

TOPIC 7: DETERMINISTIC DEMAND INVENTORY THEORY
Solutions to Practice Problems

1. $D=2000$; $S=\$10$; $I=.05+.15=.20$; $c=\$5$

Use the EOQ model. $Q^* = \sqrt{\frac{2(2000)(10)}{(0.2)(5)}} = \sqrt{\frac{40,000}{1}} = 200.$

2. Use the POQ model.

$D=100,000$

$d=100,000/250 = 400$

$P=1000$

$S=\$100$

$I=.25$

$c=\$40$

$$Q^* = \sqrt{\frac{2(100,000)(100)}{.25(40)(1 - \frac{400}{1000})}} = 1825.74 \approx 1826$$

3. $D=5,000$

$S=\$0.25$

$I=.20$

$$EOQ_{.10} = \sqrt{\frac{2(5000)(.25)}{.2(.10)}} = 353.55 \Rightarrow \text{infeasible}$$

$$EOQ_{.15} = \sqrt{\frac{2500}{2(.15)}} = 288.67 \Rightarrow \text{infeasible}$$

$$EOQ_{.20} = \sqrt{\frac{2500}{.2(.20)}} = 250 \Rightarrow \text{feasible}$$

$$TC_{250} = \frac{250}{2}(.2)(.20) + \frac{5000}{250}(.25) + 5000(.20) = \$1010.00$$

$$TC_{300} = \frac{300}{2}(.2)(.15) + \frac{5000}{300}(.25) + 5000(.15) = \$758.67$$

$$TC_{500} = \frac{500}{2}(.2)(.10) + \frac{5000}{500}(.25) + 5000(.10) = 507.5$$

Thus order 500 lbs. at a time

4. $D=50,000$

$S=\$1$

$I=.25$

$$EOQ_{.027} = \sqrt{\frac{2(50,000)(1)}{.25(.027)}} = 3849 \text{ units, which is feasible.}$$

5. a. Old EOQ = $\sqrt{\frac{2(1225)(50)}{.25(100)}} = 70$

New EOQ = $\sqrt{\frac{2(1225)(40)}{.20(100)}} = 70$

No change.

b. Old TC = $\sqrt{2(1225)(50)(.25)(100)} = \$1750$

New TC = $\sqrt{2(1225)(40)(.20)(100)} = \$1400$

A \$350 per year savings.

6. POQ model

D=5000

Working Days = 52(5) = 260

d = 5000/260 = 19.23

P=64

S=\$500

H=\$5

a. $Q^* = \sqrt{\frac{2(5000)(500)}{5(1 - 19.23/64)}} = 1,195.6$

b. $TC = \sqrt{2(5000)(500)(5)(1 - 19.23/64)} = \$4,181.90$

c. $5000/1195.6 = 4.18$

d. $1195.6/5000 = .23912$ years or 62.2 days (based on 260 working days per year)

e. $1195.6/64 = 18.68$ days

7. D=500

S=40

I=.20

$EOQ_{9.70} = \sqrt{\frac{2(500)(40)}{.2(9.70)}} = 143.59 \Rightarrow \text{feasible}$

Order 144.

8. Use the One-Time Sale Model:

$$D=500$$

$$S=\$10$$

$$I=15\%$$

$$c=\$6$$

$$\text{Discount in dollars}=\$6*50\%=\$3$$

$$EOQ = \sqrt{\frac{2(500)(10)}{(0.15)(6)}} = \sqrt{\frac{10,000}{0.9}} = 105$$

$$Q_1^* = \frac{500(3)}{(0.15)(6-3)} + \frac{6}{(6-3)}(105) = \frac{1500}{0.45} + 2(105) = 3333 + 210 = 3543 \text{ units}$$

Note: The one-time sale is so attractive that in this case the buyer ordered much more than the annual demand for the one-time sale item.

9. Use the One-time Sale Model:

$$D=2000$$

$$S=\$5$$

$$I=1\% \text{ per month} = 12(1\%) = 12\% \text{ per year}$$

$$c=\$20$$

$$\text{Discount of dollars}=\$4$$

$$EOQ = \sqrt{\frac{2(2000)(5)}{(0.12)(20)}} = \sqrt{\frac{20,000}{2.4}} = 91$$

$$Q_1^* = \frac{2000(4)}{(0.12)(20-4)} + \frac{20}{(20-4)}(91) = \frac{8000}{1.92} + 1.25(91) = 4167 + 114 = 4281 \text{ units}$$

10. EOQ with Lumpy Demand:

$$D= 20000$$

$$S= \$80$$

$$H=\$0.5$$

$$Q= 100$$

$$K^* = \left\lfloor \frac{1}{2} \left(1 + \sqrt{1 + \frac{8(20,000)(80)}{0.5[(100)^2]}} \right) \right\rfloor = \left\lfloor \frac{1}{2} \left(1 + \sqrt{1 + \frac{12,800,000}{5000}} \right) \right\rfloor = \left\lfloor \frac{1}{2} (1 + \sqrt{1 + 2560}) \right\rfloor$$

$$= \left\lfloor \frac{1}{2} (1 + \sqrt{2561}) \right\rfloor = \left\lfloor \frac{1}{2} (1 + 50.61) \right\rfloor = \left\lfloor \frac{1}{2} (51.61) \right\rfloor = \lfloor 25.8 \rfloor = 25$$

$$K^* = 0.5 * (1 + (1 + 8 * 20000 * 80 / (0.5 * 100^2))^{0.5})$$

$$= 25$$

$$\text{Order } K^*(Q) = 25(100) = 2500 \text{ units.}$$

11. EOQ with Lumpy Demand:

$$D = 50,000$$

$$S = \$1000$$

$$H = \$50$$

$$Q = 400$$

a.

$$K^* = \left\lfloor \frac{1}{2} \left(1 + \sqrt{1 + \frac{8(50,000)(1000)}{50[(400)^2]}} \right) \right\rfloor = \left\lfloor \frac{1}{2} \left(1 + \sqrt{1 + \frac{400,000,000}{8,000,000}} \right) \right\rfloor = \left\lfloor \frac{1}{2} (1 + \sqrt{1 + 50}) \right\rfloor$$

$$= \left\lfloor \frac{1}{2} (1 + \sqrt{51}) \right\rfloor = \left\lfloor \frac{1}{2} (1 + 7.14) \right\rfloor = \left\lfloor \frac{1}{2} (8.14) \right\rfloor = \lfloor 4.1 \rfloor = 4$$

$$\text{Order } K^*(Q) = 4(400) = 1600 \text{ units.}$$

b.

$$TC = \left\lceil \frac{50,000}{4(400)} \right\rceil (1000) + \left\lceil \frac{(4-1)400}{2} \right\rceil (50) = (31.25)(1000) + (600)(50)$$

$$= 31,250 + 30,000 = \$61,250$$