload

To distinguish between each student's workload in the group, you are required to provide an indication of each group member's workload in three separate disciplines. Provide the workload distribution in a separate file uploaded along with the assignment and follow the template below (or similar).

Student names	Modelling framework (30%)	Programming (50%)	Reporting (20%)
Student name #1	# %	# %	# %
Student name #2	# %	# %	# %
Student name #3	# %	# %	# %