

Inventory Rationing and Replenishment for an Omni-channel Retailer

Joost Goedhart, Rene Haijema, Renzo Akkerman

Operation Research and Logistics Group, Wageningen University and Research, Hollandseweg 1, 6706 KN Wageningen, The Netherlands

Abstract

The growth of omni-channel retailing has resulted in new challenges for retailers, such as how to allocate available inventory to the online and offline channel. Many 'brick-and-mortar' stores opened an online channel during the COVID-19 pandemic, leveraging their physical store to fulfil online customer demand. In this paper we consider a brick-and-mortar store that uses the inventory to fulfil both in-store demand as well as online orders. For demand of multiple channels to be served by one inventory, the retailer should decide how to ration its inventory across the channels, even though the products are present at the same location. Practically, rationing inventory relates to storing part of the inventory in the backroom to satisfy online demand. The rationing process occurs regularly (e.g. daily) whereas inventory replenishment is scheduled at a weekly basis. The rationing and ordering decisions are formulated as a Markov Decision Problem that maximises the expected profit. Through numerical studies we investigate different scenarios for the retailer and are able to determine what rationing and ordering policies should be used under which conditions.

Keywords: Dynamic rationing, Bricks-and-clicks, Markov Decision Process, Lost sales, Lead time, Retail