Executive Summary

The purpose of the study is to give a new dimension to the inventory literature on time-varying demand patterns. Researchers have extensively discussed various types of inventory models with linear trend (positive or negative) in demand. The main limitation in linear time-varying demand rate is that it implies a uniform change in the demand rate per unit time. This rarely happens in the case of any commodity in the market. In recent years, some models have been developed with a demand rate that changes exponentially with time. Demands for spare parts of new aero-planes, computer chips of advanced computer machines, etc. increase very rapidly while the demands for spares of the obsolete aero-planes, computers etc. decrease very rapidly with time. Some modelers suggest that this type of rapid change in demand can be represented by an exponential function of time. But it is felt that an exponential rate of change in demand is extraordinarily high and the demand fluctuation of any commodity in the real market cannot be so high. A realistic approach is to think of accelerated growth (or decline) in the demand rate in the situations cited above and it can be best represented by a quadratic function of time. Thus inventory policies were developed by constructing different inventory models under various financial parameters viz., inflation, trade credit policy and cost of preservation technology.

In chapter-2, we have developed inventory models having quadratic time dependent demand rate with constant rate of deterioration under constant inflation rate. The models are illustrated with a numerical example to study the effect of inflation rate and deterioration rate on optimal policies. Sensitivity analysis of the models is performed. The total cost is more sensitive than the cycle time and ordering quantity when the values of all parameters are under-estimated or over-estimated by 15%. It is further observed that, in both these models, the effect of inflation rate and deterioration is quite opposite on ordering policies.

An attempt was made to develop price dependent quadratic demand inventory models with variable holding cost and inflation rate in Chapter-3. The rate of deterioration is assumed as a linear function of time. Expressions for optimal policies are derived to maximize the system profit \( f(p, T) \). The profit of the system is calculated with a numerical example. It is found that the selling price \( p \) decreases while the system profit \( f(p, T) \) increases marginally as the rate of inflation increases from 0.11 to 0.15. It is also noted that the effect of inflation rate is insignificant on the total profit. The sensitivity of the models show that the
system profit $f(p, T)$ increases (decreases) for 15% over-estimation and under-estimation of all parameter values.

Perishable inventory models for stock dependent quadratic demand under inflation were discussed in Chapter-4. Here stock dependent quadratic demand rate with constant deterioration is considered in developing the inventory models. The solution of the models was obtained using the standard Reccati differential equation method. The system profit is calculated with a numerical example. It is observed that the effect of inflation rate is insignificant in the calculation of the system’s total profit for stock dependent demand models. It is also observed that the replenishment time ‘$\tau$’ increases (decreases) when all the parameter values increases (decreases). The profit function $P(T, \tau)$ is highly sensitive to the changes in the parameter ‘p’ and also for all the parameters taken together.

In Chapter-5, a mathematical model was developed when the units in the inventory are subject to a constant deterioration rate and the demand rate follows a time dependent quadratic function. It was assumed that the supplier offers a credit period to the retailer to settle the account. It was observed that the buyer’s total cost decreases with the increase in delay period for a fixed value of deterioration rate in both cases. The salvage value of deteriorated items has not shown much effect on the optimal total cost of the system.

A deterministic inventory model for perishable items with price sensitive quadratic time dependent demand under trade credit policy was developed in Chapter-6. The optimal policies were discussed when the credit period is more than (or less than) the cycle time. When comparing the two credit periods, it is observed that the total cost of the system is more in case of $M \leq T$ as compared with $M > T$. It is further observed that in both cases the total cost is highly sensitive to the changes in the value of mark up price $\eta$.

In Chapter-7, a deterministic inventory model for deteriorating items with shortages using preservation technology for deteriorating items was developed. The deterministic demand rate is assumed to be a quadratic function of time. The holding cost is assumed as linear function of time. It was noted that the cost of preservation technology increases when the rate of deterioration increases from 0.01 to 0.05. It is also observed that the use of preservation technology to control the deterioration rate is completely independent of time dependent demand patterns.

Inventory models are developed for deteriorating items which follow Weibull distribution, variable holding cost and time dependent demand rate in Chapter-8. It is observed that the profit function is highly sensitive to the changes made in all the parameters
in the model. The effect of salvage is studied on the system profit. The profit function $P(t_1,t_2)$ of the system is highly sensitive to the changes in the values of all parameters involved in the model.