Sno	Name of the Scholar	Name of the Supervisor	Title of the Research Topic	Ph.D. Award
1.	Mr R. Mohan	Prof. R.Venkateswarlu	Inventory Management Models for Perishable Items with Quadratic Demand Patterns	April 2013

ABSTRACT

The main interest of inventory models is due to its readily applicability to a large diversity of situations existing in business and industry. An inventory model is nothing but a mathematical representation of keeping stock for future demand which will useful for developing optimal strategies and control. Since 1915, a wide variety of inventory models were developed with more emphasis on mathematical analysis. While developing these inventory models, the demand rate is considered as either linearly increasing (decreasing) or exponentially increasing (decreasing) in demand. Several mathematical modelers argued that, in realistic terms, the demand need not follow either linear or exponential trend. So, it is reasonable to assume that the demand rate, in certain commodities, due to seasonal variations may follow quadratic function of time/price/stock.

In last few decades several researchers have extensively studied various aspects of inventory models considering two kinds of time –varying demand so far, viz., (a) continuous-time and (b) discrete-time. Most of the continuous–time inventory models have been developed considering either linearly increasing /decreasing demand [D(t) $=a+bt$, $a>0$, $b\neq 0$] or exponentially increasing /decreasing demand [D(t) = $Ae^{\alpha t}, A>0, \alpha\neq 0$]. It is well known that the demand rate for physical goods may also be depending on stock and price. For a comprehensive review of literature on inventory models with time/price/stock varying demand, one may refer the work of Goyal and Giri (2001).

Several mathematical modelers argued that, in realistic terms, the demand need not follow either linear or exponential trend. So, it may be reasonable to assume that the demand rate, in certain commodities, due to seasonal variations follow quadratic function of time [i.e., D(t) = $a\,t^2 + b\,t + c$; $a\neq 0, b\neq 0, c\geq 0$] or a quadratic function of price [i.e., $D(p) = a\,p^2 + bp + c$; $a\neq 0, b\neq 0, c\geq 0$]. Here c, denotes the initial rate of demand, b is the rate with which the demand rate increases (decreases) and a is the rate with which the change in the rate demand rate itself increases. This functional form, time/price dependent quadratic demands, explains the accelerated growth/decline in the demand patterns which may arise due to seasonal demand rate (Khanra and Chaudhuri, 2003). Here we have $\dot{D}(t) = 2at + b$ and $\ddot{D}(t) = 2a$. When $\dot{D}(t) = 0$, we get $t = -\frac{b}{2a}$. Now t is positive if a and b are of opposite signs. Thus $D(t)$ is (i) maximum at $t = -\frac{b}{2a}$ for $b > 0$ and $a < 0$ and (ii) minimum at $t = -\frac{b}{2a}$ for $b < 0$ and $a > 0$. In the first case

demand gradually go up to a maximum and then gradually decreases while in other case the demand gradually falls to a minimum and then increases gradually. Normally we can come across the first case in real market where as the second one is very rare. Depending on the signs of '*a*' and '*b*', following are the different types of realistic demand curves:

(i) $a > 0$ and $b > 0$ gives accelerated growth in demand model
(ii) $a > 0$ and $b < 0$ gives retarded growth in demand model
(iii) $a < 0$ and $b > 0$, we have retarded decline in demand model
(iv) $a < 0$ and $b < 0$, we have accelerated decline in demand model

This idea has motivated us to develop interest to study the quadratic demands. Very few researchers have done work regarding quadratic demand patterns. Hence this thesis focuses on developing various inventory management models with constant rate of deterioration, time dependent deterioration and Weibull deterioration rate considering the demand rate as a function of time and as well as a function of price. The thesis consists six chapters which include general introduction and review of literature in Chapter-1 and Chapter-2 respectively.

In Chapter – 3, an attempt has been made to develop an inventory model for perishable items with the assumption that the demand is quadratic function of time and the rate of deterioration is constant. Under instantaneous replenishment with zero lead-time, EOQ is determined for optimizing the total profit. The Salvage value is also considered for deteriorated items while calculating the total cost. The feasible models are presented and compared the quadratic time dependent demand models with linear demand models. The sensitivity analysis is carried out with a numerical example.

Chapter – 4 deals with inventory models for time dependent deterioration and time dependent quadratic demand. It is assumed that the deterioration rate is directly proportional to time. The total cost is calculated when shortages are not allowed. The salvage value is considered for deteriorating items. Models which are feasible are presented and studied their characteristics. The sensitivity analysis is done with a numerical example at the end of this chapter.

In Chapter – 5, inventory models are developed with time dependent quadratic demand for perishable items. It is assumed that the deterioration rate follows Weibull distribution. The case of no shortages is considered and presented the models which are realistic. The salvage value is also considered for deteriorated items in the model. The total cost of the system is calculated in both cases and compared the quadratic time dependent demand models with linear demand models. At last, the sensitivity of the models is presented and analysed.

Chapter – 6 is devoted to develop a deterministic inventory model for deteriorating items when the demand rate is assumed to be a function of price which is quadratic in nature and the deterioration rate is proportional to time. The model is solved for optimum T and calculated the total cost without shortages. Later the salvage value is used to study the effect on the inventory model. The sensitivity of the model is discussed with a numerical example.

The thesis ends with summary of findings and scope for further work.

*****