N14C47 Supply Chain Planning & Management Planning

Formula Sheet

FORECASTING

Stationary series:

Moving average (of order N): $F_{t+1} = (1/N)\sum_{i=t-N+1}^{t} D_i$

Simple exponential smoothing:

$F_{t+1} = \alpha D_t + (1-\alpha)F_t$ or $F_{t+1} = F_t - \alpha e_t$ with $e_t = F_t - D_t$

Multiple-step-ahead forecasts (with moving averages or simple exponential smoothing): the one-step-ahead and multiple-step-ahead forecasts are the same (i.e., $F_{t,t+k} = F_{t,t+1}$)

Series with (linear) trend:

Holt's double exponential smoothing:

$S_t = \alpha D_t + (1-\alpha)(S_{t-1} + G_{t-1})$ and $G_t = \beta(S_t - S_{t-1}) + (1-\beta)G_{t-1}$

$F_{t,t+k} = S_t + kG_t$

Errors and accuracy: ($e_1, \ldots, e_n$ the forecast errors observed over n periods)

Error (one-step-ahead forecasts): $e_t = F_t - D_t$

Mean absolute deviation: $MAD = (1/n)\sum_{i=1}^{n} |e_i|$

Mean squared error: $MSE = (1/n)\sum_{i=1}^{n} e_i^2$

Mean absolute percentage error: $MAPE = \left[(1/n)\sum_{i=1}^{n} |e_i / D_i|\right] \times 100$

INVENTORY CONTROL (DETERMINISTIC)

Economic order quantity:

Cost function for EOQ: $G(Q) = \frac{K\lambda}{Q} + \lambda c + \frac{hQ}{2}$ (with $h = Ic$)

Economic order quantity: $EOQ = Q^* = \sqrt{\frac{2K\lambda}{h}}$

Optimal cost (ignoring the term λc): $G(EOQ) = \sqrt{2K\lambda h}$

Production order quantity:

Cost function for POQ (ignoring the constant term λc):

$G(Q) = \frac{K\lambda}{Q} + \frac{hQ}{2}(1 - \lambda / P)$ (with $h = Ic$)

Production order quantity: $POQ = \sqrt{\frac{2K\lambda}{h'}}$ with $h' = h(1 - \lambda/P)$

Optimal cost (ignoring the term λc):

$G(POQ) = \sqrt{2K\lambda h(1 - \lambda/P)}$

Quantity discount models:

Cost functions all-units discounts: $G_j(Q) = \lambda c_j + \frac{K\lambda}{Q} + \frac{Ic_jQ}{2}$

Cost functions incremental discounts:
$G_j(Q) = \lambda C_j(Q)/Q + K\lambda/Q + I[C_j(Q)/Q]Q/2$ with $C_j(Q)/Q$ the per unit (average) purchase price when ordering in batches of size Q

INVENTORY CONTROL (STOCHASTIC)

The (R = reorder point, Q = order quantity) model:

If demand during lead time (L) is normally distributed with mean λL and variance σ^2:

Type 1 service level model:

$Q = EOQ$ and $R = \lambda L + z\sigma$ *with* $F(R) = F(z) = \alpha$

(z, F(z)) can be read from the standard normal distribution table

Type 2 service level model:

$Q = EOQ$ and $R = \lambda L + z\sigma$ *with* $n(R) = Q(1 - \beta)$

and $n(R) = \sigma L(z)$

(z, L(z)) can be read from the standard normal distribution table

Scaling of lead time demand: Assume the periodic demand has mean λ and variance σ^2 and let L be the lead time in periods, then the mean demand during lead time is λL and the variance of demand during lead time is $\sigma^2 L$

Costs (R, Q) model:

Holding cost: $h(Q/2 + R - \lambda L)$

Ordering cost: $K\lambda/Q$

Penalty cost: $P\lambda n(R)/Q$

Lotsizing MRP

Silver – Meal: $C(1) = K$
$C(j) = (j\text{-}1)[C(j\text{-}1) + hd_j] / j$ for $j > 1$

Least unit cost: $C(1) = K/d_1$
$C(j) = [(d_1 + d_2 + \ldots + d_{j-1})C(j\text{-}1) + (j\text{-}1)hd_j]/(d_1 + d_2 + \ldots + d_j)$