

Evaluating and Comparing Cyclic Timetables

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Abstract From the perspective of passengers, a timetable can be called better than another if its expected passenger time is lower in practice. So, we constructed an analytical function that evaluates a timetable on this criterion: expected passenger time in practice. Our approach does not need to simulate but directly evaluates and in doing so our method is extremely fast. The resulting method is applied to the previous and current timetable of all passenger trains in Belgium and we can conclude that the new timetable reduces the expected passenger time in practice and also that this is mainly due to better passenger transfer planning. Our method also shows that the reduction of supplements could potentially further improve the timetable.

Keywords Expected Passenger Time · Objective Function · Optimal Cyclic Timetabling · Periodic Event Scheduling Problem

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1 Introduction

Whenever a railway company updates or completely overhauls a timetable, it is highly important to evaluate the new timetable and compare it to the previous one.

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Today evaluation methods are typically restricted to simulation methods that do not report expected passenger time but focus on train time, ignoring the importance of passenger numbers, important transfers and expected secondary delays and positive effects of spreading of alternative trains. These methods do not answer all questions that should be asked when developing a new timetable.

Questions to be asked about the correctness of any timetable are: Are all minimum ride, dwell, transfer and headway times respected?

Questions investigating whether the new timetable is an improvement compared to the previous one are: Is total expected passenger time reduced? Is the average probability of missing transfers reduced? Is the timetable more robust against the expected primary delays? Are secondary delays diminished? Which regions, trains or train-pairs are causing expected passenger time or one of its components (ride, dwell, transfer knock-on time) to rise or diminish compared to the previous timetable.

We provide a methodology and tools to answer all these questions. The output is presented graphically, so that the effects - both in size and in sign - of changes in the timetable become more visually obvious. As such weak points in the new timetable, for example a badly planned but important passenger transfer, will be noticed quickly. Visual totals, per region, per train, per train-pair, per activity type (ride, dwell, transfer, knock-on) give a global idea of where the timetable spends more or less passenger time than the previous timetable.

Our method is applied on the new and previous timetable of all passenger trains in Belgium.

We believe our tool is innovative in the sense that it pinpoints where problems arise or/and where they are solved. It can then give the confidence needed to put a new timetable in practice.

2 Method

The expected passenger time is already present in the objective function of our PESP MILP model as published in [Sels et al.(2011)Sels, Dewilde, Cattrysse, and Vansteenwegen, Sels et al.(2013a)Sels, Dewilde, Cattrysse, and Vansteenwegen, Sels et al.(2013b)Sels, Dewilde, Cattrysse, and Vansteenwegen, Sels et al.(2015)Sels, Dewilde, Cattrysse, and Vansteenwegen]. In these papers, the goal was always to automatically find a new timetable that minimises the objective function. In this paper, we do not optimise a timetable, but compare a manually created previous timetable with a manually created new one. This means we only need to evaluate the objective function for both timetables and see which timetable results in the lowest value to know which one is better.

3 Results

We can conclude that the new timetable reduces expected passenger time by about 1% and that this is caused mainly by improvement of transfer planning.

The new timetable has more expected passenger time spent in ride and dwell supplements than the previous one, so the question arises if these supplements cannot be reduced to the level of the previous timetable while still keeping the advantage of the reduced time spent in transfers.

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