ANNEXURE
ANNEXURE A
ESTIMATION OF THE PARAMETERS WHEN LEAD TIME
FOLLOWS TRUNCATED NORMAL DISTRIBUTION

If \( X \sim N(\mu_1, \sigma_1^2) \) then density function for doubly truncated normal variable \( X \) truncated below point \( c \) and above at point \( d \) is given by

\[
f_t(X/\mu_1, \sigma_1^2) = \begin{cases} 
K(2\pi \sigma_1^2)^{-\frac{1}{2}}(X/2) & \text{for } c \leq X \leq d \\
0 & \text{otherwise}
\end{cases}
\]

\[
= 0
\]

Where \( K^{-1} = \int_c^d (2\pi \sigma_1^2)^{-\frac{1}{2}} A_1 \, dx \)

and \( A_1 = \exp \left\{ -\frac{1}{2} \left( \frac{X - \mu_1}{\sigma_1} \right)^2 \right\} \)

for this distribution

\[
\int_c^d f_t(X/\mu_1, \sigma_1^2) \, dx
\]

\[
eq \mu_1 + \left[ Z(A_2) - Z(A_3) \right] \sigma_1
\]

\[
= \mu_1 + \left[ \frac{Z(A_2) - Z(A_3)}{\sigma_1} \right] \sigma_1
\]
Where \( Z \sim N(0,1) \) with its p.d.f. given by
\[
Z(x) = (2\pi)^{-\frac{1}{2}} \exp(-x^2/2), \quad x \in \mathbb{R}
\]

\[
A_2 = \left( \frac{c - \mu_1}{\sigma_1} \right) \quad \text{and} \quad A_3 = \left( \frac{d - \mu_1}{\sigma_1} \right)
\]

\[
E(x^2) = \int_c^d x^2 f_t(x/\mu_1, \sigma_1^2) \, dx
\]

so that expression for the variance turns out to be
\[
V(x) = \left[ 1 + \left( A_2 Z(A_2) - A_3 Z(A_3) \right) K \right] \left[ Z(A_2) - Z(A_3) \right] ^2 K^2 \sigma_1^2
\]

For the given problem, substitute lead time variable \( t \) in place of \( x \) to obtain the lead time distribution and hence \( K, \mu \) and \( \sigma^2 \) can be obtained accordingly. It may be noted that one can also assume that lead time follows either uniform, truncated gamma or beta distribution and the model can be derived with the estimation of relevant parameters accordingly.
ANNEXURE B

ESTIMATION OF RATES OF PERISHABILITY AND COEFFICIENTS
OF PERISHABILITY

For the commodity having perishable nature, it is required to incorporate the probability density function for the number of units that are perished. For such situation, the exponential distribution is very well known and it is widely utilised. It is obvious that the number of units perished can not exceed the number of units on hand. This justifies the truncated exponential distribution for the perishable commodity.

The probability density function for the truncated exponential distribution is given by

\[ f(x) = \left( \frac{K}{\theta} \right) \exp \left( -\frac{x}{\theta} \right) \quad ; \quad 0 \leq x \leq A \]
\[ = 0 \quad ; \quad \text{Otherwise.} \]

The value of \( K \) is given by the following expression

\[ K = \left[ 1 - \exp(-\theta/A) \right]^{-1} \]

Expected value of \( x \) is given by the following expression.

\[ E(X) = \hat{\theta} = \theta - A \quad \left[ \exp(A / \theta) - 1 \right]^{-1} \]

Suppose that, on the basis of the past data, calculation of the average number of units deteriorated during the transaction of commodity \( (\mu_1) \) is calculated for fixed
procurement quantity $Q$ considering the truncated exponential distribution, then the rate of perishability and coefficient of perishability can be obtained through the following relationships:

Perishability rate $\theta_1 = \frac{\hat{\mu}_1}{Q}$ and 
Coefficient of perishability $K_1 = \frac{\hat{\mu}_1}{Q}$

After estimating parameter $\mu_1$, the average number of units deteriorated ($\mu_2$) at the time when inventory is onhand is calculated by considering exponential distribution truncated above at the point $Q - \hat{\mu}_1$.

Thus rate of perishability at the time when there is onhand inventory and coefficient of perishability can be calculated as under:

Perishability rate $\theta_2 = \frac{\hat{\mu}_2}{(Q - \hat{\mu}_1)}$ and 
Coefficient of perishability $K_2 = \frac{\mu_2}{(Q - \mu_1)^2}$. 
ANNEXURE C

PAPERS FROM THIS THESIS

1) PUBLICATION WORK


[B] PAPER PRESENTATION AT THE CONFERENCES

1. An Inventory Problem with Variable Lead Time presented at 19th annual convention of Gujarat Statistical Association held at Statistics Department, Gujarat University, Ahmedabad during April 1993.

2. An Inventory Problem with Variable Lead Time presented at 26th annual convention held on focal theme Operations Research in Management of Public Systems by Operational Research Society of India held at Utkal University, Bhubaneswar during December 1993.


5 Decision Making Approach for Inventory System: A case study for perishable commodity presented at Gujarat Science Congress held at Physical Research Laboratory, Ahmedabad during 1995.


7 Optimisation Technique for Procurement Problem: A case study for Perishable Commodity in Agroprocessing Industries presented at 29th convention held on focal theme O.R. in the Management of Services by Operational Research Society held at Indian Institute of Technology, Bombay during December, 1996.

9 Optimisation Technique for Procurement Problem related to Agroprocessing Industries presented at 84th annual convention held on focal theme Frontiers in Science and Engineering and Their Relevance to National Development by Indian Science Congress held at Delhi University, Delhi during January, 1997.

10 Decision Making Strategy Under Lost Sales Inventory Model for Perishable Items presented at 14th Pan-Pacific Conference held on focal theme Restrategising The Asia-Pacific Region Towards a New Millennium held at Kuala Lumpur, Malaysia during June 1997.


13 Optimum Procurement Quantities when Sales Promotional Scheme is Offered: A Case Study for the Procurement System of Perishable Commodity under Variable Lead Time presented under Young Scientist Programme of 85th annual convention held on focal theme Science and Technology in Independent India: Restrospect and Prospect by Indian Science Congress held at Osmania University, Hyderabad during January, 1998.

14 Optimum Procurement Quantity for the Perishable Commodity Under ASPU Approach presented at 85th annual convention held on focal theme Science and Technology in Independent India: Restrospect and Prospect by Indian Science Congress held at Osmania University, Hyderabad during January, 1998.

2 Parekh H.S. and Jani B.B.: Optimum Procurement Quantity for Perishable Commodity Under Variable Lead Time, communicated to *Decision*.

3 Parekh H.S.: Optimum Procurement Quantities when Sales Promotional Scheme is Offered: A Case Study for the Procurement System of Perishable Commodity Under Variable Lead Time, communicated to *OPSEARCH*.

