ASSIGNMENT PART 2

AE4423 – Airline Planning & Optimisation

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2022/2023

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Introduction

This is the second part of the Assignment from AE4423 – Airline Planning and Optimisation 2022/2023. The results from the first part of the assignment are not relevant for this second part.

In this part of the assignment, the mother company of your regional airline decided to hired your team. They want you to help them to organise their international flight schedule around their two hub airports, Milan Malpensa Airport (LIMC) and Bergamo-Orio al Serio Airport (LIME). Besides operating flights to European and intercontinental destinations, the airline also has a direct bus service between the two hub airports to allow for more transfer possibilities.

First read the entire assignment carefully (including the appendices) to extract all information required to adapt the models presented in the lectures!

Problem 3

The airline hired you to help them to maximize its profits by allocating its fleet and matching demand to the number of seats available in an optimal manner. **The objective of the airline is to maximize the fleet allocation contribution (i.e., reduce costs), by assigning aircraft types to scheduled flights in order to better match demand per flight with the number of supplied seats, and to capture the network effects for spillage and capture. In order to achieve this goal, you need to use the itinerary-based fleet assignment model (IFAM) discussed during the lectures.**

To achieve this goal, you need to use the column generation algorithm discussed during the lectures and follow the two steps below:

1. Solve the initial RMP of the problem and give the optimal objective value, the 5 first non-null optimal decision variables associated with the initial passengers itineraries, and the optimal non-null dual variables for the first flights of the schedule.
2. Solve the relaxed IFAM problem to the end. Indicate the columns you add to the problem and the optimisation runtime associated with each iteration you run from the column generation algorithm.
3. Consider again the IFAM problem with integer decision variables and solve it with the columns you add. Indicate the final airline cost, the total number of passengers spilled, the first 5 non-null optimal decision variables associated with the initial passengers itineraries and the first 5 non-null dual variables for the initial flights of the schedule.

Additional Information

- **Although a real Italian network will be used in this assignment, the input data is synthetic, so treat the results accordingly!**
- In the Excel file provided on Brightspace you find five sheets.
    - The **first** one refers to your airline's daily flight schedule, which contains, for each flight in the schedule, the flight number, the departure and arrival times, and operating costs for each aircraft type (in €).

- The **second** sheet presents the set of passenger itineraries, indicating the origin and destination, the demand and the fare (in €) for each itinerary. In addition, the flight or pair of flights used in each itinerary is provided.
- The **third** sheet presents the passenger itinerary recapture information, presenting the recapture rates for passengers among different itineraries. Consider a recapture rate equal to one for the fictious (spillage) path and desired path. And a recapture rate zero for the other itinerary pairs not presented in this third sheet.
- Finally, the **fourth** sheet shows the composition of your airline's fleet. It shows, for each aircraft type, how many are available, the number of seats, and the turn-around time in minutes.

Problem 4

To increase its profits your airline is considering adapting their current flight schedule, deleting some flights from their current schedule and adding some new flights. In the fifth sheet of the data file the candidate flights to delete and add are given.

- Explain the adaptations that need to be made to the mathematical model used in Problem 3.
- Explain how you can solve the adapted formulation using column generation.
- **[EXTRA 1.0 Points]** Solve the IFAM schedule design problem you formulated. Use the candidate flights to create the master flight schedule and adapt the IFAM problem in order to select the flights to operate from the flight list.

General information

- **Motivate your choices, comment on results, and be critical towards results!**
- Describe the mathematical model, your assumptions, results and KPIs for each of the assignments in detail in a comprehensive report of **no more than 12 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 Friday 14th January, 18.00 hrs**. Do not 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., do 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 **mathematical modelling (30%)**, **programming (50%)** and **reporting (20%)**. Based on this overview you will receive an individualized grade for the assignment. There is a maximum different of 2 points possible between group members. For an example of the format see Appendix A.
- **An assessment matrix** will be available to clarify the grading process.

Appendices

A. 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	Mathematical modelling (30%)	Programming (50%)	Reporting (20%)
Student name #1	# %	# %	# %
Student name #2	# %	# %	# %
Student name #3	# %	# %	# %