Task Sheet for Case Study

Student Sectioning

Starting literature:

- Aronshtam, L., & Ilani, H. (2022). Bounds on the average and minimum attendance in preference-based activity scheduling. Discrete Applied Mathematics, 306, 114-119.
- Varone, S., & Schindl, D. (2013). Course opening, assignment and timetabling with student preferences. In In: proceedings of International Conference on Operations Research and Enterprise Systems (ICORES) 2013, 2013, Barcelona, Spain, 16-18 february.

Task:

1. Gain an understanding of the problem.

    1.1. Read the given papers to understand general problem structure.
    1.2. Briefly describe the objective function and its constraints of your problem.

2. Modelling and solving the problem.
    2.1. Generate reasonable data for required parameters.
    2.2. Formulate an integer programming model to minimize the total cost. To do this, define decision variables, write constraints and specify an objective function.
    2.3. Use IBM CPLEX Studio to solve developed model of assignment problem. Write comment about the results.
    2.4. Update your main model using the extra constraints given below.
        2.4.1. Since there might not exist a feasible assignment, the model shall now be modified to guarantee the existence of solution. To achieve this, not all students have to be assigned their requested number of courses. Instead, for each student a penalty cost of M shall be added to the objective for each course fewer than the requested number of courses.
        2.4.2. Additionally, overbooking of courses shall be possible. For every course j we know a number $d_j \in Z^+$ of additional slots as well as penalty costs $f_j \in R^+$. The penalty costs f_j has to be paid once as soon as at least one of the additional slots of course j is occupied.

    2.5. Update your main model using the extra constraints given below.
        2.5.1. We are now given a minimum number g_j of participants for every course $j \in \{1, \dots, m\}$. Extend your main model correspondingly, such that this number is not undercut for any course.
        2.5.2. Due to the introduction of minimum capacities, it may happen that many students are assigned to a course of low priority to satisfy the corresponding constraint. Hence, we want to allow courses to be cancelled. Extend your previous model such that the minimum and maximum capacity constraints of a course are only enforced if the course takes place.
    2.6. Take a base model and create different instances. Generate new instances by changing the parameter values. Create at least 10 sets of different parameter configurations and solve at least 5 different instances for each. Think about meaningful variations of the parameter. Use the techniques of the lecture to create new instances. And save the results into an excel file.

2.7. Analyze the differences of the instances. Can you detect some pattern?
2.8. Find an easy heuristic.

2.8.1. Look in the literature for an easy heuristic for this problem.
2.8.2. Briefly state the idea of the heuristic, provide a numerical example (easy)
2.8.3. Compare the heuristic solution with some optimal solutions of CPLEX (BONUS TASK)

Presentation of results:

Report paper (~ 10-15 pages)
Final presentation (~30 min)
Interim presentation (not graded): (~10-15 min) Give a brief overview of the case study progress, explain the problem and model formulation. Also, opportunity for asking questions\getting help with problems. Also describe your project plan and next steps.