Dynamic Programming for Computing Non-Stationary (R,S) Policy

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In this work we propose an efficient dynamic programming approach for computing (R,S) policy parameters under non-stationary stochastic demand and service level constraints. (R,S) is a popular inventory control policy typically employed for damping planning instability (Silver, 1998). Early works in the area were heuristic (Silver, 1978; Bookbinder and Tan, 1988). Sox proposed a static control policy (Sox, 1997). The first complete approach for computing (R,S) policy parameters was proposed by Tarim and Kingsman (Tarim and Kingsman, 2004) in the form of a MIP model. Tempelmeier extended this MIP formulation in order to consider different service level measures (Tempelmeier, 2007). Tarim et al. proposed an efficient CP approach for solving large instances (Tarim et al., 2008). The approach proposed in this work outperforms Tarim et al. CP approach. Our computational experiments show that this new approach is also more scalable, being able to efficiently handle much longer planning horizons. Our method exploits the well known concept of State Space Relaxation (SSR). A filtering procedure and an augmenting procedure for the state space graph are proposed. Starting from a relaxed state space graph our method tries to remove provably suboptimal arcs and states (filtering) and then it tries to efficiently build up (augmenting) a reduced state space graph representing the original problem. Our experimental results show that the filtering procedure and the augmenting procedure often generate a small filtered state space graph, which can be easily processed using dynamic programming in order to produce a solution for the original problem.
Keywords: Inventory Control; Non-stationary (R,S) Policy; Stochastic Demand; Dynamic Programming; State Space Relaxation; State Space Filtering

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S. A. Tarim, B. Hnich, R. Rossi and S. Prestwich, 2008. Cost-based Filtering Techniques for Stochastic Inventory Control under Service Level Constraints, Constraints, forthcoming