Chapter 4

Optimal Selling Price and Order Size for Non–Instantaneous Deteriorating Items With Generalized Price and Time–Dependent Demand and Partial Backlogging

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ABSTRACT

The problem of determining the optimal selling price and lot size for an inventory system with non-instantaneous deteriorating item is considered in this chapter. In order to provide general framework, the pricing and lot sizing problem is modeled assuming a general price and time dependent demand function. The model allows for backlogging of demand which is characterized by decreasing function of waiting time. As the problem involves revenue and costs, a natural objective function for the model is profit per period. First, the sub problem in which price is fixed is solved to determine the optimal inventory policy. To broaden the problem, a procedure is developed for obtaining the optimal selling price and order size. To investigate the characteristics of the proposed model, numerical illustrations are presented.

INTRODUCTION

Many researchers worked on the inventory model with the assumptions that the products have infinite life time, but this does not hold in reality. To maintain deteriorating inventory is a major issue for almost all business organizations. There are some products like seasonal goods, fruits, vegetables which deteriorate.
rate in certain time period. Certain goods lose their potency with time like electronic items, radioactive substances etc. Certain inventory such as highly volatile liquids as ethanol, gasoline etc. Deteriorating function is various types which may be constant and time dependent. Taking into consideration Ghare and Schrader (1963) presented first paper on deterioration. After that Covert and Philip (1973) developed an EOQ model for deteriorating items with Weibull distribution. Misra (1975) researched a model with optimum production lot size system for deteriorating inventory. Then, Liao (2007) formulated an EPQ model for deteriorating items under permissible delay in payments. Mondal et al. (2009), Ghosh et al. (2011), Mahata (2011), Sarkar (2013), Guchhait et al. (2013) presented research papers on deteriorating items. Shah et al. (2013) considers an inventory system with non-instantaneous deteriorating item in which demand rate is a function advertisement of an item and selling price. As recently, Palanivel and Uthayakumar (2015) provided a production inventory model with probabilistic deteriorating items includes promotional effort and variable production cost. Ouyang et al. (2015) developed an order size dependent trade credit integrated inventory model with deterioration. Mahata and De (2016) presented an inventory system for price dependent demand of ameliorating items and Wu et al. (2016) formulated an inventory model in which deteriorating items has maximum lifetime under discounted cash-flow analysis.

In most of the inventory models demand rate is generally taken as constant but in real life demand is not usually constant. It depends on time, stock, price, credit period etc. sometimes selling price plays important role in increasing demand. Panda (2009) formulated an EOQ model for discounted selling price and stock dependent demand for perishable items. Sana (2010) presented an EOQ model over an infinite time horizon for perishable items where demand is price dependent. Sana (2011) consider a model of price sensitive demand for perishable item. Choudhary et al. (2013) formulated an inventory model for stock dependent demand for deteriorating items. Soni (2013) developed a model of multivariate function of price and level of inventory dependent demand rate for non-instantaneous deteriorating items. Pal et al. (2014) presented a model of price and credit period dependent demand, Barron and Sana (2015) formulated a multi item EOQ model for promotional effort dependent demand. As now, Neeraj and Sanjey (2016) developed an inventory model is built with inventory-dependent demand rate and two warehouses in which demand rate is a polynomial of current inventory level. Shah et al. (2016) presented an integrated production inventory model for time and price dependent demand with preservation technology investment to reduce time varying deteriorating items.

Most researchers assumed that shortages are completely backlogging. Some customers would like to wait for backlogging during the shortage period but the other would not. Many researchers worked on this direction. Some of them are Maihami and Kamalabadi (2012), Pal et al. (2014), Chowdhury et al. (2015) presented paper on shortages. As recently, Fergany (2016), Pervin et al. (2016), Geetha and Udayakumar (2016) and Mishra (2016) formulated in inventory model with shortages.

The motivation behind developing an inventory model in the present article is to prepare a more general inventory model which includes; (a) Demand rate as a function of time and selling price, (b) non-instantaneous deterioration, and (c) Shortages are allowed and are partially backlogged.

**NOTATION AND ASSUMPTIONS**

To develop the model, we use the following notation and assumptions. Some additional notation will be introduced later when they are needed.