13

Determining the Optimal Level of Product Availability

PowerPoint presentation to accompany
Chopra and Meindl Supply Chain Management, 5e

Learning Objectives

1. Identify the factors affecting the optimal level of product availability and evaluate the optimal cycle service level
2. Use managerial levers that improve supply chain profitability through optimal service levels
3. Understand conditions under which postponement is valuable in a supply chain
4. Allocate limited supply capacity among multiple products to maximize expected profits

Importance of the Level of Product Availability

- Product availability measured by cycle service level or fill rate
- Also referred to as the customer service level
- Product availability affects supply chain responsiveness
- Trade-off:
  - High levels of product availability ➔ increased responsiveness and higher revenues
  - High levels of product availability ➔ increased inventory levels and higher costs
- Product availability is related to profit objectives and strategic and competitive issues

Factors Affecting the Optimal Level of Product Availability

- Cost of overstocking, C_o
- Cost of understocking, C_u
- Possible scenarios
  - Seasonal items with a single order in a season
  - One-time orders in the presence of quantity discounts
  - Continuously stocked items
  - Demand during stockout is backlogged
  - Demand during stockout is lost

L.L. Bean Example

Table 13-1

Demand D_i (in hundreds)	Probability p_i	Cumulative Probability of Demand Being D_i or Less (P_i)	Probability of Demand Being Greater than D_i
4	0.01	0.01	0.99
5	0.02	0.03	0.97
6	0.04	0.07	0.93
7	0.08	0.15	0.85
8	0.09	0.24	0.76
9	0.11	0.35	0.65
10	0.16	0.51	0.49
11	0.20	0.71	0.29
12	0.11	0.82	0.18
13	0.10	0.92	0.08
14	0.04	0.96	0.04
15	0.02	0.98	0.02
16	0.01	0.99	0.01
17	0.01	1.00	0.00

L.L. Bean Example

$$\text{Expected demand} = \sum D_i p_i = 1{,}026$$

$$\text{Expected profit} = \sum_{i=4}^{10} \left[D_i (p - c) - (1{,}000 - D_i)(c - s) \right] p_i + \sum_{i=11}^{17} 1{,}000(p - c)\, p_i = \$49{,}900$$

Expected profit
from extra 100 parkas = 5,500 x Prob(demand ≥ 1,100) – 500 x Prob(demand < 1,100)
= \$5,500 x 0.49 – \$500 x 0.51 = \$2,440

Expected profit from
ordering 1,300 parkas = \$49,900 + \$2,440 + \$1,240 + \$580
= \$54,160

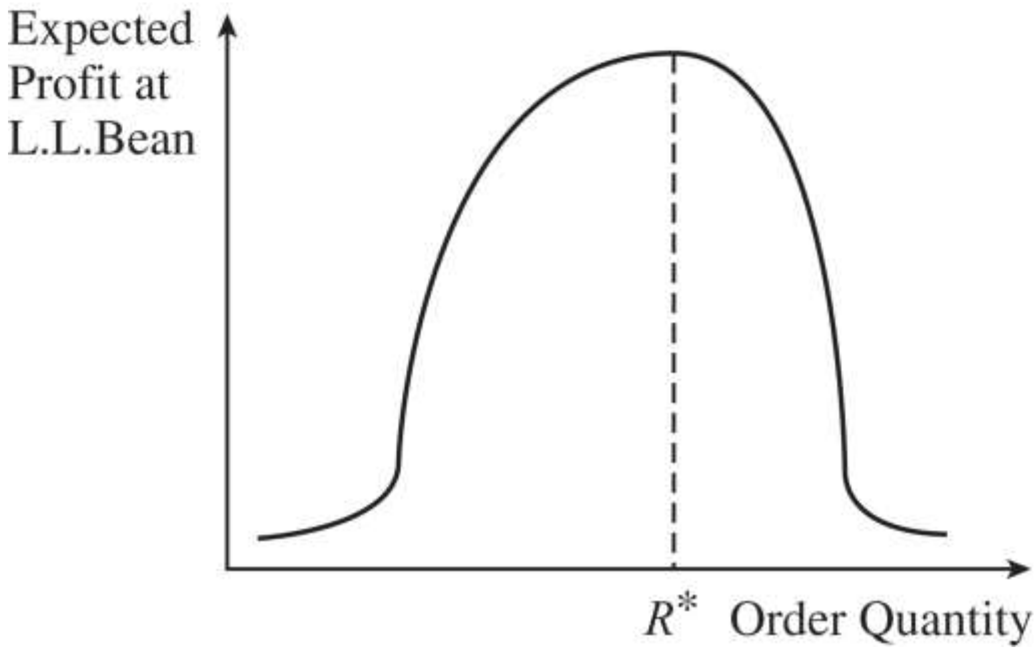
L.L. Bean Example

Additional Hundreds	Expected Marginal Benefit	Expected Marginal Cost	Expected Marginal Contribution
11th	5,500 x 0.49 = 2,695	500 x 0.51 = 255	2,695 – 255 = 2,440
12th	5,500 x 0.29 = 1,595	500 x 0.71 = 355	1,595 – 355 = 1,240
13th	5,500 x 0.18 = 990	500 x 0.82 = 410	990 – 410 = 580
14th	5,500 x 0.08 = 440	500 x 0.92 = 460	440 – 460 = –20
15th	5,500 x 0.04 = 220	500 x 0.96 = 480	220 – 480 = –260
16th	5,500 x 0.02 = 110	500 x 0.98 = 490	110 – 490 = –380
17th	5,500 x 0.01 = 55	500 x 0.99 = 495	55 – 495 = –440

Table 13-2

L.L. Bean Example

Figure 13-1



$$fr = 1 \times \text{Prob}(\text{demand} \le 1{,}300) + \sum_{D_i > 1{,}300} (1{,}300 / D_i)\, p_i = 0.99$$

Optimal Cycle Service Level for Seasonal Items – Single Order

C_o: Cost of overstocking by one unit, $C_o = c - s$
C_u: Cost of understocking by one unit, $C_u = p - c$
CSL^*: Optimal cycle service level
O^*: Corresponding optimal order size

Expected benefit of purchasing extra unit = $(1 - CSL^*)(p - c)$

Expected cost of purchasing extra unit = $CSL^*(c - s)$

Expected marginal contribution of raising order size = $(1 - CSL^*)(p - c) - CSL^*(c - s)$

Optimal Cycle Service Level for Seasonal Items – Single Order

$$CSL^* = \text{Prob}(\text{Demand} \le O^*) = \frac{p-c}{p-s} = \frac{C_u}{C_u + C_o} = \frac{1}{1+\left(C_o / C_u\right)}$$

$$O^* = F^{-1}(CSL^*, \mu, \sigma) = NORMINV(CSL^*, \mu, \sigma)$$

$$\text{Expected profit} = (p-s)\mu F_s\left(\frac{O-\mu}{\sigma}\right) - (p-s)\sigma f_s\left(\frac{O-\mu}{\sigma}\right)$$
$$- O(c-s)F(O,\mu,\sigma) + O(p-c)\left[1 - F(O,\mu,\sigma)\right]$$

Optimal Cycle Service Level for Seasonal Items – Single Order

$$\text{Expected profits} = (p - s)\mu\, NORMDIST\left[(O - \mu)/\sigma, 0, 1, 1\right]$$

$$- (p - s)\sigma\, NORMDIST\left[(O - \mu)/\sigma, 0, 1, 0\right]$$

$$- O(c - s)\, NORMDIST(O, \mu, \sigma, 1)$$

$$+ O(p - c)\left[1 - NORMDIST(O, \mu, \sigma, 1)\right]$$

Evaluating the Optimal Service Level for Seasonal Items

Demand $\mu = 350$, $\sigma = 100$, $c = \$100$, $p = \$250$,
disposal value = \$85, holding cost = \$5

Salvage value = \$85 – \$5 = \$80

Cost of understocking = $C_u = p - c$ = \$250 – \$100 = \$150

Cost of overstocking = $C_o = c - s$ = \$100 – \$80 = \$20

$$CSL^* = \text{Prob}(\text{Demand} \text{ £ } O^*) = \frac{C_u}{C_u + C_o} = \frac{150}{150+20} = 0.88$$

$$O^* = NORMINV(CSL^*, m, s) = NORMINV(0.88, 350, 100) = 468$$

Evaluating the Optimal Service Level for Seasonal Items

$$\text{Expected profits} = (p - s)\mu\, NORMDIST\left[(O-\mu)/\sigma, 0, 1, 1\right]$$
$$-(p - s)\sigma\, NORMDIST\left[(O-\mu)/\sigma, 0, 1, 0\right]$$
$$-O(c - s)\, NORMDIST(O, \mu, \sigma, 1)$$
$$+O(p - c)\left[1 - NORMDIST(O, \mu, \sigma, 1)\right]$$

$$= 59{,}500\, NORMDIST(1.18, 0, 1, 1)$$
$$-17{,}000\, NORMDIST(1.18, 0, 1, 0)$$
$$-9{,}360\, NORMDIST(468, 350, 100, 1)$$
$$+70{,}200\left[1 - NORMDIST(468, 350, 100, 1)\right]$$
$$= \$49{,}146$$

Evaluating the Optimal Service Level for Seasonal Items

$$\text{Expected overstock} = (O-\mu)F_S\left(\frac{O-\mu}{\sigma}\right) + \sigma f_S\left(\frac{O-\mu}{\sigma}\right)$$

$$\text{Expected overstock} = (O-\mu)NORMDIST\left[(O-\mu)/\sigma,0,1,1\right] + \sigma\, NORMDIST\left[(O-\mu)/\sigma,0,1,0\right]$$

$$\text{Expected understock} = (\mu-O)\left[1-F_S\left(\frac{O-\mu}{\sigma}\right)\right] + \sigma f_S\left(\frac{O-\mu}{\sigma}\right)$$

$$\text{Expected understock} = (\mu-O)\left[1-NORMDIST\left[(O-\mu)/\sigma,0,1,1\right]\right] + \sigma\, NORMDIST\left[(O-\mu)/\sigma,0,1,0\right]$$

Evaluating Expected Overstock and Understock

$$\mu = 350, \quad \sigma = 100, \quad O = 450$$

Expected overstock

$$= (O - \mu)\,NORMDIST\left[(O-\mu)/\sigma, 0, 1, 1\right] + \sigma\,NORMDIST\left[(O-\mu)/\sigma, 0, 1, 0\right]$$

$$= (450 - 350)\,NORMDIST\left[(450-350)/100, 0, 1, 1\right] + 100\,NORMDIST\left[(450-350)/100, 0, 1, 0\right] = 108$$

Expected understock

$$= (\mu - O)\left[1 - NORMDIST\left[(O-\mu)/\sigma, 0, 1, 1\right]\right] + \sigma\,NORMDIST\left[(O-\mu)/\sigma, 0, 1, 0\right]$$

$$= (350 - 450)\left[1 - NORMDIST\left[(450-350)/100, 0, 1, 1\right]\right] + 100\,NORMDIST\left[(450-350)/100, 0, 1, 0\right] = 8$$

One-Time Orders in the Presence of Quantity Discounts

1. Using $C_o = c - s$ and $C_u = p - c$, evaluate the optimal cycle service level CSL^* and order size O^* without a discount
   - Evaluate the expected profit from ordering O^*
2. Using $C_o = c_d - s$ and $C_u = p - c_d$, evaluate the optimal cycle service level CSL^*_d and order size O^*_d with a discount
   - If $O^*_d \geq K$, evaluate the expected profit from ordering O^*_d
   - If $O^*_d < K$, evaluate the expected profit from ordering K units
3. Order O^* units if the profit in step 1 is higher
   - If the profit in step 2 is higher, order O^*_d units if $O^*_d \geq K$ or K units if $O^*_d < K$

Evaluating Service Level with Quantity Discounts

- Step 1, c = \$50

Cost of understocking $= C_u = p - c =$ \$200 – \$50 = \$150

Cost of overstocking $= C_o = c - s =$ \$50 – \$0 = \$50

$$CSL^* = \text{Prob}(\text{Demand} \le O^*) = \frac{C_u}{C_u + C_o} = \frac{150}{150+50} = 0.75$$

$$O^* = NORMINV(CSL^*, \mu, \sigma) = NORMINV(0.75, 150, 40) = 177$$

Expected profit from ordering 177 units = \$19,958

Evaluating Service Level with Quantity Discounts

- Step 2, c = \$45

Cost of understocking = $C_u = p - c$ = \$200 – \$45 = \$155

Cost of overstocking = $C_o = c - s$ = \$45 – \$0 = \$45

$$CSL^* = \text{Prob}(\text{Demand} \pounds O^*) = \frac{C_u}{C_u + C_o} = \frac{150}{150 + 45} = 0.775$$

$$O^* = NORMINV(CSL^*, m, s) = NORMINV(0.775, 150, 40) = 180$$

Expected profit from ordering 200 units = \$20,595

Desired Cycle Service Level for Continuously Stocked Items

- Two extreme scenarios
  1. All demand that arises when the product is out of stock is backlogged and filled later, when inventories are replenished
  2. All demand arising when the product is out of stock is lost

Desired Cycle Service Level for Continuously Stocked Items

- Q: Replenishment lot size
- S: Fixed cost associated with each order
- ROP: Reorder point
- D: Average demand per unit time
- ƒ: Standard deviation of demand per unit time
- ss: Safety inventory ($ss = ROP - D_L$)
- CSL: Cycle service level
- C: Unit cost
- h: Holding cost as a fraction of product cost per unit time
- H: Cost of holding one unit for one unit of time. $H = hC$

Demand During Stockout is Backlogged

Increased cost per replenishment cycle of additional safety inventory of 1 unit $= (Q > D)H$

Benefit per replenishment cycle of additional safety inventory of 1 unit $= (1 - CSL)C_u$

$$CSL^* = 1 - \left[\frac{HQ}{DC_u}\right]$$

Demand During Stockout is Backlogged

Lot size, Q = 400 gallons

Reorder point, ROP = 300 gallons

Average demand per year, D = 100 x 52 = 5,200

Standard deviation of demand per week, σ_D = 20

Unit cost, C = $3

Holding cost as a fraction of product cost per year, h = 0.2

Cost of holding one unit for one year, H = hC = $0.6

Lead time, L = 2 weeks

Mean demand over lead time, D_L = 200 gallons

Standard deviation of demand over lead time, $\sigma_L = s_D\sqrt{L}$

$$= 20\sqrt{2} = 28.3$$

Demand During Stockout is Backlogged

$$CSL = F(ROP, D_L, \sigma_L) = NORMDIST(300, 200, 28.3, 1) = 0.9998$$

$$C_u = \frac{HQ}{(1 - CSL)D} = \frac{0.6 \times 400}{0.0002 \times 5{,}200} = \$230.8 \text{ per gallon}$$

Evaluating Optimal Service Level When Unmet Demand Is Lost

Lot size, Q = 400 gallons

Average demand per year, D = 100 x 52 = 5,200

Cost of holding one unit for one year, H = \$0.6

Cost of understocking, C_u = \$2

$$CSL^* = 1 - \frac{HQ}{HQ + DC_u}$$

$$= 1 - \frac{0.6 \times 400}{0.6 \times 400 + 2 \times 5{,}200} = 0.98$$

Managerial Levers to Improve Supply Chain Profitability

- "Obvious" actions
  1. Increase salvage value of each unit
  2. Decrease the margin lost from a stockout
- Improved forecasting
- Quick response
- Postponement
- Tailored sourcing

Managerial Levers to Improve Supply Chain Profitability

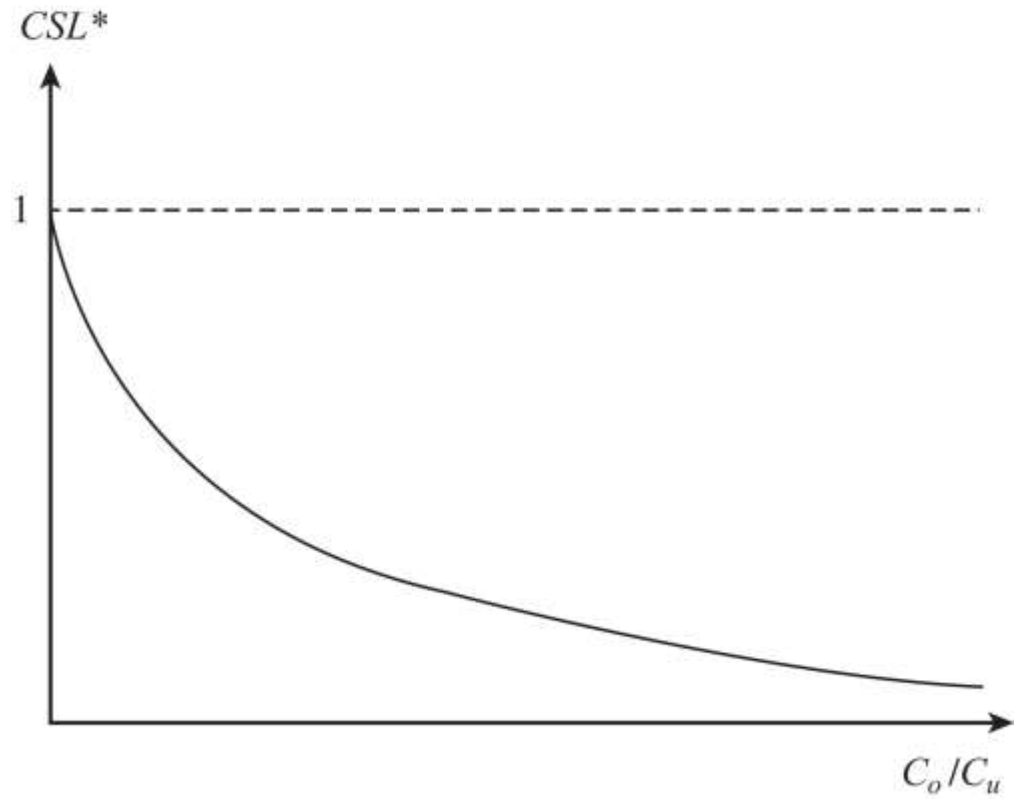


Figure 13-2

Improved Forecasts

- Improved forecasts result in reduced uncertainty
- Less uncertainty results in
  - Lower levels of safety inventory (and costs) for the same level of product availability, or
  - Higher product availability for the same level of safety inventory, or
  - Both

Impact of Improved Forecasts

Demand: $\mu = 350, \ \sigma = 150$

Cost: $c = \$100$, Price: $p = \$250$, Salvage: $s = \$80$

$$\text{Cost of understocking} = C_u = p - c = \$250 - \$100 = \$150$$

$$\text{Cost of overstocking} = C_o = c - s = \$100 - \$80 = \$20$$

$$CSL^* = Prob(Demand \leq O^*) \geq \frac{150}{150 + 20} = 0.88$$

Impact of Improved Forecasts

Standard Deviation of Forecast Error σ	Optimal Order Size O^*	Expected Overstock	Expected Understock	Expected Profit
150	526	186.7	8.6	$47,469
120	491	149.3	6.9	$48,476
90	456	112.0	5.2	$49,482
60	420	74.7	3.5	$50,488
30	385	37.3	1.7	$51,494
0	350	0	0	$52,500

Table 13-3

Impact of Improved Forecasts

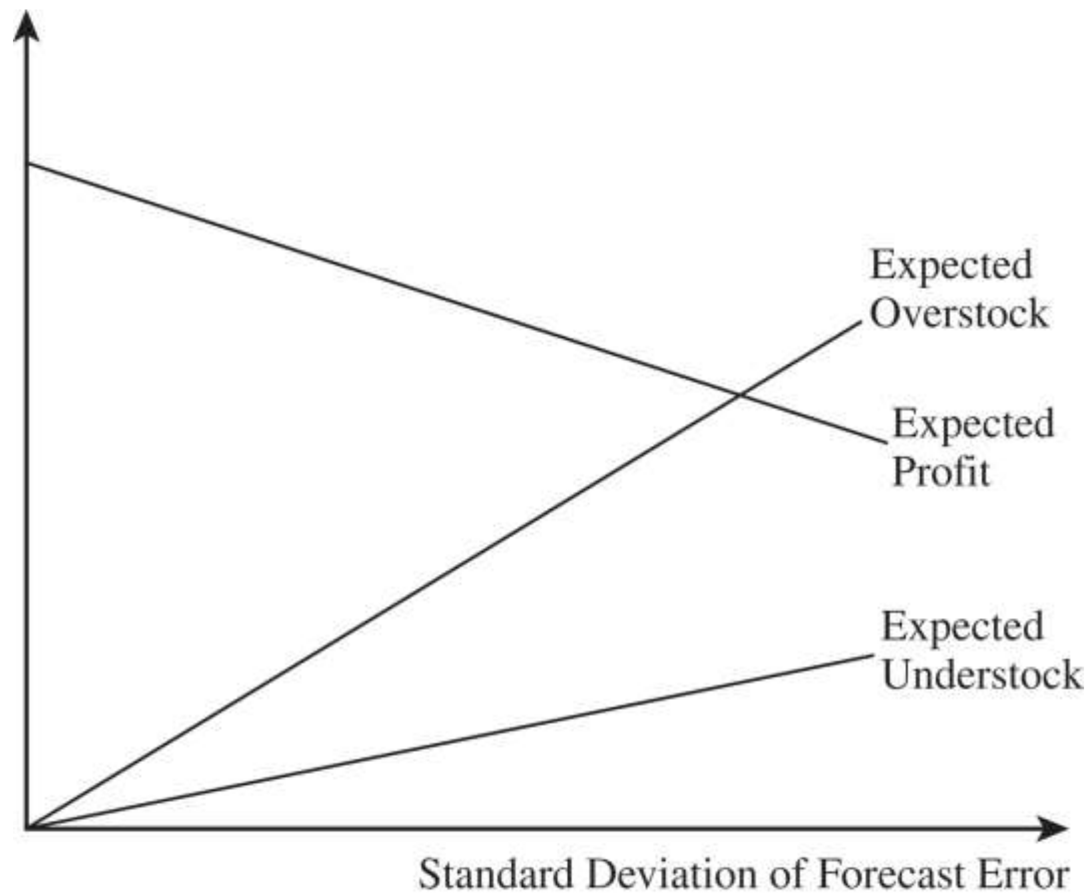


Figure 13-3

Quick Response: Impact on Profits and Inventories

- Set of actions taken by managers to reduce replenishment lead time
- Reduced lead time results in improved forecasts
- Benefits
  - Lower order quantities thus less inventory with same product availability
  - Less overstock
  - Higher profits

Quick Response: Multiple Orders Per Season

- Ordering shawls at a department store
  - Selling season = 14 weeks
  - Cost per shawl = \$40
  - Retail price = \$150
  - Disposal price = \$30
  - Holding cost = \$2 per week
  - Expected weekly demand D = 20
  - Standard deviation σ_D = 15

Quick Response: Multiple Orders Per Season

- Two ordering policies
  1. Supply lead time is more than 15 weeks
     - Single order placed at the beginning of the season
     - Supply lead time is reduced to six weeks
  2. Two orders are placed for the season
     - One for delivery at the beginning of the season
     - One at the end of week 1 for delivery in week 8

Single Order Policy

$$\text{Expected demand} = \mu = 14D = 14 \times 20 = 280$$

$$\text{Standard deviation} = \sigma = \sqrt{14}\sigma_D = \sqrt{14} \times 15 = 56.1$$

$$CSL^* = \frac{p - c}{p - s} = \frac{150 - 40}{150 - 30} = 0.92$$

$$O^* = NORMINV(CSL^*, \mu, \sigma) = NORMINV(0.92, 280, 56.1) = 358$$

Single Order Policy

Expected profit with a single order	= $29,767
Expected overstock	= 79.8
Expected understock	= 2.14
Cost of overstocking	= $10
Cost of understocking	= $110
Expected cost of overstocking	= 79.8 x $10 = $798
Expected cost of understocking	= 2.14 x $110 = $235

Two Order Policy

$$\text{Expected demand} = \mu_7 = 7 \times 20 = 140$$

$$\text{Standard deviation} = \sigma_7 = \sqrt{7} \times 15 = 39.7$$

$$O_1 = NORMINV(CSL^*, \mu_7, \sigma_7) = NORMINV(0.92, 140, 39.7) = 195$$

Expected profit from seven weeks = $14,670

Expected overstock = 56.4

Expected understock = 1.51

Expected profit from season = $14,670 + 56.4 x $10 + $14,670

= $29,904

Quick Response: Multiple Orders Per Season

- Three important consequences
  1. The expected total quantity ordered during the season with two orders is less than that with a single order for the same cycle service level
  2. The average overstock to be disposed of at the end of the sales season is less if a follow-up order is allowed after observing some sales
  3. The profits are higher when a follow-up order is allowed during the sales season

Quick Response: Multiple Orders Per Season

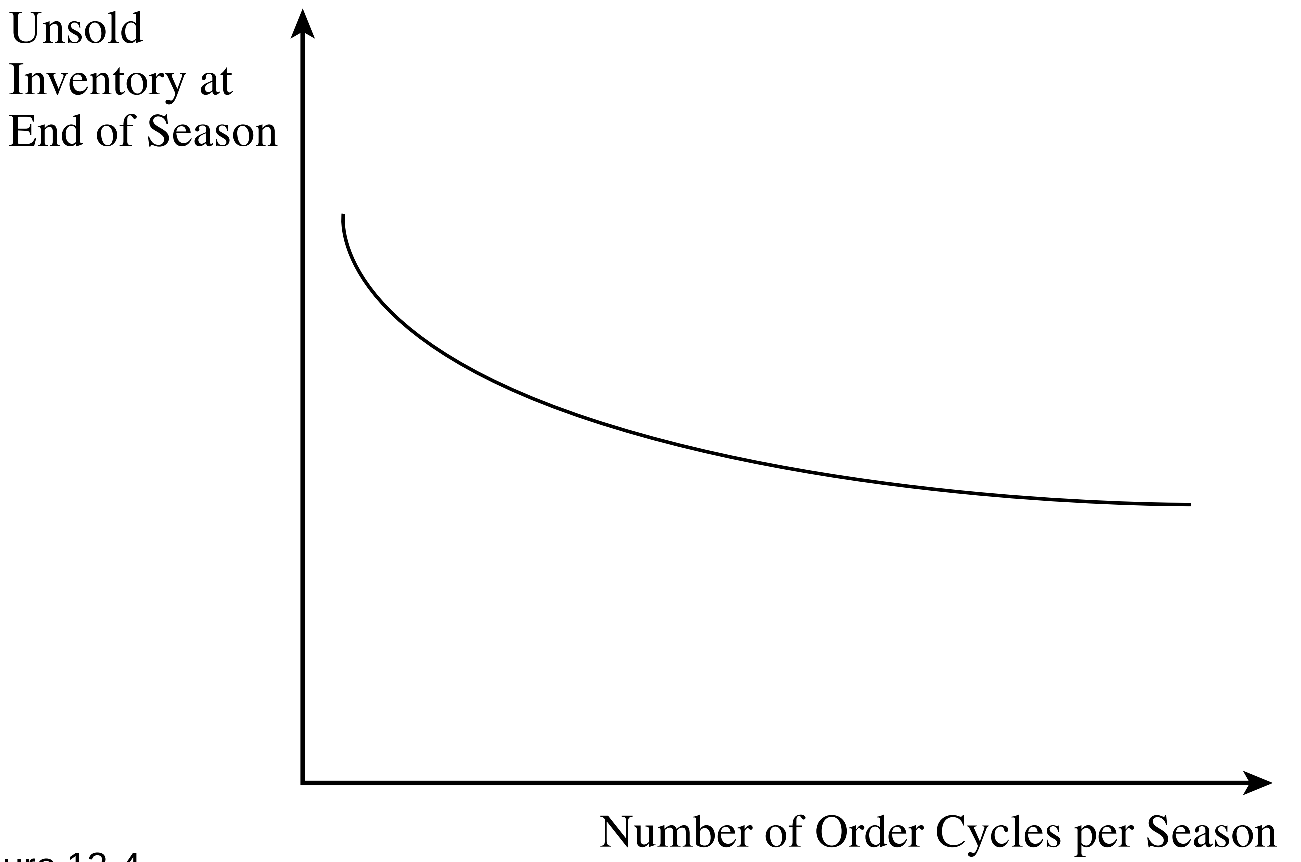


Figure 13-4

Quick Response: Multiple Orders Per Season

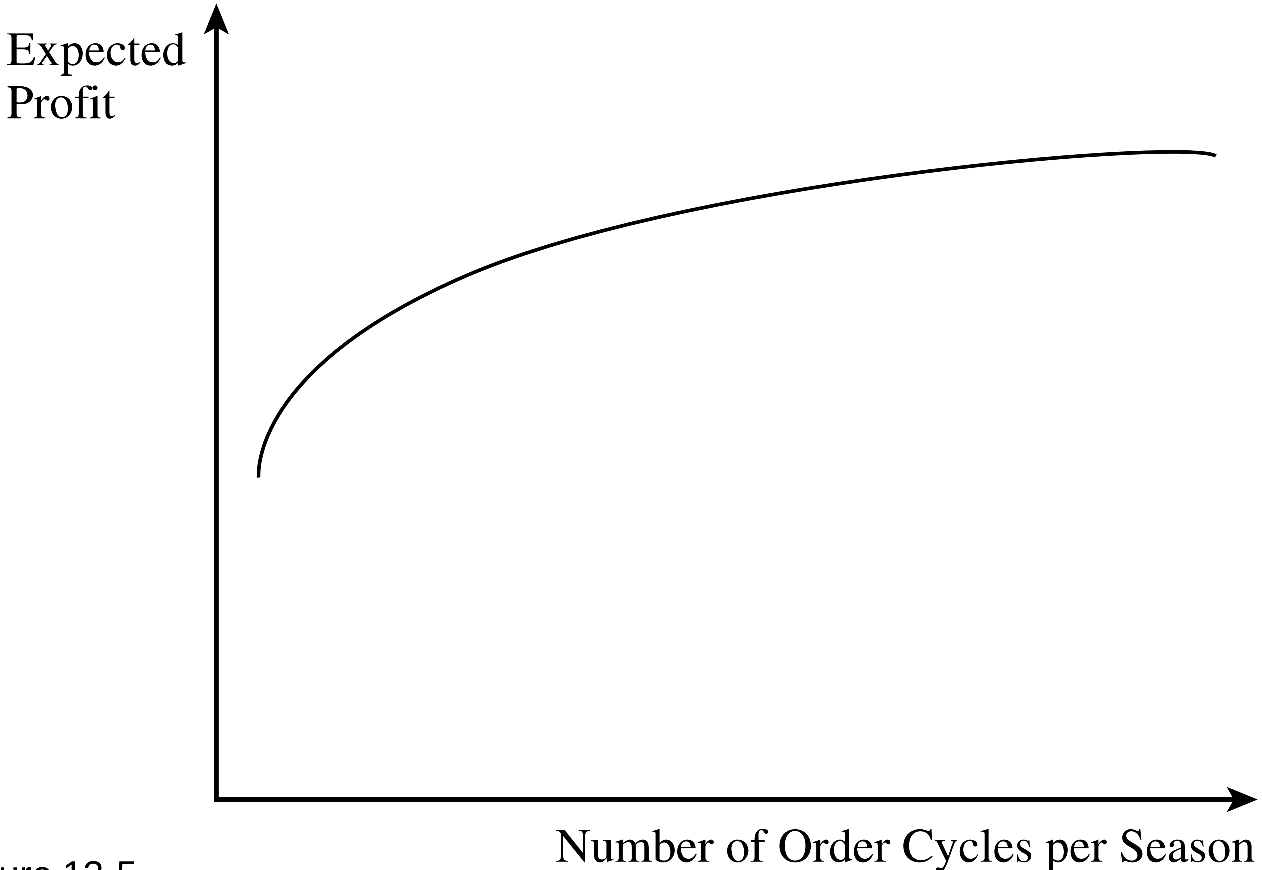


Figure 13-5

Two Order Policy with Improved Forecast Accuracy

$$\text{Expected demand} = \mu_7 = 7 \times 20 = 140$$

$$\text{Standard deviation first 7 weeks} = \sigma_7 = \sqrt{7} \times 15 = 39.7$$

$$\text{Standard deviation second 7 weeks} = \sigma_7^2 = \sqrt{7} \times 3 = 7.9$$

$$O_2 = NORMINV(CSL^*, \mu_7, \sigma_7^2) = NORMINV(0.92, 140, 7.9) = 151$$

Expected profit from second order = $15,254

Expected overstock = 11.3

Expected understock = 0.30

Expected profit from season = $14,670 + 56.4 x $10 + $15,254

= $30,488

Postponement: Impact on Profits and Inventories

- Delay of product differentiation until closer to the sale of the product
- Activities prior to product differentiation require aggregate forecasts more accurate than individual product forecasts
- Individual product forecasts are needed close to the time of sale
- Results in a better match of supply and demand
- Valuable in online sales
- Higher profits through better matching of supply and demand

Value of Postponement: Benetton

For each of four colors

Demand $\mu = 1{,}000$, $\sigma = 50$,

Sale price p = \$50, Salvage value s = \$10

Production cost Option 1 (no postponement) = \$20

Production cost Option 2 (postponement) = \$22

Value of Postponement: Benetton

- Option 1, for each color

$$CSL^* = \frac{p - c}{p - s} = \frac{30}{40} = 0.75$$

$$O^* = NORMINV(CSL^*, \mu, \sigma) = NORMINV(0.75, 1000, 500) = 1{,}337$$

Expected profits = $23,664

Expected overstock = 412

Expected understock = 75

Total production = 4 x 1,337 = 5,348

Expected profit = 4 x 23,644 = $94,576

Value of Postponement: Benetton

- Option 2, for all sweaters

$$CSL^* = \frac{p-c}{p-s} = \frac{28}{40} = 0.70$$

$$\mu_A = 4 \times 1{,}000 = 4{,}000 \qquad \sigma_A = \sqrt{4} \times 500 = 1{,}000$$

$$O_A^* = NORMINV(0.7, \mu_A, \sigma_A) = NORMINV(0.7, 4000, 1000) = 4{,}524$$

Expected profits = $98,092

Expected overstock = 715

Expected understock = 190

Value of Postponement: Benetton

- Postponement is not very effective if a large fraction of demand comes from a single product
- Option 1

Red sweaters demand $\mu_{red} = 3{,}100$, $\sigma_{red} = 800$

Other colors $\mu = 300$, $\sigma = 200$

$$O^{*}_{red} = NORMINV(CSL^{*}, m_{red}, s_{red})$$

$$= NORMINV(0.75, 3100, 800) = 3{,}640$$

Expected profits$_{red}$ = \$82,831

Expected overstock = 659

Expected understock = 119

Value of Postponement: Benetton

Other colors $\mu = 300$, $\sigma = 200$

$$O^* = NORMINV(CSL^*, \mu, \sigma) = NORMINV(0.75, 300, 200) = 435$$

Expected profits_{other} = \$6,458

Expected overstock = 165

Expected understock = 30

Total production = 3,640 + 3 x 435 = 4,945

Expected profit = \$82,831 + 3 x \$6,458 = \$102,205

Expected overstock = 659 + 3 x 165 = 1,154

Expected understock = 119 + 3 x 30 = 209

Value of Postponement: Benetton

- Option 2

$$\mu_A = 3{,}100 + 3 \times 300 = 4{,}000$$

$$\sigma_A = \sqrt{800^2 + 3 \times 200^2} = 872$$

Total production = 4,475

Expected profit = $99,872

Expected overstock = 623

Expected understock = 166

Tailored Postponement: Benetton

- Use production with postponement to satisfy a part of demand, the rest without postponement
- Produce red sweaters without postponement, postpone all others

Profit = $103,213

- Tailored postponement allows a firm to increase profits by postponing differentiation only for products with uncertain demand

Tailored Postponement: Benetton

- Separate all demand into base load and variation
  - Base load manufactured without postponement
  - Variation is postponed

  Four colors

  Demand mean $\mu = 1{,}000$, $\sigma = 500$

  - Identify base load and variation for each color

Tailored Postponement: Benetton

Table 13-4

Manufacturing Policy				
Q_1	Q_2	Average Profit	Average Overstock	Average Understock
0	4,524	$97,847	510	210
1,337	0	$94,377	1,369	282
700	1,850	$102,730	308	168
800	1,550	$104,603	427	170
900	950	$101,326	607	266
900	1,050	$101,647	664	230
1,000	850	$100,312	815	195
1,000	950	$100,951	803	149
1,100	550	$99,180	1,026	211
1,100	650	$100,510	1,008	185

Tailored Sourcing

- A firm uses a combination of two supply sources
  - One is lower cost but is unable to deal with uncertainty well
  - Second more flexible but is higher cost
- Focus on different capabilities
- Increase profits, better match supply and demand
- May be volume based or product based

Setting Product Availability for Multiple Products Under Capacity Constraints

- Two styles of sweaters from Italian supplier

High end	Mid-range
$\mu_1 = 1{,}000$	$\mu_2 = 2{,}000$
$\sigma_1 = 300$	$\sigma_2 = 400$
$p_1 = \$150$	$p_2 = \$100$
$c_1 = \$50$	$c_2 = \$40$
$s_1 = \$35$	$s_2 = \$25$
$CSL = 0.87$	$CSL = 0.80$
$O = 1{,}337$	$O = 2{,}337$

Setting Product Availability for Multiple Products Under Capacity Constraints

- Supplier capacity constraint, 3,000 units

Expected marginal contribution high-end

$$= MC_1(1{,}000)$$

$$= p_1\left[1 - F_1(1{,}000)\right] + s_1F_1(1{,}000) - c_1$$

$$= 150 \times (1 - 0.5) + 35 \times 0.5 - 50$$

$$= \$42.50$$

Expected marginal contribution mid-range

$$= MC_2(1{,}999)$$

$$= p_2\left[1 - F_2(1{,}999)\right] + s_2F_2(1{,}999) - c_2$$

$$= 100 \times (1 - 0.499) + 25 \times 0.499 - 40$$

$$= \$22.57$$

Setting Product Availability for Multiple Products Under Capacity Constraints

$$MC_i(Q_i) = p_i \left[1 - F_i(Q_i)\right] + s_i F_i(Q_i) - c_i$$

1. Set quantity $Q_i = 0$ for all products i
2. Compute the expected marginal contribution $MC_i(Q_i)$ for each product i
3. If positive, stop, otherwise, let j be the product with the highest expected marginal contribution and increase Q_j by one unit
4. If the total quantity is less than *B*, return to step 2, otherwise capacity constraint are met and quantities are optimal

$$Max \sum_{i=1}^{n} \Pi_i(Q_i)$$

subject to:

$$\sum_{i=1}^{n} Q_i \le B$$

$$Q_i \ge 0$$

Setting Product Availability for Multiple Products Under Capacity Constraints

	Expected Marginal Contribution		Order Quantity	
Capacity Left	High End	Mid Range	High End	Mid Range
3,000	99.95	60.00	0	0
2,900	99.84	60.00	100	0
2,100	57.51	60.00	900	0
2,000	57.51	60.00	900	100
800	57.51	57.00	900	1,300
780	54.59	57.00	920	1,300
300	42.50	43.00	1,000	1,700
200	42.50	36.86	1,000	1,800
180	39.44	36.86	1,020	1,800
40	31.89	30.63	1,070	1,890
30	30.41	30.63	1,080	1,890
10	29.67	29.54	1,085	1,905
1	29.23	29.10	1,088	1,911
0	29.09	29.10	1,089	1,911

Table 13-5

Setting Optimal Levels of Product Availability in Practice

1. Beware of preset levels of availability
2. Use approximate costs because profit-maximizing solutions are quite robust
3. Estimate a range for the cost of stocking out
4. Tailor your response to uncertainty

Summary of Learning Objectives

1. Identify the factors affecting the optimal level of product availability and evaluate the optimal cycle service level
2. Use managerial levers that improve supply chain profitability through optimal service levels
3. Understand conditions under which postponement is valuable in a supply chain
4. Allocate limited supply capacity among multiple products to maximize expected profits