INVENTORY CONTROL FOR TWO STAGE PERISHABLE ITEMS

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Abstract

Two-stage perishable items are very common among industries such as aerospace, automobile, chemical, printed circuit boards, etc. Items such as sealants and paints, packed in containers that are used in manufacturing process, come with an initial shelf life (Stage I) and an useful life (Stage II) once the product is exposed to the environment. Literature on such two-stage perishable products is very limited. In Chapter 2, we develop a mathematical model to analyse products with two-stage perishability with an objective of minimizing wastage, waiting time, ordering and the holding cost of inventory when both the demand and the service time are deterministic. We model the problem as an extension of Economic Order Quantity (EOQ)model with *N*-policy (where *N* is the amount of demand accumulated before the seal is broken), two-stage perishability, waiting time, service period and holiday period. We determine the long run average cost which we show is convex in *N*. We obtain the optimal order quantity, the optimal unit size, and the *N* for which the total cost is minimized. We determine other quantities of interest such as the fill rate. We show that the fill rate increases with increase in stage II life, service rate and decreases with increase in *N*. We perform sensitivity analysis to see the impact of change in cost parameters on optimal *N* value, which increases with increase in wastage and ordering cost while it decreases with increase in holding and waiting cost. We conclude with numerical experiments. In many real life scenarios, demand is random. As well, the service time may also be unknown. In Chapter 3, we consider the same perishable inventory systems with two types of shelf life as discussed in Chapter 1. We relax the assumption of deterministic demand and service time. We assume a Poisson demand arrival and exponential service time distribution. We develop a mathematical model for inventory control. We construct a multi-dimensional discrete-time Markov chain with *N*-policy. We shown that the steady-state distribution of the inventory level is intractable. We compute cycle time distribution, expected wastage, backlogging, and holding cost. The optimal lot size, the optimal unit size, and the *N* value is determined. Sensitivity analysis is performed to show the impact of various parameters on the decision variable. Numerical experiments show that the cost per delivery is much higher for stochastic case than for deterministic case. In Chapter 4, we study inventory control of a class of perishable item which can be converted into another form (State II) and reconverted to original form (State I), at a cost, thus increasing its fixed lifetime to two or more periods. We consider a two-period period newsvendor-model with an intermittent period for a perishable product with fixed lifetime equal to one period. The item is perishable in both the states. We consider a two-period model with higher demand in the second period. The model is used to characterize the optimal inventory transfer policy form the first to the second period in a stochastic setting. In the intermittent period, the demand distribution of the second period is revealed and the re-conversion factor is to be determined. We show that the total profit function is concave in both the conversion (_) and the re-conversion (_) factors. The optimal value of the two factors is found through analytical model for given parameters and variables with the objective of maximizing the expected profit. From the analysis in this study we see that _ and _ are inversely related to the conversion and reconversion cost as well as profit per unit in the first period. On the other hand, it increases with increase in profit per unit and mean demand in the second period as well as the cost in the first period. A numerical analysis is also demonstrated.