Inventory Control Formulas - (Q, R) System

Input Parameters

c: Unit cost (e.g., $20)
k: Setup or ordering cost per order (e.g., $100)
rho: Penalty cost per unit of unmet demand (e.g., $20)
I: Annual interest rate (e.g., 0.25 for 25%)
L: Lead time in months (e.g., 4 months)
mu_L: Average demand during lead time (e.g., 500 units)
sigma_L: Standard deviation of lead time demand (e.g., 100)
L(z): Loss function value for z-score
F(z): Cumulative standard normal distribution value

1. Holding Cost Per Unit Per Year

h = I * c
(I: Interest rate, c: Unit cost)

2. Annual Demand

lambda = (12 / L) * mu_L
(L: Lead time in months, mu_L: Demand during lead time)

3. Initial EOQ (Unconstrained Lot Size)

Q0 = sqrt(2 * k * lambda / h)
(k: Ordering cost, lambda: Annual demand, h: Holding cost)

4. Service Level & Z-Score

1 - F(R0) = (Q0 * h) / (rho * lambda)
(F(R0): Service level, rho: Penalty cost)

5. Reorder Point

R = mu_L + z * sigma_L
(mu_L: Mean demand, sigma_L: Std dev of demand, z: z-score)

6. Safety Stock

SS = z * sigma_L

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7. Expected Backorders per Cycle

n(R) = sigma_L * L(z)

(L(z): Loss function at z)

8. Adjusted EOQ (With Penalty Cost)

Q = sqrt[2 * lambda * (k + rho * n(R)) / h]

Performance Measures

A. Time Between Orders: T = Q / lambda

B. Holding Cost: HC = h * (Q/2 + R - mu_L)

C. Ordering Cost: OC = k * lambda / Q

D. Penalty Cost: PC = (lambda / Q) * rho * n(R)

E. % No Stockout: P = F(z)

F. % Demand Not Met: P = n(R) / Q