

Chapter 10

Average Time

Normal time

Standard Time

Number of Observations

Average Time

$$\text{Ave time} = \frac{\text{Sum of times recorded}}{\text{Number of observations}}$$

Normal Time

$$\text{Normal time} = \text{Ave. time} * \text{Performance Factor}$$

Standard Time

$$\text{Standard time} = \frac{\text{Normal time}}{1 - \text{Allowance Factor}}$$

Required sample size

$$n = \left(\frac{zS}{e} \right)^2$$

If desired accuracy h is expressed as an absolute amount, substitute e for $h\bar{x}$, where e is the absolute amount of acceptable error

Compute standard deviation (s)

$$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n - 1}}$$

Required sample size

$$n = \left(\frac{zS}{h\bar{x}} \right)^2$$

- where
- h = accuracy level (acceptable error) desired in percent of the job element expressed as a decimal
 - z = number of standard deviations required for the desired level of confidence
 - S = standard deviation of the initial sample
 - \bar{x} = mean of the initial sample
 - n = required sample size

Required sample size

$$n = \frac{z^2 p(1 - p)}{h^2}$$

- where
- n = required sample size
 - z = standard normal deviate for desired confidence level
 - p = estimated value of sample proportion
 - h = acceptable error level in percent (as a decimal)

Chapter 11

Turnover Rate

Weeks of Supply

Percent of Assets to Inventory Turnover Rate

Turnover Rate

$$\text{Inventory turnover} = \frac{\text{COGS}}{\text{Ave. inventory}}$$

Percent invested in inventory

$$\% \text{ invested} = \left[\frac{\text{Average Inventory investment}}{\text{Total Assets}} \right] * 100$$

Week of Supply

$$\text{Weeks of supply} = \frac{\text{Ave. Inventory}}{\text{Ave. weekly COGS}}$$

$$\text{Week of supply} = \frac{\text{Ave. Inventory}}{\left[\frac{\text{Annual COGS}}{52 \text{ weeks}} \right]}$$

Chapter 11s

Percent of Shutdown

Bullwhip Measure

Holding Costs

Bullwhip

$$\text{Bullwhip} = \frac{\text{Variance of orders}}{\text{Variance of demand}} = \frac{\sigma_{\text{orders}}^2}{\sigma_{\text{demand}}^2}$$

Holding Cost

$$\text{Daily holding cost} = \frac{\text{Annual holding cost} * \text{product value}}{365}$$

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Dollar Volume

EOQ

Holding Cost

Set-up Cost

Total Cost

Safety Stock

Reorder Point

POQ

Total Cost

$$TC = \frac{D}{Q} S + \frac{Q}{2} H$$

Total Cost Including cost of material

$$TC = \frac{D}{Q} S + \frac{Q}{2} H + PD$$

Reorder Point

$$ROP = \left(\frac{\text{demand}}{\text{per day}} \right) \left(\frac{\text{Lead time}}{\text{in days}} \right)$$

$$ROP = d * L$$

$$d = \frac{D}{\# \text{ of working days in a year}}$$

Quantity Discount Model

Total annual cost = Setup cost + Holding Cost + Product cost

$$TC = \frac{D}{Q} S + \frac{Q}{2} IP + PD$$

where Q = Quantity ordered P = Price per unit
 D = Annual demand in units I = Holding cost per unit per year
 S = Ordering or setup cost per order expressed as a percent of price P

$$Q^* = \sqrt{\frac{2DS}{IP}}$$

Economic Order Quantity (EOQ)

$$\begin{aligned} \text{Annual Setup Cost} &= \left(\frac{\text{Annual Demand}}{\# \text{ unit in each order}} \right) \left(\frac{\text{Setup or order cost}}{\text{per order}} \right) \\ &= \left(\frac{D}{Q} \right) S \end{aligned}$$

Annual Holding Cost

$$\begin{aligned} \text{Annual Holding Cost} &= \left(\frac{\text{Order Quantity}}{2} \right) \left(\frac{\text{Holding Cost per}}{\text{unit per year}} \right) \\ &= \left(\frac{Q}{2} \right) H \end{aligned}$$

Q = Number of pieces per order

Q^* = Optimal number of pieces per order (EOQ)

D = Annual demand in units for the inventory item

S = Setup or ordering cost for each order

H = Holding or carrying cost per unit per year

$$\frac{D}{Q} S = \left(\frac{Q}{2} \right) H$$

$$Q^* = \sqrt{\frac{2DS}{H}}$$

Probabilistic Demand

$$ROP = \text{demand during lead time} + Z\sigma_{dLT}$$

Z = Number of standard deviations

σ_{dLT} = Standard deviation of demand during lead time