
Maximising employee satisfaction with individual preferences

Fairness enhanced rostering

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Abstract

The past few decades have seen significant advances in scheduling employees using optimisation methods. Personnel rostering is the process of assigning employees to shifts respectively shifts to employees. This is an enormous issue affecting companies and employees not least because it is well known that working in shifts strongly affects private life. Due to diverging settings and requirements, there is a large variety of mathematical solution methods. We refer to Burke et al (2004) and Ernst et al (2004) for a classification of solution approaches. A recent systematic literature review by Van den Bergh et al (2013) concluded that there is a trend towards consideration of preferences in personnel scheduling to increase employee satisfaction.

However, whilst research has identified some well-performing solution methods for personnel rostering with the aim of cost minimisation, few studies on maximising employees' long-term satisfaction have been conducted. To gain higher job satisfaction, aspects of fairness as well as individual preferences should be taken into account within scheduling (cf. Stolletz and Brunner, 2012). In 1976, Warner published a study in which individual preferences are quantified in the objective function for the first time. He developed a solution approach for cyclical scheduling of nurses. Topaloglu and Ozkarahan (2004) conducted an implicit goal programming model for solving the tour scheduling problem allowing various preferences of employees, such as day off requests, shift type preferences and weekend requirements. Bester et al (2007)

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used tabu search for solving a nurse rostering problem that considers preferred shifts and focuses on fair treatment to minimise the overall dissatisfaction. In their study, they accumulate dissatisfaction over several planning horizons. To increase fairness among employees in one planning period, Rönnberg and Larsson (2010) tried to maximise the fulfilment of preferences in total as well as the lowest score. This individual score is calculated based on fulfilment of preferences and thus increases with realization and decreases with denial of requests.

The central aim of this study is to examine the requirements in the field which have been insufficiently taken into account yet and to develop a solution method for a real world duty scheduling problem. A German care facility for disabled people with about 65 employees serves as case study for our research. This is only one example of a 24/7 service which is seen as a major issue for many companies and their employees. The facility is organized into six residential groups that differ in their demand regarding staff and care. Every group has a residential group manager who is responsible for the personnel and their employment. Each employee is usually assigned to one group but due to some exceptions several employees work for two groups. The workforce is a mixture of both full-time and part-time employees. Employees have different skills and qualification levels and there are predefined shifts for special tasks, such as trainings and one-to-one care. Also, some further peculiarities like a collective agreement and several individual agreements regarding working time, e.g. reasoned by physical condition, come along with this example. Certainly, common requirements must be kept during the duty rostering, such as legal and policy regulations. Furthermore, each employee is allowed to ask for specific shifts on/off or specific days on/off. These preferences can be classified in normal and high priority. Due to working with people, it is also important to observe some social and practical guidelines, e.g. a mixed-gender team composition. Another important peculiarity is the separate scheduling of the night shifts for one calendar year in advance. In our approach, we depict the planning process as it is handled. Thus, the workforce and the night shifts' assignments are given beforehand and we deal with the remaining day shifts.

For this case study, we develop a specific solution method for the personnel rostering problem in which the employees will be given the possibility of participation in the planning process. We first construct a feasible solution which should be improved in the next step. For defining a feasible solution, we distinguish hard and soft constraints. Although it is a soft constraint, the employees' preferences are given high attention by trying to fulfil as many as possible. The constructed feasible solution is improved using simulated annealing. In line with the care facility's interests, this method makes the roster fairer and the individual schedules more comfortable. Using this approach, the employees' self-determination and thus their satisfaction could be increased. To assess the long-term effect, we look at the satisfaction over the planning periods. Therefore, we determine the short-term satisfaction as the difference between preferences and assigned shifts and accumulate it with last months' satisfaction. In doing so, we weight deviations from preferences differently depending on their priority and type of deviation. For example, assigning a shift to someone who asked for a day off is worse than assigning another shift than the preferred shift at the same day.

Up to now, most of the studies do not incorporate satisfaction with respect to the long-term and the diverse treatment of preferences' fulfilment. However, some useful aspects of existing solution methods can be adopted like the minimisation of the overall dissatisfaction (cf. Bester et al, 2007), the permission for various preference types as it is handled in Topaloglu and Ozkarahan (2004) as well as the scoring of individual preferences in Rönnberg and Larsson (2010).

Moreover, in this study analyses are performed to compare the applicability of our solution approaches to real and artificially generated instances. For this reason, we receive real world data from the case study. Based on these, we create artificial instances to run extensive and large-scale tests. Finally, this study proposes novel elements in staff rostering including the detailed consideration of satisfaction. In the end, a roster is built that considers preferences fairly over the planning periods and thus increases employee long-term satisfaction.

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