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Integer Programming  
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In the article "Implementation of a university course and examination timetabling system", Dimopoulou and Miliotis of the Athens University of Economics and Business describe how to design and implement a combined university course-exam timetable. This topic is of great interest because universities face these issues on a regular basis. At the heart of the matter, the goal is to obtain a feasible schedule which satisfies the basic constraints as well as any other university/departmental specific constraints. The authors’ aim is not to just find a feasible solution, but to find a fair feasible solution, i.e. a compact schedule.

As one can tell from the title of the article, there are two problems to be addressed. One for the course scheduling and the other for the examination schedule. For the course schedule, the authors state the problem as allocating the set of offered courses to time periods and classrooms in such a manner that no professor, student, or room is used more than once per period and that no room capacity is exceeded. The exam problem is to assign exams to a limited number of time periods.

To construct a formulation for the course schedule, two types of groups are created. The first, subject groups, contains a set of courses followed by the same students. So, the courses in each subject group require scheduling at different time periods. A subject group is formed by assembling the mandatory courses of a university stream uncommon to other university streams. A university stream is a class of mandatory and optional courses suggested by the university to be followed by the students for each semester of the degree program. A subject group of size one contains the optional courses or courses common to other university streams. Because the courses in a subject group are in conflict with one another, a conflict matrix is defined so that a one (1) is placed in each column of row i if subject group i conflict with the subject group. The second group is the time group. It defines a group of courses scheduled for a specific time period. The classrooms were also divided into six (6) groups of different capacity in order to assign the appropriate subject groups to classrooms. The IP formulation is the standard Max \textbf{x} subject to \( x \in \mathcal{X} \). There are three (3) sets of constraints in the formulation: one that assigns each subject group \( i \) with \( s(i) \), the cardinality of subject group \( i \), courses to exactly \( s(i) \) time groups; one
that accounts for classroom availability; and one set that ensures assignment of at most one subject group of the set of subject groups in conflict to a time group. For the tested application, there are about 180 courses that need to be scheduled each semester over 60 allotted teaching periods.

There are three week exam periods at the end of the semester and double-length exam period in September. Each exam day has four (4) periods. The exam formulation has the following constraints: there are no conflicts; all exams are assigned to periods; the seating capacity cannot be exceeded; only one mandatory course may be tested per exam day; the mandatory courses of the university stream must be spread evenly over the exam period; and the length of the exam period is minimum. The solution generated from the course schedule model can be used as an initial solution for the exam problem. To obtain a feasible solution, the authors devised procedures. Constraints 1 and 2 are automatically satisfied by the solution generated by the IP formulation. Procedure EXAMS allocates the exams of an examination day to the four (4) periods of the day. Its output satisfies constraints 3, 4, and 6. Only constraint 5 remains to be satisfied. Procedure UFOM reorganizes the mandatory courses’ exams in order to spread them uniformly over the exam period. It takes the output of procedure EXAMS as input and performs algebraic and logical arithmetic on it.

Both of these problems were addressed in one system. The system contains a user interface that allows for data entry, modification, and display. It also performs all computations and generates reports detailing the solutions. The system was implemented on a Pentium III PC. The DOS-based MPCODE and Windows XPRESS-MP were used to solve the IP. Data from the Athens University of Economics and Business were used. The system consists of five (5) modules: the data module, the control system module, the optimization module, the report generating module, and the evaluation module. It worked well on problems with 500 constraints and 1000 variables.

The system provides an integrated application for both problems and is a useful tool for the efficient management of the university’s resources. The information was presented in a manner that can be easily understood by OR people as well as non-scientific people. The organization of the article could have been better. The authors discussed the complete system before discussing the exam scheduling which is a part of the complete system. The system that was designed could be of use to most universities.
Bibliography