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On Inventory Control of Product Recovery Systems Subject to Environmental Mechanisms

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Abstract:
The aim of this paper is to study the impact of inventory control in reducing the carbon footprint of an organization. Through a stochastic inventory model, our research extends the traditional minimization cost problem by incorporating environmental legislation. We consider a finite-horizon closed-loop system whereby decisions are subject to an emissions trading scheme and to random demand and returns. Demand can be satisfied by two sources. The primary source is environmentally friendly but expensive, whereas the second is cost effective but with negative environmental consequences. The problem is formulated as a stochastic dynamic problem, where replenishment and carbon management decisions must be made at each period. The objective is to describe how replenishment and carbon management strategies are affected by environmental constraints. In particular, considering the computation restriction of dynamic programming, in order to extend the results, we propose a genetic algorithm to find near-optimal solutions for larger instances. A sensitivity analysis is performed to identify the impact of carbon allowance prices, emission-cap and other environmental factors in the decision-making process. The results indicate that environmental strategies and their factors have an impact on replenishment decisions. There is an emission-cap from which a company must focus on decisions at the strategic level rather than on tactical and operational decisions. In addition, if the carbon allowance price is such that the environmental benefit absorbs the cost of less polluting technology, a change in the inventory policy must be made.