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Optimal lot size of EPQ model considering imperfect and defective products

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Abstract

The economic production quantity (EPQ) is a commonly used inventory model. An assumption in the EPQ model is that all units produced are perfect. Some researchers have studied the effects after relaxing this assumption on the inventory models. The objective of this paper is to determine the economic production quantity with reduced pricing, rework and reject situations in a single-stage system in which rework takes place in each cycle after processing to minimize total system costs. The assumption entertained in this paper is that processing leads to different products classified in the four groups of perfect products, imperfect products, defective but reworkable products, and, finally, non-reworkable defective products. The percentage of each type is assumed to be constant and deterministic. A mathematical model is developed and numerical examples are presented to illustrate the usefulness of this model compared to previous ones.

Keywords: Economic production quantity; Reduced price; Rework; Reject

1. Introduction

The classical EPQ model has been in use for a long time. It is a well-established and widely used technique in inventory management (Bedworth and Bailey, [1]). The EPQ model can be considered as an extension of the well-known economic order quantity, EOQ, model introduced by Harris [10] to minimize total inventory cost for a single-stage production system. A usual unrealistic assumption in EPQ is that all units produced are of good quality (Warets, [21]). The classical EPQ model shows that the optimal lot size will generate minimum manufacturing cost, thus producing minimum total setup and inventory costs. However, this is only true if all manufactured products are of perfect quality. In reality this is not the case; therefore, it is necessary to allow cost for handling imperfect products as this cost can influence the decision for selecting the economic lot size (Chan et al., [4]). Hence, in recent decades, researchers tried to determine the optimal batch quantity of imperfect production system considering different operating conditions. A brief discussion of their work is given as follows:

Gupta and Chakraborty [9] considered the reworking option of rejected items. They considered recycling from the last stage to the first stage and obtained an economic batch quantity model. Porteus formulated the relationship between process quality improvement and setup cost reduction and illustrated that the annual cost can be further reduced when a joint investment in both process quality improvement and setup reduction is optimally made [15]. Cheng [5] validates Porteus's model by including the learning effects on setup frequency and process quality. Rosenblatt and Lee [16] assumed that the time from the beginning of the production run until the process goes out of control is exponential and that defective

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