CHAPTER 4
EOQ Model

Economic Order Quantity

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EOQ Assumptions

- Known & constant demand
- Known & constant lead time
- Instantaneous receipt of material
- No quantity discounts
- Only order (setup) cost & holding cost
- No stockouts

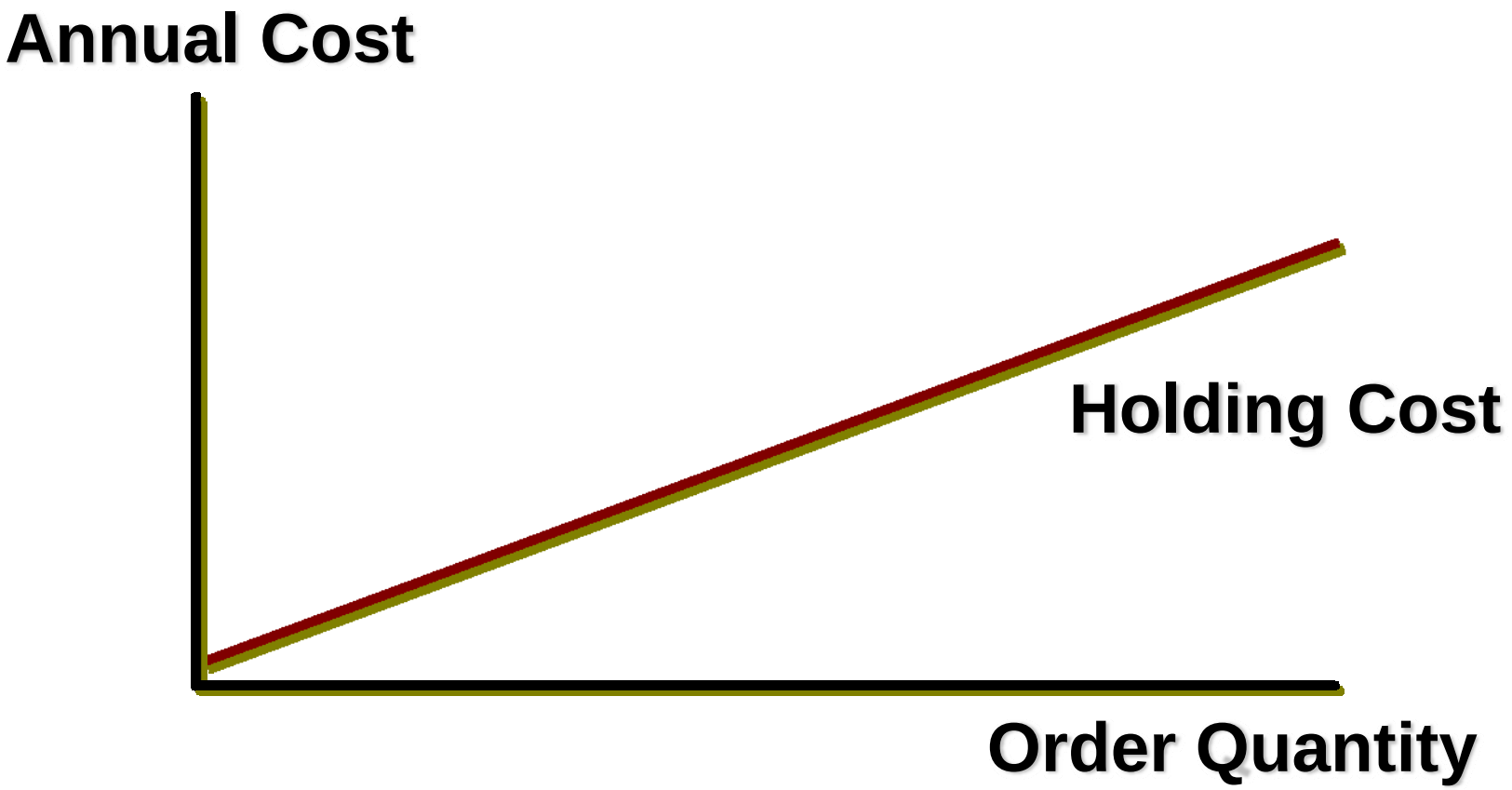
Inventory Holding Costs

Reasonably Typical Profile

Category	% of Inventory Value
Housing (building) cost	6%
Material handling costs	3%
Labor cost	3%
Inventory investment costs	11%
Pilferage, scrap, & obsolescence	3%
Total holding cost	**26%**

EOQ Model

EOQ Model



Why Order Cost Decreases

- Cost is spread over more units

Example: You need 1000 microwave ovens

1 Order (Postage $ 0.35)

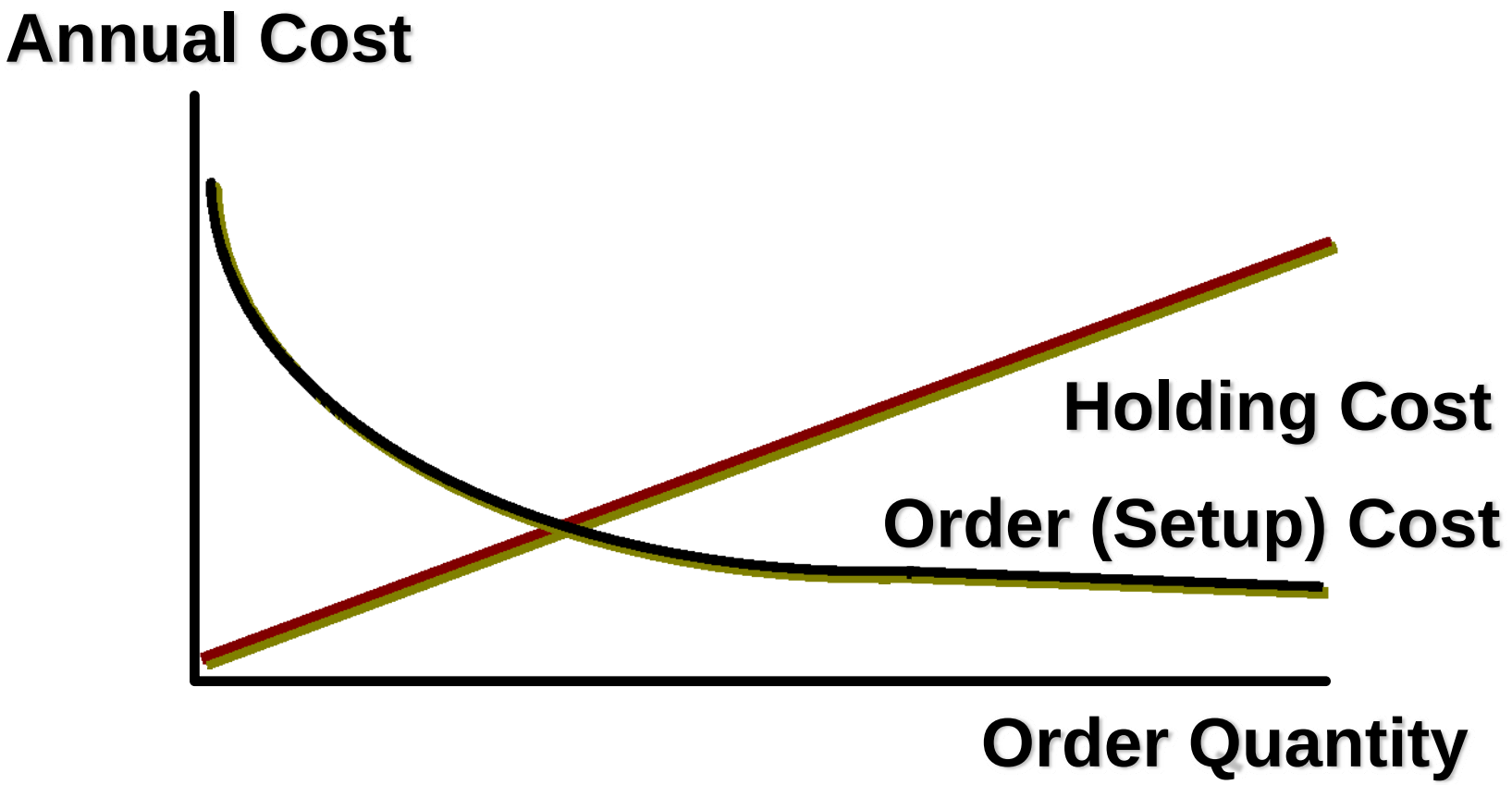
Purchase Order	
Description	Qty.
Microwave	1000

Order quantity

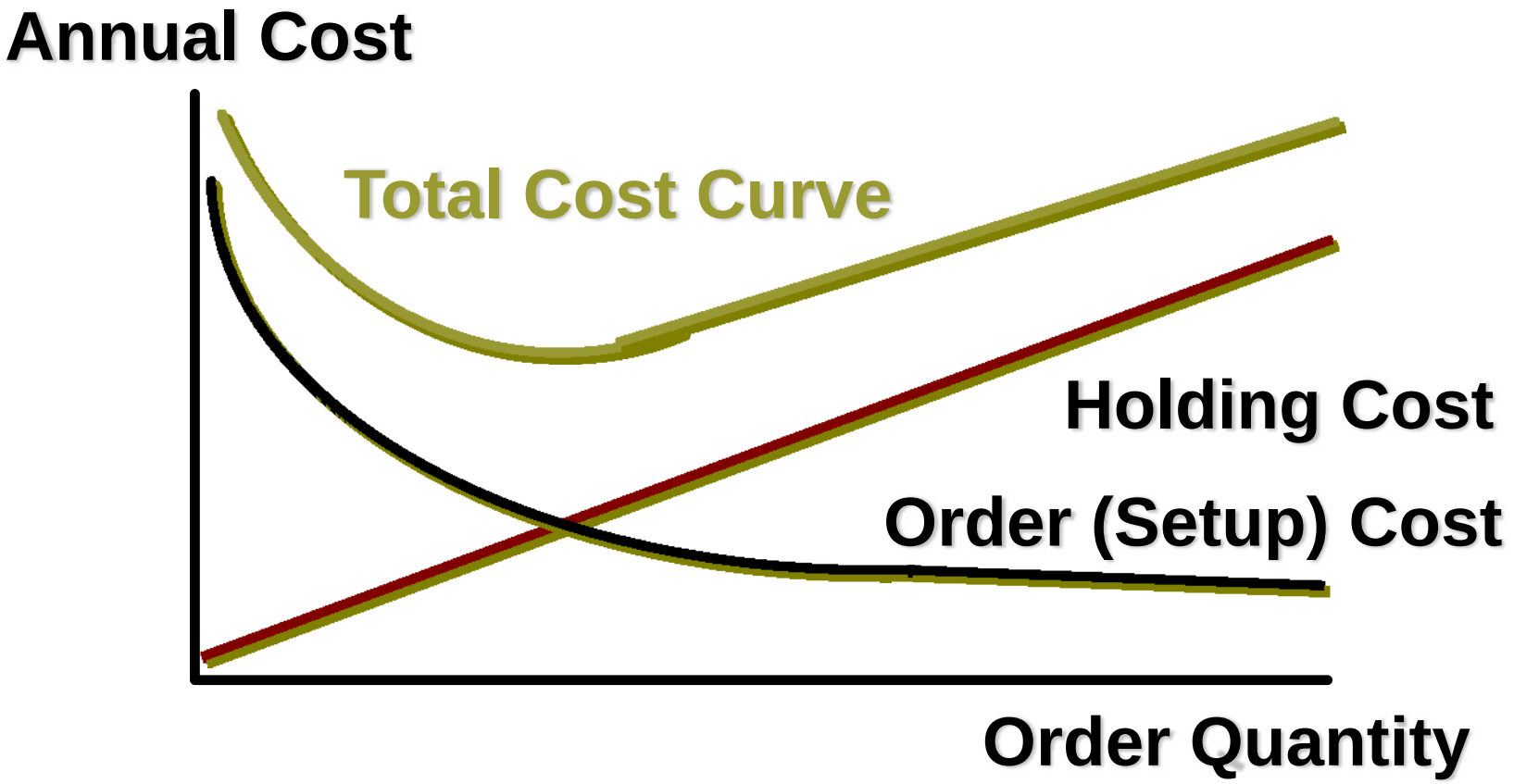
1000 Orders (Postage $350)

Purchase Order	
Description	Qty.
Microwave	1

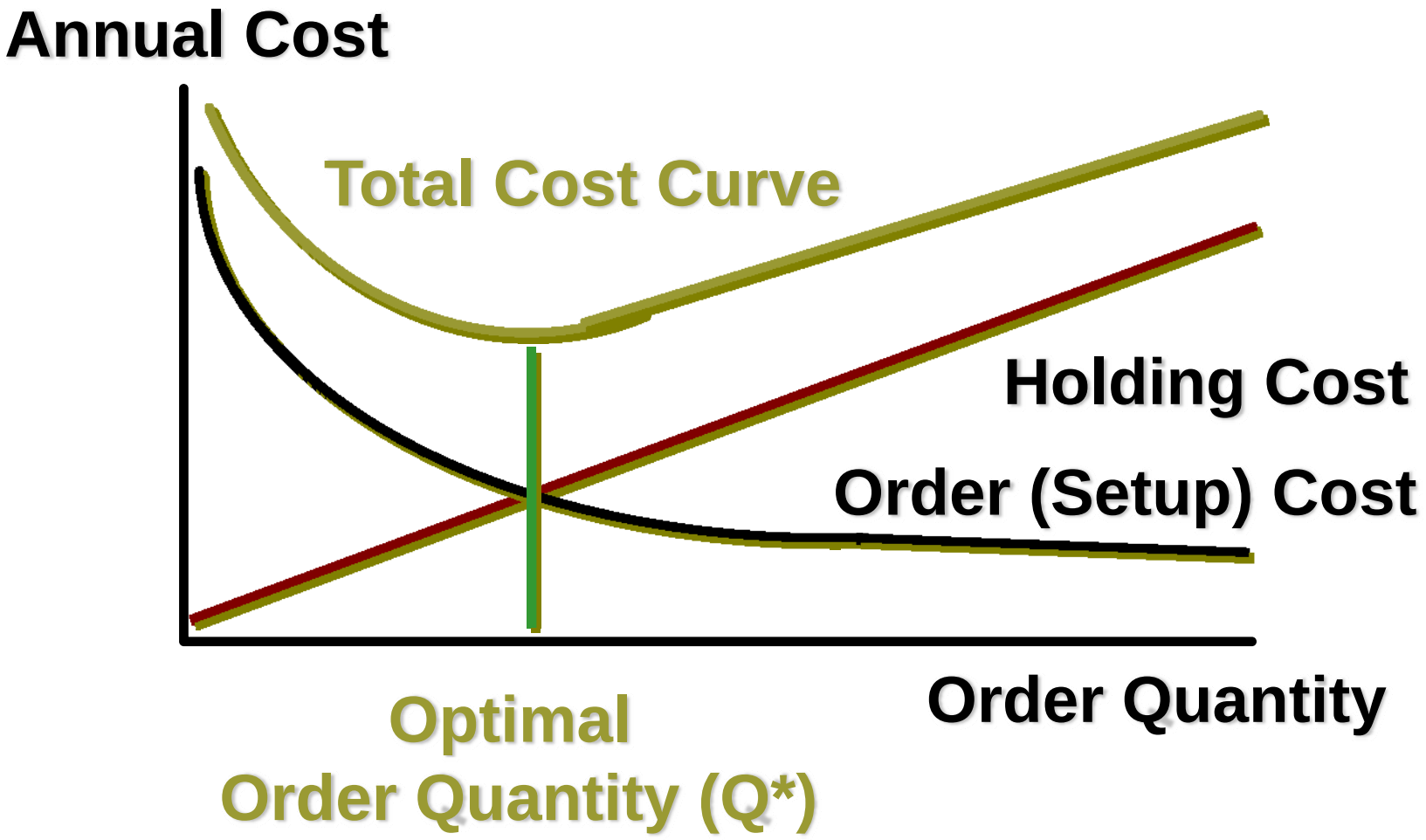
EOQ Model



EOQ Model


Annual Cost
Total Cost Curve
Holding Cost
Order (Setup) Cost
Order Quantity

EOQ Model


Annual Cost
Total Cost Curve
Holding Cost
Order (Setup) Cost
Order Quantity
Optimal
Order Quantity (Q*)

EOQ Formula Derivation

D =	Annual demand (units)
C =	Cost per unit ($)
Q =	Order quantity (units)
S =	Cost per order ($)
I =	Holding cost (%)
H =	Holding cost ($) = I x C

Number of Orders = D / Q
Ordering costs = S x (D / Q)

Average inventory
units = Q / 2
$ = (Q / 2) x C

Cost to carry
average inventory = (Q / 2) x I x C
= (Q /2) x H

Total cost = $(Q/2) \times I \times C + S \times (D/Q)$
inv carry cost *order cost*

Take the 1st derivative:

$d(TC)/d(Q) = (I \times C) / 2 - (D \times S) / Q^2$

To optimize: set $d(TC)/d(Q) = 0$

$DS/ Q^2 = IC / 2$

$Q^2/DS = 2 / IC$

$Q^2= (DS \times 2)/ IC$

$Q = \text{sqrt} (2DS / IC)$

Economic Order Quantity

$$EOQ = \sqrt{\frac{2 \times D \times S}{H}}$$

D = Annual demand (units)

S = Cost per order ($)

C = Cost per unit ($)

I = Holding cost (%)

H = Holding cost ($) = I x C

EOQ Model Equations

$$\text{Optimal Order Quantity} = Q^* = \sqrt{\frac{2 \cdot D \cdot S}{H}}$$

$$\text{Expected Number Orders} = N = \frac{D}{Q^*}$$

$$\text{Expected Time Between Orders} = T = \frac{\text{Working Days / Year}}{N}$$

$$d = \frac{D}{\text{Working Days / Year}}$$

$$ROP = d \cdot L$$

D = Demand per year

S = Setup (order) cost per order

H = Holding (carrying) cost

d = Demand per day

L = Lead time in days

EOQ Example

You're a buyer for SaveMart.

SaveMart needs 1000 coffee makers per year. The cost of each coffee maker is $78. Ordering cost is $100 per order. Carrying cost is 40% of per unit cost. Lead time is 5 days. SaveMart is open 365 days/yr.

What is the optimal order quantity & ROP?

SaveMart EOQ

$$EOQ = \sqrt{\frac{2 \times D \times S}{H}}$$

D = 1000
S = $100
C = $ 78
I = 40%
H = C x I
H = $31.20

$$EOQ = \sqrt{\frac{2 \times 1000 \times \$100}{\$31.20}}$$

$$EOQ = 80 \text{ coffeemakers}$$

SaveMart ROP

ROP = demand over lead time
= daily demand x lead time (days)
= *d x l*

D = annual demand = 1000
Days / year = 365
Daily demand = 1000 / 365 = 2.74
Lead time = 5 days

ROP = 2.74 x 5 = 13.7 => 14

SaveMart

Average (Cycle Stock) Inventory

Avg. CS = OQ / 2
= 80 / 2 = 40 coffeemakers
= 40 x $78 = $3,120

Inv. CC = $3,120 x 40% = $1,248

Note: unrelated to reorder point

Economic Order Quantity

$$EOQ = \sqrt{\frac{2 \times D \times S}{H}}$$

D = Annual demand (units)

S = Cost per order ($)

C = Cost per unit ($)

I = Holding cost (%)

H = Holding cost ($) = I x C

$$EOQ = \sqrt{\frac{2 \times D \times S}{H}}$$

What if …

1. *Interest rates go up ?*
2. *Order processing is automated ?*
3. *Warehouse costs drop ?*
4. *Competitive product is introduced ?*
5. *Product is cost-reduced ?*
6. *Lead time gets longer ?*
7. *Minimum order quantity imposed ?*