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Extracting Railway Passenger Demand Patterns from Origin-Destination Data for Developing Demand-Oriented Service Plans

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Train passenger demand fluctuates throughout the day and week and these fluctuations are expected to increase due to the COVID-19 pandemic. In order to let train services, such as the line plan and timetable, match this fluctuating demand, insights are needed into how the demand is changing and for which periods the demand is relatively stable. Hierarchical clustering on origin-destination (OD) data is used to determine for each workday continuous time-of-day periods in which the passenger demand is homogeneous. The periods found for each workday are subsequently used as input in a clustering algorithm to look for similarities and differences between workdays. Both normalized and regular OD matrices are tested as input for the method. In normalized OD matrices, only the structure of the demand is captured, while in the regular OD matrices both the structure and the volume of the demand are included. The methods for finding homogeneous periods in demand during the day and week are applied to a case study covering a large part of the railway network in the Netherlands. We find large differences between the periods based on regular OD matrices and those based on normalized OD matrices. The periods based on regular OD matrices seem more appropriate to use as input for designing a service plan. Comparison of the periods over the week shows that mainly the peak periods on Friday are far away from Monday to Thursday, and hence could benefit from an altered service plan.

Keywords
Railway passenger demand patterns, Origin-destination data, Clustering, Homogeneous periods