

# Inventory Models for Deteriorating Items

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## INTRODUCTION

The focus of the Operations Research is on applications of mathematics and logic in research and decision-making on operations, as well as problem solving in all types of public and private organization business, industry, government and state enterprises in order to bring about optimal outcomes in organizational operations. A common misconception held by many is that O.R. is a collection of mathematical tools. While it is true that it uses a variety of mathematical techniques, operations research has a much broader scope. It is in fact a systematic approach to solving problems, which uses one or more analytical tools in the process of analysis. However, O.R. does not preclude the use of human judgment or non-quantifiable reasoning; rather, the latter are viewed as being complementary to the analytical approach. One should thus view O.R. not as an absolute decision making process, but as an aid to making good decisions. O.R. plays an advisory role by presenting a manager or a decision-maker with a set of sound, scientifically derived alternatives. However, the final decision is always left to the human being who has knowledge that cannot be exactly quantified, and who can temper the results of the analysis to arrive at a sensible decision. In this chapter we discuss inventory system with special focus on deteriorating inventory items which is one of the main streams of the operations research.

Inventory is simply a stock of physical assets having some economic value, which can be either in the form of material, money or labour. Inventory is also known as an idle resource as long as it is not utilized. Inventory, may be regarded as those goods which are procured, stored and used

for day to day functioning of the organization. This can be in the form of physical resource such as raw materials, semi finished goods used in the production process, finished products ready for delivery to consumers, human resources such as unutilized labour, or financial resource such as working capital etc. Inventories are materials stored, waiting for processing, or experiencing processing.

Inventory Management and Inventory Control must be designed to meet the dictates of the marketplace and support the company's strategic plan. The many changes in market demand, new opportunities due to worldwide marketing, global sourcing of materials, and new manufacturing technology, means many companies need to change their Inventory Management approach and change the process for Inventory Control. The Inventory Management system and the Inventory Control Process provides information to efficiently manage the flow of materials, effectively utilize people and equipment, coordinate internal activities, and communicate with customers.

Deterioration is defined as decay, damage, dryness and spoilage. It is that process in which an item loses its utility and become useless. Inventory in deteriorating items is a general phenomenon in daily life. Many items like fruit, vegetables, milk, fashion goods, electronic components, medicines, alcohol and gasoline etc. are called deteriorating items. So decay or deterioration of physical goods in stock is a very realistic factor and there is a big need to consider this in inventory modeling when items are deteriorating. Deterioration rate can be a constant fraction of the on hand inventory or it could be changing (increasing or decreasing) according to some function. The underlying deterioration distribution affects the nature of the

deterioration rate. There are six steps for development of instantaneous and non instantaneous deteriorating inventory models. These can be listed as follows

- Define the problem and gather relevant data.
- Formulate a mathematical model to represent the problem.
- Develop a procedure for driving solutions to the problem.
- Test the model and refine it as needed.
- Prepare for the application of the model.
- Implementation.

## **BACKGROUND**

Inventory System is one of the main streams of the Operations Research which is essential for business enterprises and Industries. Supply Chain Management (SCM), a branch of inventory system studies, as defined by Tom McGuffog is “Maximizing added value and reducing total cost across the entire trading process through focusing on speed and certainty of response to the market.” Supply Chain Management has become a necessity especially for manufacturing industry when it comes to deliver products at a competitive cost and at a higher quality than their competitors.

Inventory control is very critical elements in any operations and this is the cost drivers and directly impacts the bottom lines in the balance sheet. Inventory means value and is an asset of the business organizations. Every business has a standard for inventory turnaround that is optimum for the business. The health of the inventory turn relates to the health of business.

The vast application of inventory control has made it a burning topic among the researchers. The deteriorating inventory modeling is one of the most attractive areas among the researcher. There

are some significant contributions given by the researchers. Some of the recent contributions in this area are as follows:

Skouri et al. (2009) developed an Inventory models with ramp type demand rate, partial backlogging and Weibull's deterioration rate. Hsu et al. (2010) develop a deteriorating inventory policy when the retailer invests on the preservation technology to reduce the rate of product deterioration. Mishra and Singh (2010) developed a deteriorating inventory model with partial backlogging when demand and deterioration rate is constant. They made Abad (1996, 2001) more realistic and applicable in practice. He et al. (2010) gave an optimal production inventory model for deteriorating item with multiple market demand. Mandal (2010) gave an EOQ inventory model for Weibull distributed deteriorating items under ramp type demand and shortages. Chang et al. (2010) gave optimal replenishment policy for non instantaneous deteriorating items with stock dependent demand. Das et al. (2010) presents a production lot size inventory model in which the production rate constitutes of productions during both regular time and overtime. The demand rate is assumed as stock-dependent and the stock itself is depleted due to demand and deterioration. Dye et al. (2011) studied a deteriorating inventory system with fluctuating demand and trade credit financing and establish a deterministic economic order quantity model for a retailer to determine its optimal selling price, replenishment number and replenishment schedule with fluctuating demand under two levels of trade credit policy. Hung (2011) gave an inventory model with generalized type demand, deterioration and backorder rates. Mishra and Singh (2011) developed deteriorating inventory model for time dependent demand and holding cost with partial backlogging. Cheng et al. (2011) gave an inventory model for time-dependent deteriorating items with trapezoidal type demand rate and partial backlogging. Lin



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