Accepted Manuscript

An order-revenue inventory model with returns and sudden obsolescence

Yonit Barron

PII: S0167-6377(17)30214-6
DOI: https://doi.org/10.1016/j.orl.2017.11.005
Reference: OPERES 6301

To appear in: *Operations Research Letters*

Received date : 10 April 2017
Revised date : 6 November 2017
Accepted date : 6 November 2017

An order-revenue inventory model with returns and sudden obsolescence

Yonit Barron

Department of Industrial Engineering and Management, Ariel University, Ariel 40700, Israel

Abstract

This paper introduces an EOQ-like state-dependent inventory model with returns and sudden obsolescence. Returns arrive according to a MAP process governed by the underlying Markov chain. Additionally, the system is totally obsoleted at stationary renewal times. Hitting level 0 yields an order of size Q. We assume order, loss, and shortage costs in addition to revenue. By applying hitting-time transforms and martingales we derive the cost functionals under the discounted criterion. Numerical results, insights, and a comparative study are provided.

Key words:
Inventory model, MAP process, Economic-Order-Quantity, Returns, Obsolescence, Phase-type distribution.

1. Introduction

Many companies deliver their product information to consumers at home via websites, e-mails, and broadcast media. Home shopping is beneficial for both customers and businesses; however, it is sometimes perceived to be quite risky. Companies have tried to soften customers' risk by offering a trial period for their product and return policies, and realize that a better understanding of returning items and innovation can provide a competitive advantage. According to a study conducted by Accenture, return rates in the consumer electronics industry and department stores range between 11% and 20% ([15]). Products that are subject to rapid changes in fashion or in competition due to technological advances are particularly vulnerable to a sudden collapse of demand and, thus, more difficult to deal with ([12]). Typical real-life examples can be found in electronics, computer manufacturing, printers, mobile phones, and products purchased from Internet retailers ([14], [13], and [1]).

In this paper we introduce an (Economic-Order-Quantity) EOQ-like stochastic continuous-review sudden obsolescence problem with returns. Between successive obsolescence events, the inventory process $\widetilde{I}(t)$ behaves as a MAP with positive jumps governed by a continuous-time Markov chain that determines the rates of inflows (returns) and outflows (demand). The inputs of returns are a superposition of sporadic returns and continuous returns as follows:

i. There are continuous "small" inflows that, together with demand, form a fluid process.

ii. In addition, at random times, sporadic amounts of returns form a Poisson process of instantaneous big inflows (represented by positive jumps). These returns can arrive from a secondary storage facility or a big customer.

Additionally, we consider sudden total obsolescence at stationary renewal times; that is, the items that are held in inventory lose all their value at once and the inventory drops instantaneously to zero. Another interpretation can be the seasonal cleaning of shelves, and unexpected events or disasters (e.g., theft, earthquakes, weather-related damage, fire, malfunctioning of storage equipment, or perishability). We model the time between consecutive obsolescence as independent and identically (i.i.d.) exponentially

Email address: ybarron@ariel.ac.il (Yonit Barron)