Purchasing and Inventory Decisions

Economic Order Quantity (EOQ)

$$\textbf{EOQ} = \mathbf{Q^*} = \sqrt{\frac{2 \times D \times S}{I \times C}}$$

$$\textbf{Expected nº of orders (N)} = \frac{D}{EOQ}$$

$$\textbf{Time Between Orders } (\mathbf{T^*}) = \frac{EOQ}{D}$$

$$\textbf{EOP} = \frac{EOQ}{D} \times 365$$

$$\textbf{ROP} = d \times LT$$

$$\textbf{TC} = \frac{D}{Q} \times S + (I \times C) \times \frac{Q}{2}$$

D = Annual Demand
Q = Order quantity
S = Procurement cost
I = Carrying cost
C = Cost per unit
d = Demand rate
LT = Lead Time

d and LT must be in the same time dimension

Quantity Discounts

$$\textbf{EOQ}_i = \mathbf{Q^*} = \sqrt{\frac{2 \times D \times S}{I \times C_i}}$$

$$\textbf{TC}_i = P_i \times D + \frac{D}{Q_i} \times S + (I \times C_i) \times \frac{Q_i}{2}$$

P_i = Price per unit for quantitiy Q_i

Q_i = Order quantity

Deal Buying

$$\textbf{EOQ} = \mathbf{Q^*} = \sqrt{\frac{2 \times D \times S}{I \times C}}$$

$$\hat{\mathbf{Q}} = \frac{d \times D}{(p - d) \times I} + \frac{p \times Q^*}{p - d}$$

$$\textbf{EOP} = \frac{\hat{Q}}{D} \times 365$$

d = unit price decrease

p = price per unit before discount

Pull Method

$$\textbf{POQ} = \mathbf{Q_p^*} = \sqrt{\frac{2 \times D \times S}{I \times C}} \times \sqrt{\frac{p}{p - d}}$$

$$\textbf{POP} = \frac{Q_p^*}{D} \times 365$$

p = output or supply rate
d = demand rate
S = Setup cost

Reorder Point

$$\mathbf{Q^*} = \sqrt{\frac{2 \times D \times S}{I \times C}}$$

μ = Mean avg demand during ROP = $d \times LT$

$$\textbf{ROP} = d \times LT + z \times \sigma_{dLT}$$

$$\boldsymbol{\sigma_{dLT}} = \sigma_d \times \sqrt{\text{Lead Time}}$$

$$\textbf{Safety Stock} = z \times \sigma_{dLT}$$

$$\textbf{SL} = 1 - \text{Probability of stockout}$$

$$\textbf{AIL} = \frac{Q}{2} + z \times \sigma_{dLT}$$

$$\textbf{TC} = \frac{D}{Q} \times S + (I \times C) \times \frac{Q}{2} + I \times C \times z \times \sigma_{dLT} + \frac{D}{Q} \times k \times \sigma_{dLT} \times E_{(z)}$$

D = Annual Demand
S = Procurement cost
I = Carrying cost
C = Cost per unit
d = Avg demand
LT = Lead time

k = cost of stockout

z = Normal Distribution table

$E_{(z)}$ = Unit Normal Loss Integrals

Periodic Review Method

$$\mathbf{Q^*} = \sqrt{\frac{2 \times D \times S}{I \times C}}$$

$$\textbf{Review Interval } (\mathbf{T^*}) = \frac{Q^*}{D}$$

$$\textbf{Maximum Level } (\mathbf{M^*}) = d \times (T^* + LT) + z \times \sigma_{dLT}$$

$$\boldsymbol{\sigma_{dLT}} = \sigma_d \times \sqrt{T^* + LT}$$

$$\textbf{AIL} = \frac{d \times T^*}{2} + z \times \sigma_{dLT}$$

$$\textbf{TC} = \frac{D}{Q} \times S + (I \times C) \times \frac{Q}{2} + (I \times C) \times z \times \sigma_{dLT} + \frac{D}{Q} \times k \times \sigma_{dLT} \times E_{(z)}$$

Joint Ordering

$$\textbf{Common Review Time } (\mathbf{T^*}) = \sqrt{\frac{2 \times (O + \sum S_i)}{I \times \sum C_i D_i}}$$

$$\mathbf{Q_i^*} = T^* \times d_i$$

$$\mathbf{M_i^*} = d_i \times (T^* + LT) + z_i \times (\sigma_{dLT})_i$$

$$(\boldsymbol{\sigma_{dLT}})_i = (\sigma_d)_i \times \sqrt{T^* + LT_i}$$

$$\textbf{AIL}_i = \frac{d_i \times T^*}{2} + z_i \times (\sigma_{dLT})_i$$

$$\textbf{SL}_i = 1 - \frac{(\sigma_{dLT})_i \times (E_{(z)})_i}{Q_i^*}$$

$$\textbf{TC} = \frac{O + \sum S_i}{T} + \frac{I \sum C_i D_i}{2} + I \sum C_i z_i (\sigma_{dLT})_i + \frac{1}{T} \sum k_i (\sigma_{dLT})_i (E_{(z)})_i$$

O = common procurement cost

Service Level

$$\textbf{SL} = 1 - \frac{\sigma_{dLT} \times E_{(z)}}{Q}$$

Transportation Decisions

Break Weight

$$\textbf{BW} = \frac{\text{Rate}_{\text{Next}} \times \text{Weight}_{\text{Next}}}{\text{Rate}_{\text{Current}}}$$

$\text{Rate}_{\text{Next}}$ = Rate for the next higher weight break

$\text{Weight}_{\text{Next}}$ = Min weight of next highest weight break

$\text{Rate}_{\text{Current}}$ = Rate for actual weight of shipment

Cost Types

$$\textbf{Transportation} = R \times D$$

$$\textbf{In} - \textbf{transit Inventory} = \frac{I \times C \times D \times T}{365}$$

$$\textbf{Source Inventory} = \frac{I \times C \times Q}{2}$$

$$\textbf{Destination Inventory} = \frac{I \times C' \times Q}{2}$$

R = Transport rate
D = Annual Demand
I = Carrying cost, %/year
C = Product value at source
T = Time in transit
Q = Shipment size
C': Product value at destination
$C' = C + R$