

The overlapping case in an integrated staffing and rostering formulation

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Staffing which aims to determine the suitable personnel structure is one of the human resource management activities. The personnel structure represents the number of personnel in distinct personnel subgroups, distinguished by specific work-related and individual characteristics. Occasionally, the staffing is then followed by the rostering activity to allocate the personnel to shifts subject to various constraints. However, in a situation where the suitability of the personnel structure depends on the rostering result, the two activities are not appropriate to be performed in a sequential way. Instead, staffing and rostering activities need to be performed in an integrated manner. In this situation, the existence of an undesired staffing situation (such as overstaffing and work overload) can only be known accurately after solving the rostering problem.

A three-examination framework has been proposed by [Komarudin et al. (2012)] to integrate the staffing and the rostering activities. It is intended to improve the roster quality by analyzing the current personnel structure. Specifically, it consists of (1) static check, (2) roster quality component examination and (3) simple neighborhood examination. Experiments demonstrated that several alternative personnel structures enable better quality rosters can be obtained.

The current work extends the [Komarudin et al. (2012)]'s framework by providing two alternatives to define the subgroups of the personnel structure. A personnel structure can be formulated so that members with the same set of characteristics are classified into one subgroup. An alternative representation can be constructed based on the main characteristic. The advantage of these alternatives is that they enable modeling various situations including cross-trained personnel, float unit personnel and multi-department situations.

Moreover, the current work provides a novel formulation for defining overlapping rostering constraints. These are constraints that concern with two or more personnel subgroups, e.g. multi-skill-based coverage requirement, tutorship and

training constraints. The overlapping constraint is important in that it can take a significant portion of the constraints in a rostering problem (see for example [Bilgin et al. (2012)]). Moreover, the overlapping constraint formulation clarifies the relationship of the personnel structure to the roster quality by specifying which subgroups affect the violation of a certain rostering constraint.

Two types of overlapping rostering constraints can be considered. The first type includes the rostering constraints that are expressed in terms of characteristics that are possessed by at least two personnel subgroups. An example of the first type is the multi-skilled-based coverage requirement. The rostering constraints of the second type, on the contrary, are expressed in terms of characteristics that are not all possessed by one of the personnel subgroups. For instance, tutorship is a rostering constraint that requires the trainee nurse, when on duty, to be accompanied by the tutor nurse. The two or more personnel subgroups can substitute each other in the first type. While in the second type, they act as complement to each other.

The example of the overlapping case is demonstrated by applying extensions of the three examinations to the emergency ward from [Bilgin et al. (2012)]. Detailed models and illustrations will be provided.

References

- [Komarudin et al. (2012)] Komarudin, Greet Vanden Berghe, Marie-Anne Guerry and Tim De Feyter. Three personnel structure examinations for improving nurse roster quality. *ORBEL26*, 2012.
- [Bilgin et al. (2012)] Burak Bilgin, Patrick De Causmaecker, Benoît Rossie and Greet Vanden Berghe. Local search neighbourhoods for dealing with a novel nurse rostering model. *Annals of Operations Research*, 194(1), pp.33–57, 2012.