IBM -Naalaiya Thiran

Retail Store Stock Inventory Analytics

Literature Survey

1)Towards Intelligent Retail: Automated on-Shelf Availability Estimation Using a Depth Camera

Authors: Annalisa Milella; Antonio Petitti; Roberto Marani; Grazia Cicirelli; Tiziana D'orazio

Efficient management of on-shelf availability and inventory is a key issue to achieve customer satisfaction and reduce the risk of profit loss for both retailers and manufacturers. Conventional store audits based on physical inspection of shelves are labor-intensive and do not provide a reliable assessment. The aim is to develop a low-cost embedded system for early detection of out-of-stock situations with particular regard to perishable goods stored in countertop shelves, refrigerated counters, baskets or crates. The proposed solution exploits 3D point cloud reconstruction and modelling techniques, including surface fitting and occupancy grids, to estimate product availability, based on the comparison between a reference model of the shelf and its current status. No a priori knowledge about the product type is required, while the shelf reference model is automatically learn based on an initial training stage. The output of the system can be used to generate alerts for store managers, as well as to continuously update product availability estimates for automated stock ordering and replenishment and for e-commerce apps. Experimental tests performed in a real retail environment show that the proposed system is able to estimate the on-shelf availability percentage of different fresh products with a maximum average discrepancy with respect to the actual one of about 5.0%.

2)Distributionally Robust Multiperiod Inventory Model for Omnichannel Retailing Considering Buy-Online, Pickup-in-Store and Out-of-Stock, Home-Delivery Services

Authors: Youngchul Shin; Young-bin Woo; Ilkyeong Moon

The idea proposes the distributionally robust multiperiod inventory model incorporating the buy-online-pickup-in-store (BOPIS) and out-of-stock-home-delivery-service (OSHDS), which are the representative services of omnichannel retailing. Under this omnichannel system, the retailer operates both online and brick-and-mortar (B&M) stores simultaneously, which allow interactive flows of customer demands and desired products. The BOPIS allows customers who buy products through the online store to pick them up in the B&M store. Meanwhile, the OSHDS allows customers who find the product they want out of stock in a B&M store to receive it later, through express delivery from the online store. To capture the correlated uncertain demands of the BOPIS and OSHDS, we adopt a factor-based demand model that is affinely dependent on predefined uncertain factors. To handle a multistage decision process under uncertain demands, we utilize a rule-based approximation and distributionally robust bound to derive a tractable formulation. Computational results achieved in this article offer some insights that BOPIS and OSHDS play a role in providing retailer with flexibility, which could handle unsatisfied demands efficiently**.**

3) Stock Management Problem: Adaptive Fixed-Time Convergent Continuous Controller Design

Authors: Michael V. Basin; Fernando Guerra-Avellaneda; Yuri B. Shtessel

This idea presents an adaptive fixed-time convergent continuous controller designed to solve a stock management problem with the objective to drive stock and supply chain levels at the reference values, subject to loss rate disturbances whose bounds are unknown. The only measurable state of the supply chain is the inventory retailer stock level, whereas the supply line inventory level should be estimated. The designed controller includes a fixed-time convergent differentiator, an adaptive fixed-time convergent disturbance observer, and a fixed-time convergent regulator. The adaptive fixed-time convergent observer is used to estimate a disturbance without excessively increasing the controller gains. The controller design is validated in a case study of stock management. The calculated upper estimate for the total settling

(convergence) time and the obtained simulation results confirm the fixed-time convergence and the robustness of the designed controller.

4)Joint Ordering and Markdown Policy for Short Lifetime Products With Competitive Price- and Freshness-Based Demand

Authors: Xue Qiao; Zheng Wang; Haoxun Che

Retailers with short lifetime products in stock always face a problem of whether new products should be ordered when on-hand products partially decay and how to deal with the old products if a new batch is ordered. In this article, we consider the sales of a perishable product with a fixed short lifetime in two shelves, where new items of the product in a regular shelf are sold in a preset normal price, and old items in a markdown (discount) shelf are sold in a discounted price. We study the problem of the joint ordering of new items and pricing of old items and propose a joint ordering and markdown policy when the demand of the product depends on its price, and freshness as well as unsatisfied demand is lost. First, we formulate a one-period model, in which the present shelf ages of items in the two shelves are considered and use the Karush–Kuhn–Tucker condition to analytically obtain the optimal solution of the joint ordering and markdown problem. Second, numerical experiments are conducted to evaluate the performance of the two-shelf policy when the optimal solution of the one-period model is applied to the multiperiod problem in the form of a myopic policy. The results show that the proposed two-shelf joint ordering and markdown policy for perishable products performs better than the traditional one-shelf policy. Note to Practitioners —In this article, we develop a joint ordering and markdown policy for perishable products deployed on two shelves: a regular shelf for fresh products and a markdown shelf for less fresh products. Although the closed-form policy is obtained for the one-period situation with deterministic demand, it is not difficult to extend it to the multiperiod case with random demand.