International Conference
on Industrial Engineering and Systems Management
IESM 2009
May 13-15
MONTRÉAL - CANADA

Influence of product return lead-time on inventory control

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Abstract

We consider a production-inventory system with capacity constraint and item returns correlated to demand. The system is modelled by an $M/M/1$ make-to-stock queue with lost sales. A satisfied demand incurs an item return with a certain probability, after an exponentially distributed return lead-time.

We distinguish two cases: When the number of items to be returned is observable and when it is not observable. For the first case, we partially characterize the optimal policy. For the second case, we consider a simple base-stock policy as a heuristic. Finally, we carry out a numerical study in order to investigate the impact of return lead-time on these policies. In particular, we exhibit interesting limit behavior, when the return lead-time is either small or large.

Key words: Inventory control, Reverse logistics, Queueing system, Markov decision process.

1 Introduction

We develop, in this article, a model which can be included in the growing field of reverse logistics [3]. Reverse logistics is the management of products that can be returned by the customers for different reasons (ecological, legal, economical). From a logistic point of view, and regardless of why they occur, product returns complicate the management of an inventory system [2]. First, returns represent an exogenous inbound material flow causing an increase of the inventory between replenishments. Second, returned products - when recovered - give another alternative supply source for replenishing the serviceable inventory [4]. Several researches have investigated the influence of item returns on inventory control. For a complete overview, we refer the reader to Fleischmann et al [3].

Problems encountered in reverse logistics can be classified into three main categories [3]:

(1) Problems related to transportation and distribution of the returned items.
(2) Problems related to inventory control.
(3) Problems related to treatment of the returned items.

We focus on the second category which represents more than 50% of published articles these ten last years in the field of reverse logistics [9].

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