Chapter 2
Lot Size Model for Reverse Logistics with Quadratic Demand

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**ABSTRACT**

Taking care of nature is the prime responsibility of the companies nowadays. This chapter proposes inventory model with reverse logistics for environmental concerns. Customers return used products and after remanufacturing such products they become as good as new products. Now, demand is satisfied by newly produced as well as remanufactured products. Quadratic demand is discussed in the present inventory model. Such demand increases initially and after sometimes it shows decreasing pattern. Shortages are also allowed to take place. Optimal cost is worked out for the present system. Numerical example and sensitivity analysis are given to validate mathematical model and to find critical inventory parameters. Based on it, managerial issues are discussed.
1. INTRODUCTION

Recycling has been adopted for environmental awareness all over the world in recent years. By establishing reverse supply chain, resources as well as energy can be conserved. Less energy is required to process recycled items than new ones. Reverse logistics helps to lessen global warming and reduce pollution.

Initially Schrady (1967) studied deterministic inventory model for repairable items in which he determined optimal procurement and repair quantities. Fleischmann et al. (1997) gave a review on quantitative models for reverse logistics. Mabini et al. (1992) formulated EOQ models for controlling repairable inventories. After that, Richter (1996a, 1996b) developed EOQ model for repair and waste disposal. Teunter (2001) analyzed model for economic ordering quantities for recoverable items. Koh et al. (2002) gave results for optimal ordering and recovery policy for reusable items. Savaskan et al. (2004) addressed the problem of choosing the appropriate reverse channel structure for the collection of used products from customers. Konstantaras and Papachristos (2004) studied periodic review inventory model for manufacturing and remanufacturing in finite horizon. They determined the period for switching from remanufacturing to manufacturing. Inderfurth et al. (2005) made EPQ model addressing deterioration of re-workable goods. King et al. (2006) described and compared the four alternative strategies to reduce waste viz. repair, recondition, remanufacture or recycle. Konstantaras and Papachristos (2008) developed optimal policy for return goods for the inventory system. The above cited studies are based on the constant demand for the any phase of the system may be production of good items or remanufactured items. Jaber and Saadany (2009) assumed that demand for manufactured items and repaired items are different. Omar and Yeo (2009) determined a joint policy for raw materials procurement, new products production and used product repair such that total relevant cost of the system is minimized. Sadani and Jaber (2010) studied production and remanufacturing model with price and quality dependent return rate. Konstantaras et al. (2010) developed lot-size model for recoverable products with inspection and sorting. Hasanov et al. (2012) studied production, remanufacturing and waste disposal model for case of partial back ordering. Konstantaras (2010) considered inventory model for the case of variable set up numbers of equal sized batches for production and remanufacturing processes. Chung and Wee (2011) investigated green product designs and remanufacturing efforts with short life cycles. Singh and Saxena (2012) developed integrated supply chain model with coordinated production and remanufacturing due to time-dependent rates. They allowed shortages and backlogged the excess demand. Yang et al. (2012) analyzed inventory model in which decrease in value of products is considered as deterioration. In order to add value, these outdated products can be remanufactured or resold to market. Singh et al. (2013) developed
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