

Optimization models and algorithms for balancing physician shift scheduling in Emergency Departments

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SUMMARY

The shift assignment problem in staff scheduling, even in a restricted real version, is NP-hard [1]. In this presentation, we deal with the Emergency Department (ED) Physician scheduling problem, which is a specially complex problem in this category. It addresses each and every detail of the real-life situation, including the real work calendar and a one-year planning horizon. There are many different types of shifts of varying lengths-, to accommodate a non-uniform daily shift demand dependent on day type, and many ergonomic constraints imposed by mandatory and personnel requirements. The objective function pays attention to the fairness of the schedules among physicians, which entails balancing the distribution of different types of shifts among physicians under a range of often conflicting criteria. Physicians differ in their dedication and the type of shifts they can work.

The problem is initially modelled as an ILP problem but, after a real instance of this problem remains unsolved by a well-known ILP solver in one week, metaheuristic-based algorithms are designed. The first approach considered a GRASP-based algorithm, where the fitness function uses memory elements and the solution of an LP problem, solving a physicians demand-covering problem. The local improvement combines a Variable Neighborhood Descent Search algorithm and Network Flow Optimization models [2]. The schedules were implemented for four years at the ED of the Hospital of Navarre. Additional constraints and criteria made us develop a matheuristic algorithm that iteratively combines random partial constructive phases with small ILP problems. Solutions obtained by this algorithm outperformed the solutions of the first one, being used at the hospital for the last two years.

Keywords: OR in health services, GRASP, Matheuristic, Physician scheduling Problem

AMS Classification: 90B90, 90C10, 90C59

References

- [1] M. CILDOZ, F. MALLOR, P.M. MATEO. A GRASP-based algorithm for solving the emergency room physician scheduling problem. *Applied Soft Computing* **volume**(103), 107151, 2021.
- [2] HOONG CHUIN LAU. On the Complexity of manpowe shift scheduling. *Computers Operations Research* **volume**(23), 93–102, 1996.

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