Analysis of Economic Order Quantity Model for Perishable Items Whose Deterioration Starts After Some Fixed Time

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ABSTRACT

This paper deals with an optimal replenishment policy for the items having deterministic demand and whose deterioration starts after some fixed time. In earlier studies, it had been assumed that the deterioration of items starts immediately after the procurement, but it’s not necessary in most of the cases. For instance, food grains will not start deteriorating immediately after procurement; most of the industrial products also start deteriorating only after some fixed time. Thus, this study removes this unrealistic assumption and considers items whose deterioration starts after some fixed time. The impact of deterioration on cost and how it will impact cycle time has been illustrated in this study. Complete analysis of the proposed model has been done with both optimizing and numerical techniques.

Keywords: Convexity, Cycle Time, Deterioration, EOQ, Inventory

INTRODUCTION

Materials, manufacturing and marketing departments are the three major operating subsystems of any organization whether it is a production house or a service center, i.e. neither the goods producing organization nor the service providing organizations works without inventory, they have to maintain some inventory for smooth running of their businesses.

In recent years, the study of deteriorating items has gained great importance. Research in this direction began with the work of Whitin (1957), who
considered fashion goods deteriorating at the prescribed storage period. Ghare and Schrader (1963) were the first to use the concept of deterioration, they developed an inventory model with a constant rate of deterioration, followed by Covert and Philip (1973) who formulated a model with a variable rate of deterioration with two parameter Weibull distribution, which was further extended by Shah and Jaiswal (1977).

Dave and Patel (1981) studied an inventory model with deterministic but linearly changing demand rate and constant deterioration over a finite planning horizon. Hollier and Mak (1983) had developed two mathematical models for an inventory system in which the units are deteriorating at a constant rate and the demand rate which follows negative exponential decrease. Sachan (1984) extended Dave and Patel’s model to allow shortages. Datta and Pal (1988) developed an EOQ model by introducing a variable deterioration rate and power demand pattern. T.C.E. Chang (1989) had considered infinite-horizon inventory problem in which items are decaying at a constant rate and the demand rate follows an exponentially decreasing function.

Chung and Ting (1994) determined the replenishment schedules for deteriorating items with time proportional demand. Hariga and Benkherouf (1994) developed an inventory replenishment model for deteriorating items with exponentially varying demand. This work was extended by Hargia (1995) to allow shortages. Hargia (1995) developed models for deteriorating items with time dependent demand. Su Chao ton, Tong Lee-Ing and Liao Hung-Chiang (1996) also developed a model under inflation for stock dependent consumption rate and exponential decay. Chakrabarti and Chaudhuri (1997) studied an inventory model with linearly changing demand rate, constant deterioration rate and shortages in all cycles over a finite planning horizon. A.K. Bhunia and M. Maiti (1998) had formulated and solved two models for deteriorating items with linearly time dependent demand where replenishment rate changes linearly with the change in demand and on-hand inventory amount.

Chang H-Y and Dye C-Y (1999) presented model for the situation where the demand rate is a time-continuous function and items deteriorate at a constant rate with partial backlogging. Peter Chu and Patrick S. Chen (2002) showed the inventory carrying cost is in the proportion to the cost of deteriorated items, then offered a formulated approximated solution. Chun Tao Chung (2004) established an EOQ model for deteriorating items under inflation when the supplier offers a permissible delay to the purchaser if the order quantity is greater than or equal to a predetermined quantity. Kuo-Lung Hou (2006) developed an inventory model for deteriorating items with stock-dependent consumption rate and shortages under inflation and time discounting. Jui-Jung Liao (2007) had explored the inventory replenishment policy for deteriorating items, in which the supplier provides a permissible delay to the purchaser if the order quantity is greater than or equal to a predetermined quantity. Yu-Chung Tsao and Guo-Ji Sheen (2008) had studied the
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