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Using cross-learning forecasting methods to improve anticipatory order picking efficiency
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E-commerce activities put warehouses under high pressure. First, the smaller order sizes result in efficiency loss when retrieving the requested items from storage due to missing economies of scale, while the cost for handling and packaging of these smaller orders tends to be higher [2]. Second, the very short delivery lead times require warehouses to respond to incoming customer orders within hours or even minutes. Because of this short planning horizon, customer demand is highly uncertain up to the moment that a customer places the order. Such a high degree of dynamism makes it more challenging to operate at minimum cost and easily leads to ad-hoc decisions and missed opportunities for optimization [2].

To deal with such a high degree of dynamism and uncertainty while ensuring high efficiency in our picking operations, we make use of anticipatory order picking (AOP). The core idea is to explicitly incorporate forecast information, provided by machine learning methods, and allow the picking of SKUs even before they are actually ordered by the customer. As such, products can be picked when their cost (marginal travel time) is low, which results in a reduced total travel time compared to the situation in which products can only be picked once ordered. Our previous research also revealed that AOP leads to a better capacity utilization, a more balanced workload and an earlier completion time for picking all customer orders over the full planning horizon.

In this research, we focus on the generation of the required forecast information to allow for a successful AOP implementation. Many of the popular methods for forecasting retail sales data are limited to individual products. At the same time, however, empirical studies show that small forecast accuracy improvements can result in significant higher service levels and lower stock holding cost [3]. The M forecasting competitions, whose goal is to identify ways to improve the forecasting accuracy by empirically evaluating several forecasting methods, show that machine learning forecasting methods utilizing cross-learning obtained more accurate results than the alternatives when the dataset comprise aligned highly correlated series structured in a hierarchical fashion [1].

The accuracy and content of the forecast information are decisive factors on the performance of anticipatory order picking. With reasonably accurate forecasts, warehouse operators can substantially shorten the completion time of the picking process. In this study, we make use of machine learning forecasting methods for demand prediction using real-life instances after which we employ this information to construct order picking plans. We aim to explore how using the demand of related products to forecast the demand of individual product may provide more accurate inputs for AOP than using the demand of that individual product only and how such forecast information can be connected to improve order picking performance.

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