CHAPTER 8

STOCHASTIC INVENTORY MODEL FOR MULTIPLE SUPPLIERS

CHAPTER 8

8.1. INTRODUCTION:

In this chapter, we have generalized the model and consider the case where there are M suppliers, and at any time suppliers may be available or not available which we represent as ON or OFF state. The stochastic process representing the supplier availabilities would have 2^M states: $0, 1, 2, \ldots\ldots\ldots, 2^M-1$. State 0 would correspond to the situation where all the suppliers being ON, state 1 would correspond to only the M^{th} supplier being OFF etc. and finally state 2^M-1 would correspond to all being OFF. The transition probabilities $P_{ij}(t)$, i, $j=0, 1, 2, \ldots\ldots, 2^M-1$, decision variables q_i and costs C_{i0}, $i=0, 1, 2, \ldots\ldots, 2^M-1$ are defined in a manner similar to chapter 4.

The system of equations for C_{i0} is obtained as

$$C_{i0} = P_{i0}\left(\frac{q_i}{d+\theta}\right)A(q_i, r, \theta) + \sum_{j=1}^{2^M-1} P_{ij}\left(\frac{q_i}{d+\theta}\right)\left[A(q_i, r, \theta) + C_{j0}\right] \qquad i = 0, 1, \ldots\ldots, 2^M - 2$$

$$C_{2^M-1,0} = \overline{C} + \sum_{i=1}^{M} \rho_i C_{i0}\ , \qquad \text{where } \rho_i = \frac{\mu_i}{\sum_{j=1}^{M}\mu_j}$$

$$\overline{C} = \frac{e^{\frac{-\delta r}{(d+\theta)}}}{\delta^2}\left[he^{\frac{\delta r}{(d+\theta)}}\left(\delta r - (d+\theta)\right) + \left(\pi\delta d + h(d+\theta) + \hat{\pi}\right) - \theta c\delta\right] + \frac{\theta c}{\delta}$$

with $\delta = \sum_{j=i}^{M}\mu_j$

Equations for T_{i0} are written in a similar way as in Lemma (4.3.4).

Solving the above equations require the exact solution for the transient probabilities $P_{ij}(t)$ of the CTMC with the 2^M states which appears to be a formidable task, because we would first need the exact solution for the transient probabilities $P_{ij}(t)$ of the CTMC with the 2^M states. It would also be necessary to solve explicitly for the quantities C_{00} and T_{00} using the system of 2^M equations in 2^M unknowns.

As the number of suppliers is very large, that is we have a situation approximating a free market, we can develop a much simpler model by assuming that if an order needs to be placed and at least one of the suppliers is available, then the order quantity will be q units regardless of which supplier is available. We combine the first 2^M-1 states where at least one supplier is available and define a super state denoted by o. The last state denoted by $\bar{1}$, is the state where all the suppliers are OFF. We also assume that for any supplier the ON and OFF periods are exponential with parameters λ and μ, respectively.

With these assumptions the expected cost and the expected length of a cycle are obtained as

$$C_{oo} = A(q, r, \theta) + P_{o\bar{1}}(q/(d+\theta))\, C_{\bar{1}o}(r),$$

$$T_{oo} = q/(d+\theta) + P_{o\bar{1}}(q/(d+\theta))/M_\mu$$

Therefore, the average cost function is given by

$$AC = C_{oo}/T_{oo}$$

where $A(q, r, \theta)$, $P_{o\bar{1}}(q/(d+\theta))$ and $C_{\bar{1}o}(r)$ have the same meaning as in chapter 2.

8.2. CONCLUSION:

When the number of suppliers become large, the objective function of multiple suppliers problem reduces to that of classical EOQ model. This can be shown by arguing that as the length of stay in state $\bar{1}$ is exponential with parameter M_μ, it becomes a degenerate random variable with mass at 0; that is the process never visits or stays in state $\bar{1}$.