# Inventory Management Formulas

ABC Inventory Analysis

Order sku's in decreasing order of $D^{\$}$, where

$D^{\$}$ = annual dollar volume = unit price times annual demand

$D$ = total “annual” demand (or total annual usage)

$C_T$ = transaction, ordering, or “setup" cost (ordering or procurement cost per order)

$C_I$ = holding cost (or carrying cost) per unit per year

c = cost (purchase or production) per unit

$F_I$ = holding cost per unit per year as a fraction of the purchase cost; $C_I = (F_I)(c)$

$Q$ = order quantity

TC($Q$) = total annual cost as a function of the amount ordered ($Q$)

TVC($Q$) = total annual variable cost (exclusive of annual purchase costs)

$Q^*$ = optimal order quantity (or the Economic Order Quantity)

$n^*$ = optimal number of orders to place per year ($D/Q^*$)

## Economic Order Quantity (EOQ) Model

Total Annual Cost = Annual Ordering Costs + Annual Average Holding Costs + Annual Purchasing Costs

$$TC(Q) = C_T\left(\frac{D}{Q}\right) + C_I\left(\frac{Q}{2}\right) + cD$$

Total Annual Variable Cost:

$$TVC(Q) = C_T\left(\frac{D}{Q}\right) + C_I\left(\frac{Q}{2}\right)$$

## EOQ Formula

The optimal (economic) order quantity is: $Q^* = \sqrt{\frac{2DC_T}{C_I}}$

The optimal number of orders to place per year is $n^* = (D/Q^*)$

The optimal total annual variable cost is $TVC(Q^*) = C_T\left(\frac{D}{Q^*}\right) + C_I\left(\frac{Q^*}{2}\right) = C_I Q^*$

## Newsvendor Model

$C_L$ marginal cost if demand is **too low** ("overage cost")
typically includes *cost of item – salvage value*

$C_U$ marginal (opportunity) cost if demand is **too high** ("underage cost")
typically includes opportunity cost of lost contribution margin ("lost profit") plus shortage costs, i.e., *price – cost + shortage cost*

## Newsvendor Formula

Continuous Demand**:**

The optimal quantity q* is given by

$$P(\text{demand} \geq q^*) = \frac{C_L}{C_U + C_L}$$

Discrete demand distribution**:**

The optimal order quantity $q^*$ is the **largest** value $q$ for which

$$P(\text{demand} \geq q) \geq \frac{C_L}{C_U + C_L}$$