

Multi-period railway timetabling to match time-dependent demand

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The demand for passenger railway services varies throughout the day. Usually there is a peak period at the beginning and end of the workday in which many people go to or return from work or school. Outside these peak periods the passenger volumes are much lower, and more people travel for leisure purposes. Nevertheless, in many European countries a fixed line plan and cyclic railway timetable is used, which is the same for every hour of the day. Benefits of such a timetable are that they are easy to remember for passengers and that people travelling outside the peak hours still have many options for their trip. However, one disadvantage is that these line plans and timetables are usually based on peak hour demand. Since people who travel outside the peak hours usually have different travel purposes and therefore destinations, this service plan is not optimal for passengers in the off-peak. In previous work of the authors, a mixed-integer linear programming (MILP) model was proposed to create a multi-period line plan, where an optimal line plan was created for each predefined period with homogeneous demand [1]. Here, we extend this work by presenting a MILP model for creating a timetable for the multi-period line plan. In multi-period timetabling, a cyclic timetable is constructed for each period with homogeneous demand and its own line plan. In addition to the regular constraints for cyclic timetabling, multi-period timetabling should consider two additional requirements. First, special attention is needed for planning the transition between two periods. Second, we want to maintain as much regularity during the day as possible. So, if there is a line that is contained in the line plans of several periods, we want to deviate the departure and arrival times as little as possible. We will present the proposed model and some preliminary results of a case study based on real data of part of the Dutch railway network.

Keywords: timetabling, time-dependent demand, railway, mixed-integer linear programming

References

1. van der Knaap, R.J.H., van Oort, N., de Bruyn, M., & Goverde, R.M.P. (2024) Railway line planning for varying demand with stop and frequency setting for asymmetric lines [Manuscript in preparation]