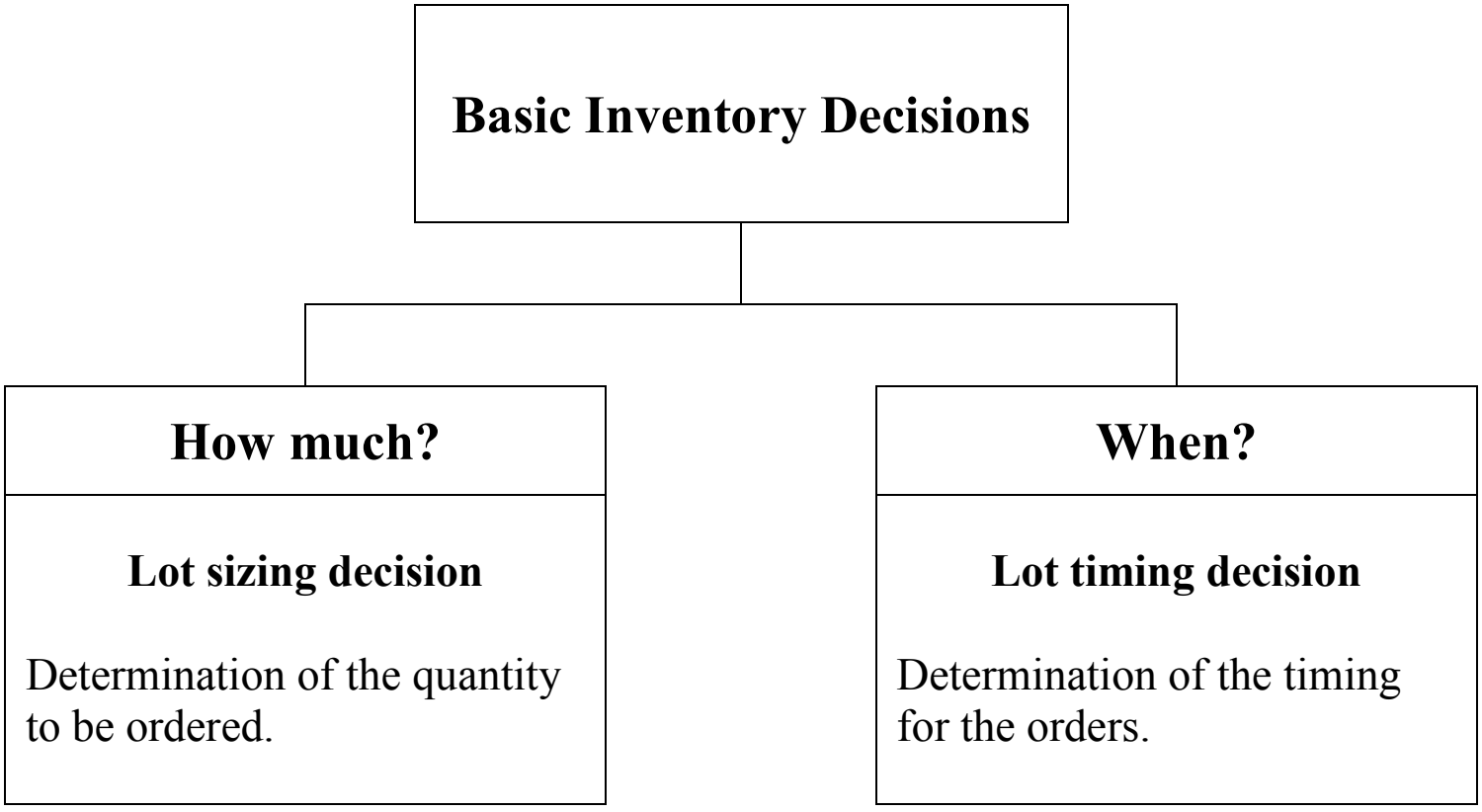
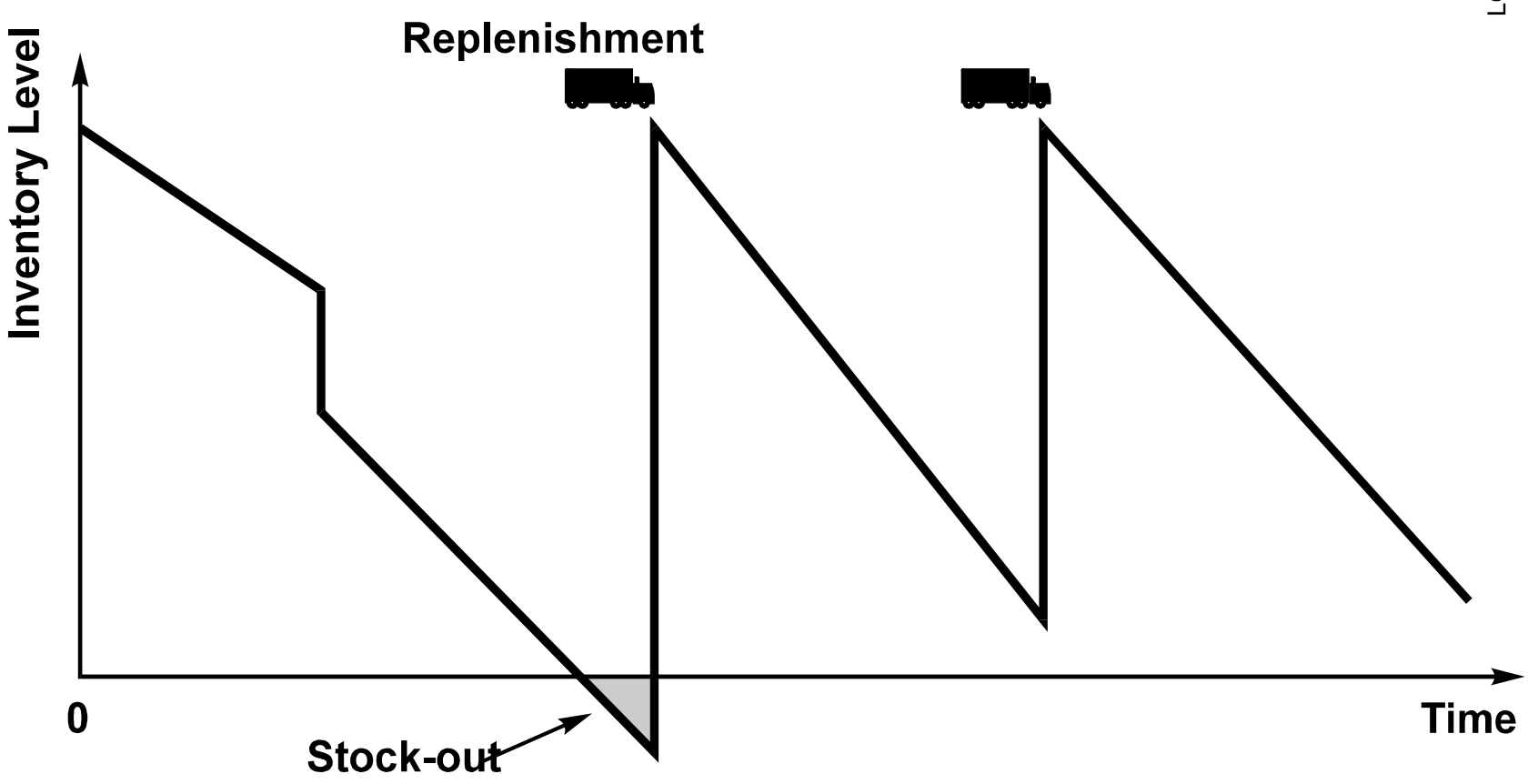
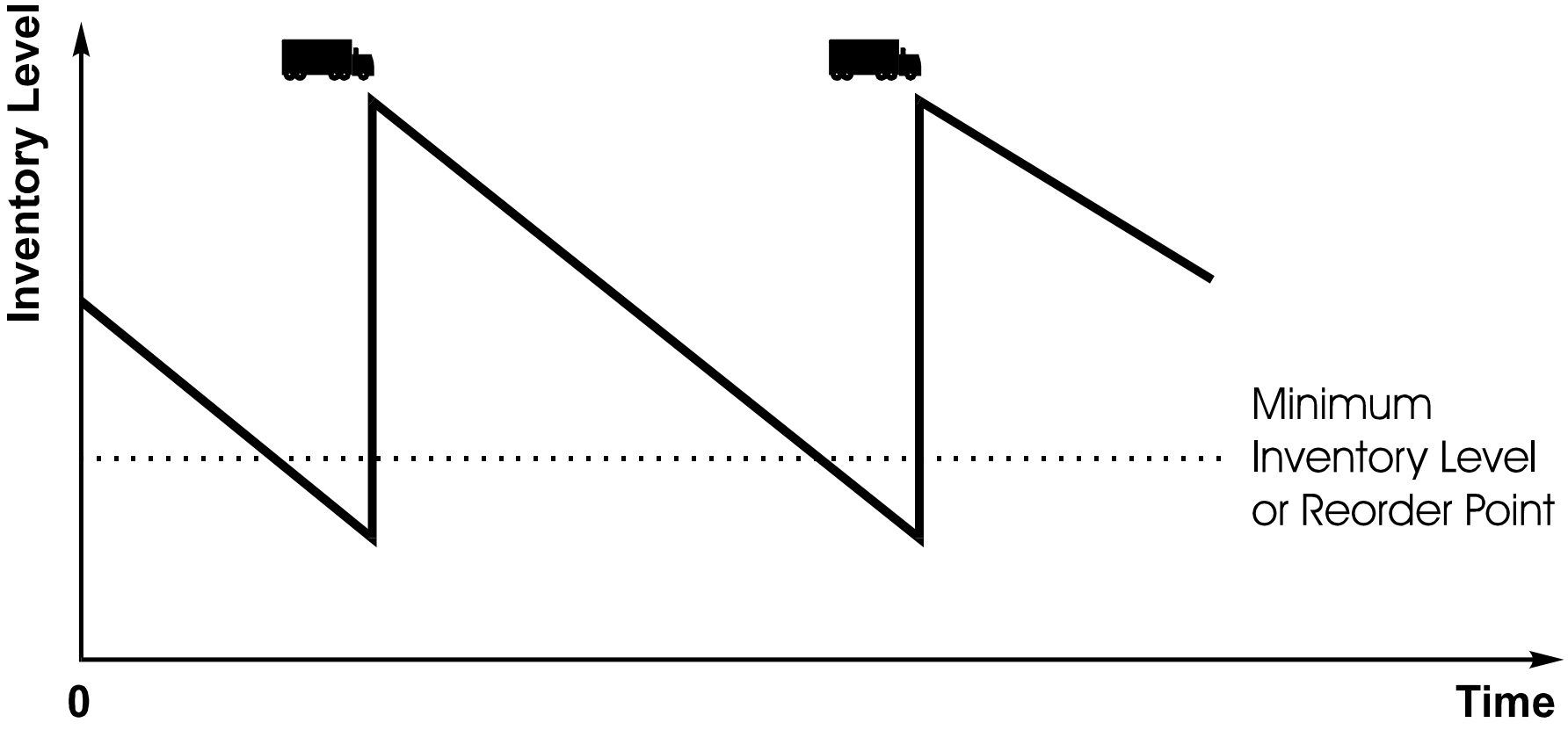
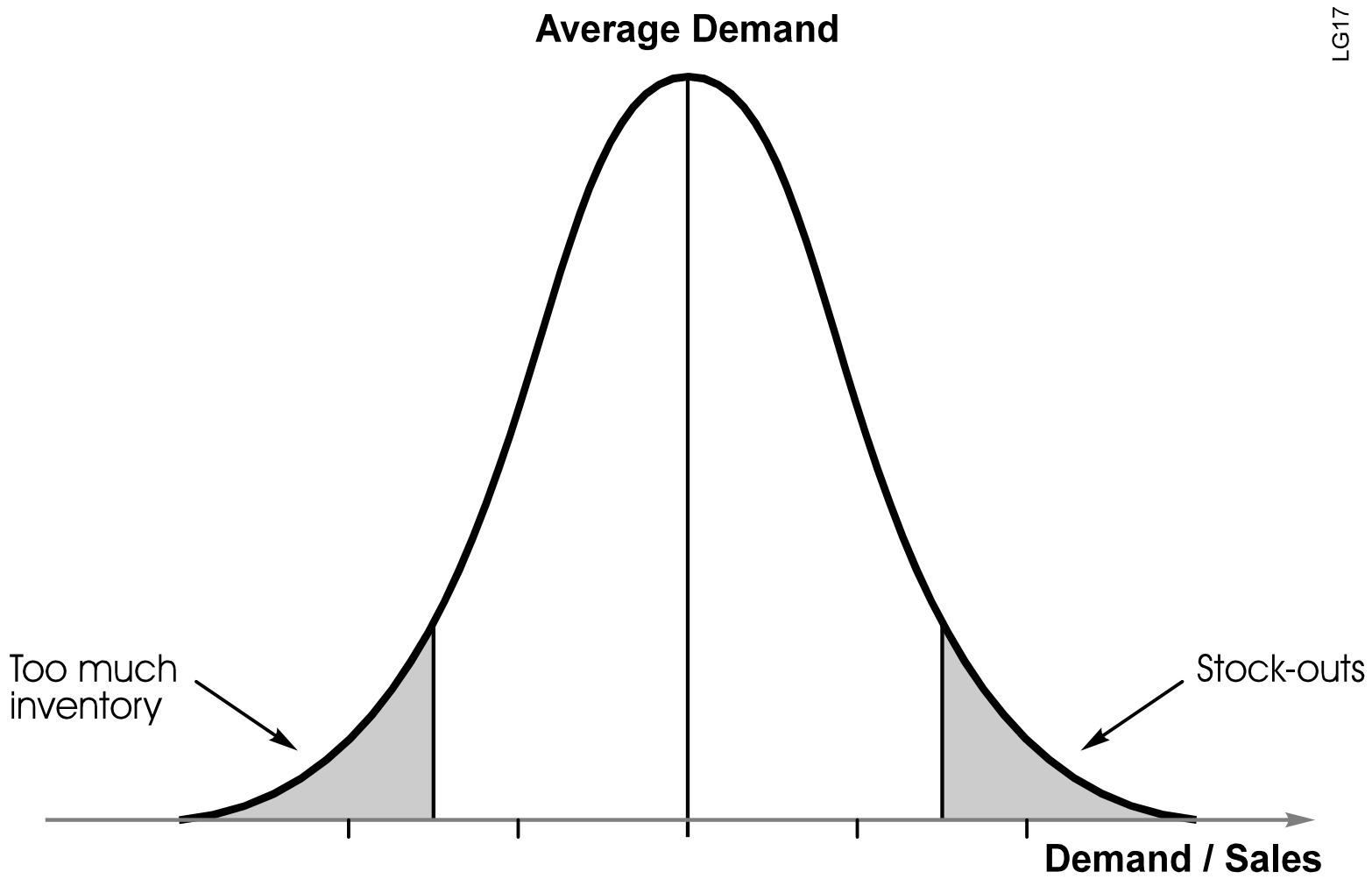

Basic Inventory Decisions
How much?
Lot sizing decision
Determination of the quantity to be ordered.
When?
Lot timing decision
Determination of the timing for the orders.

LG04



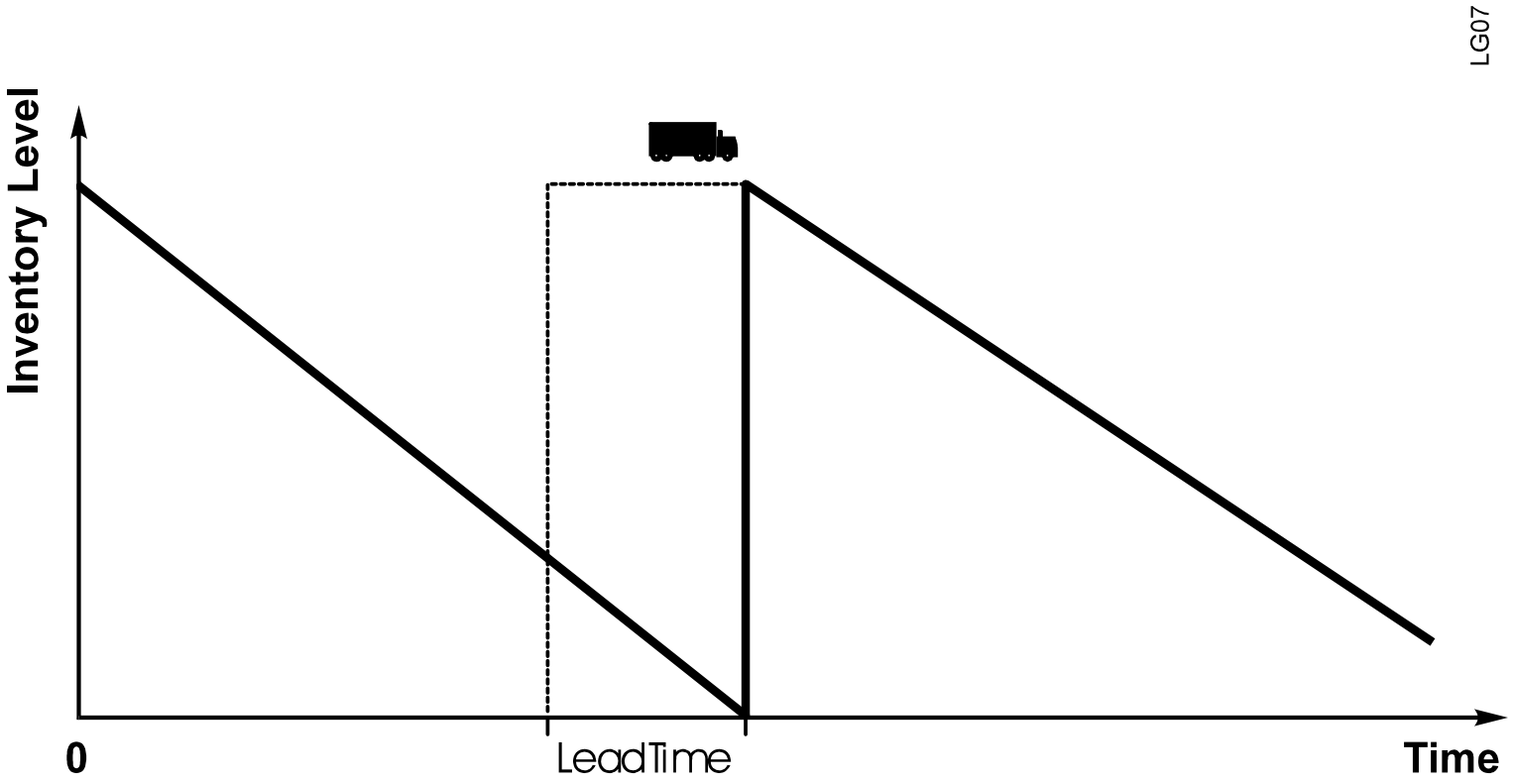
LG05

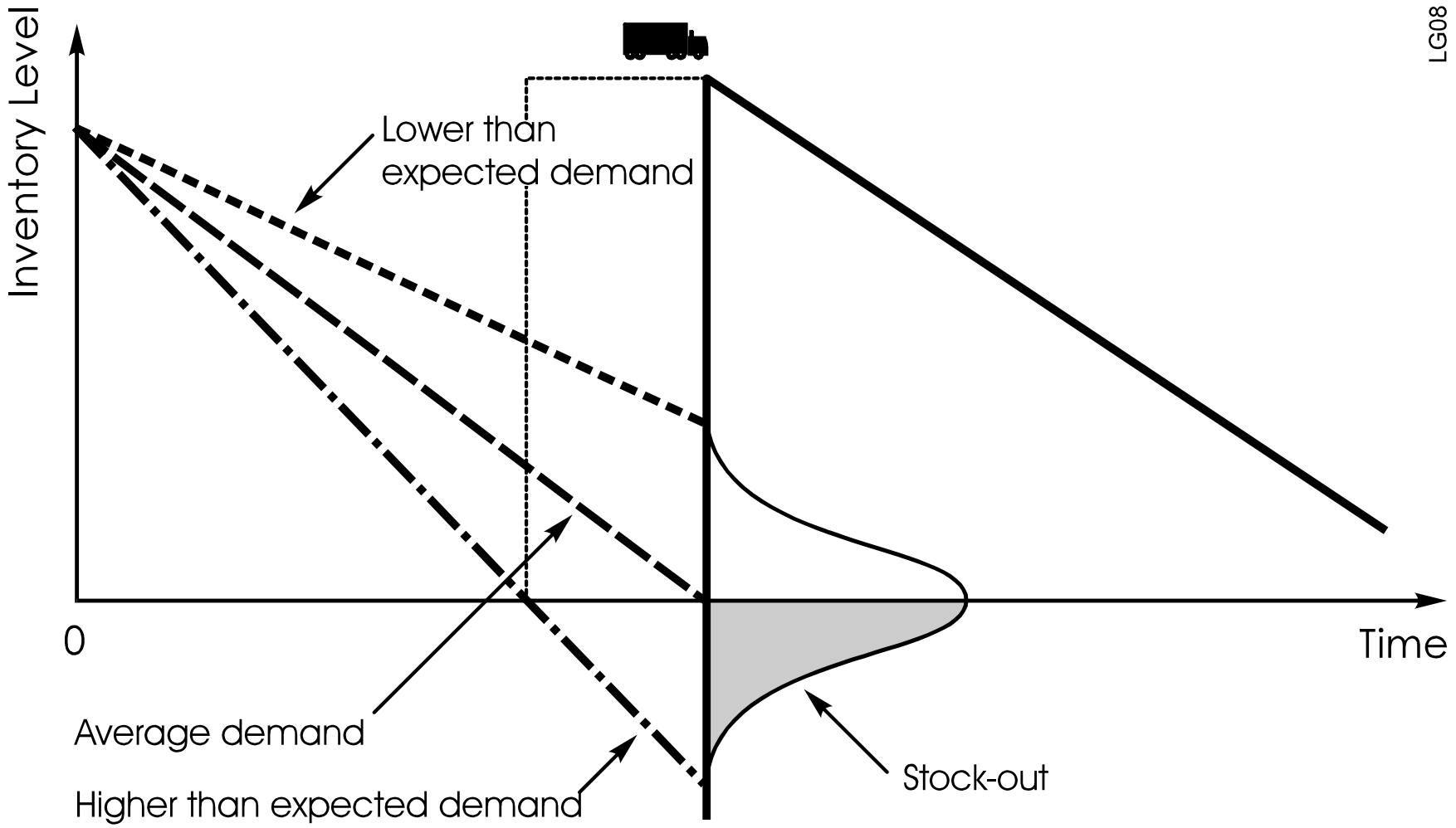

Inventory Level
Minimum
Inventory Level
or Reorder Point
0
Time



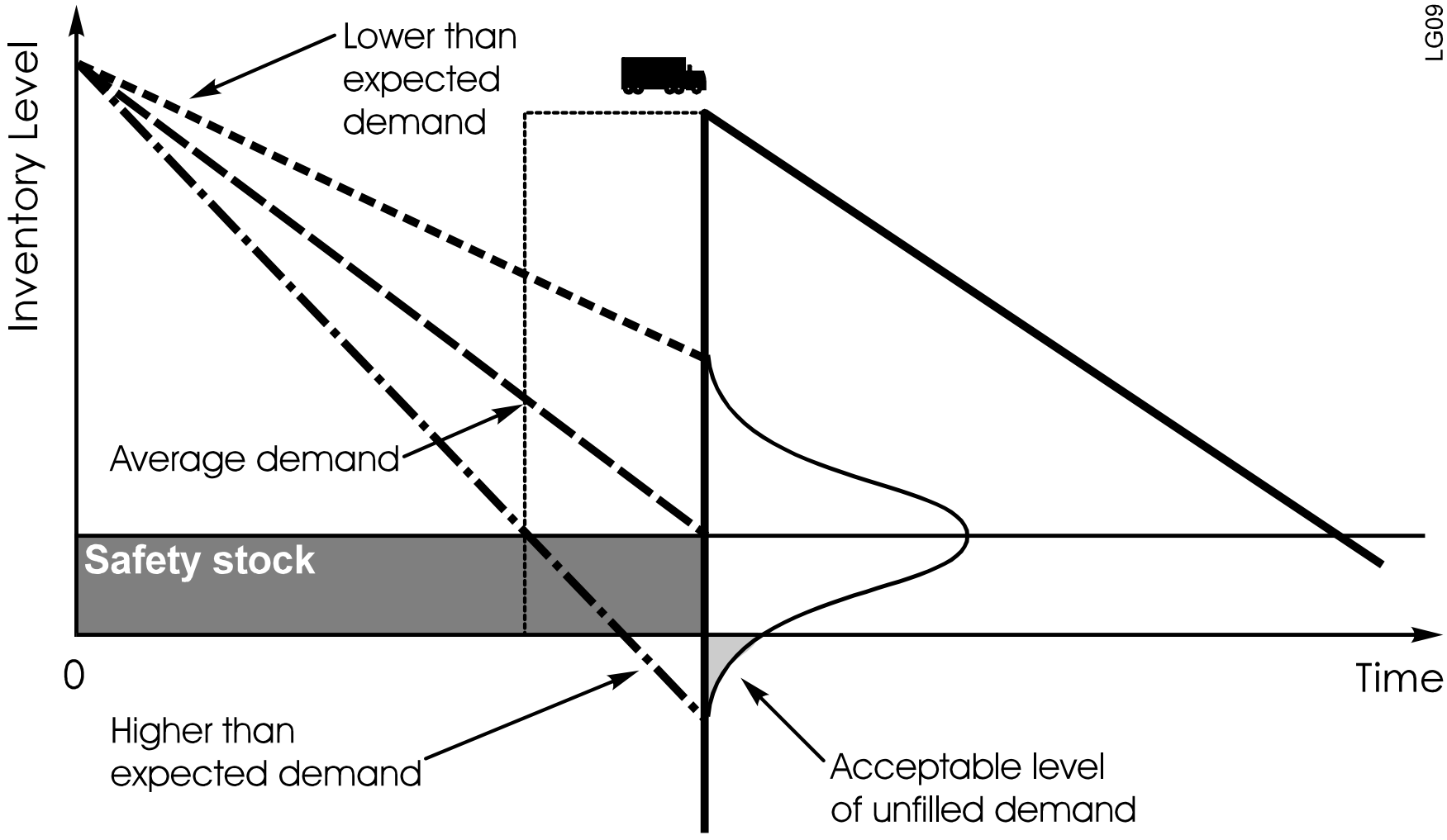
Demand Distribution

Ideal depletion



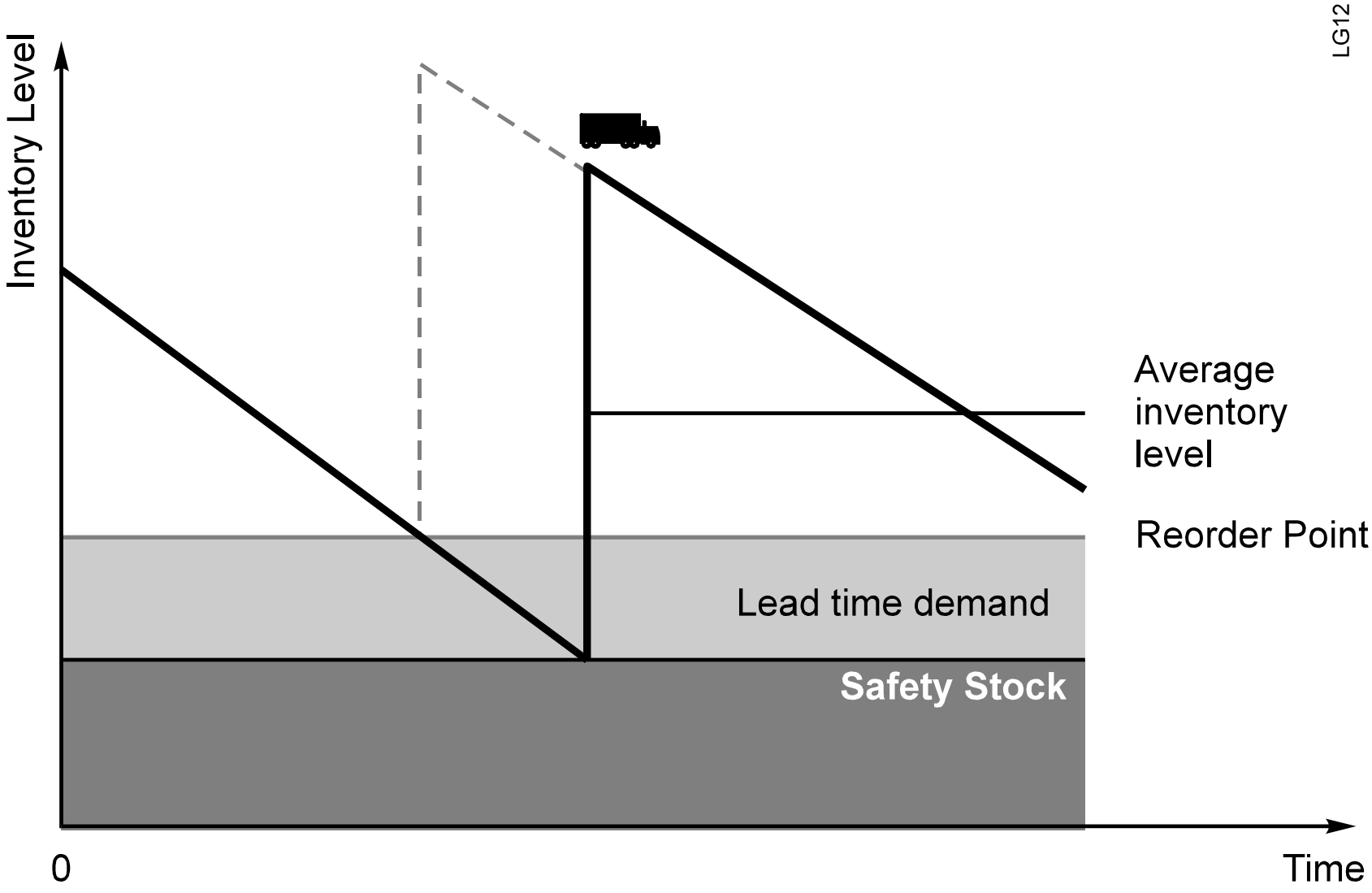


Without Safety Stock

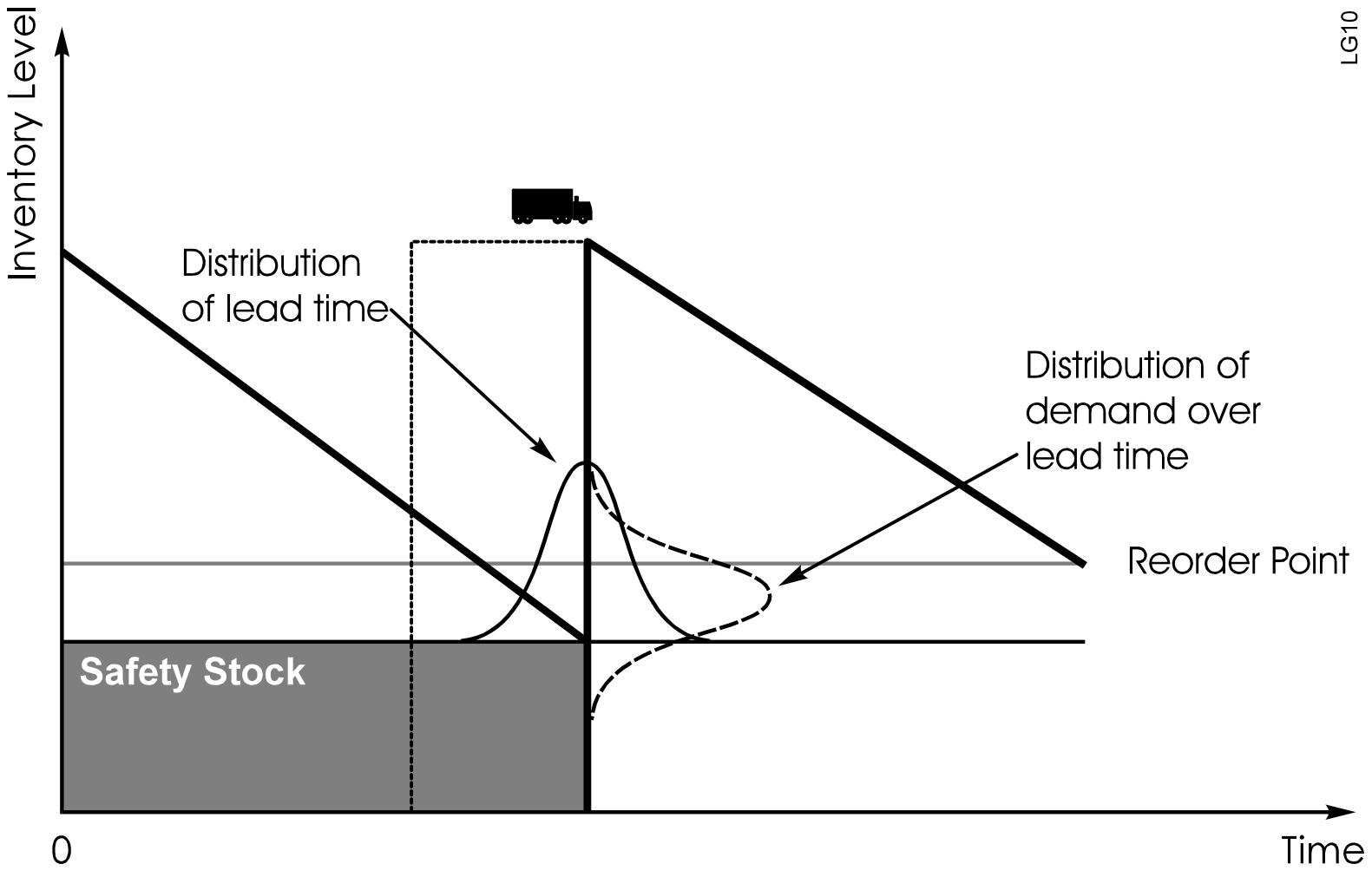


With Safety Stock

LG12



Inventory/Time with ROP



Lead Time Variability

Reorder Point With Variable Demand

$$R = \bar{d}L + z\sigma_d\sqrt{L}$$

where

$\bar{d}$ = average daily demand

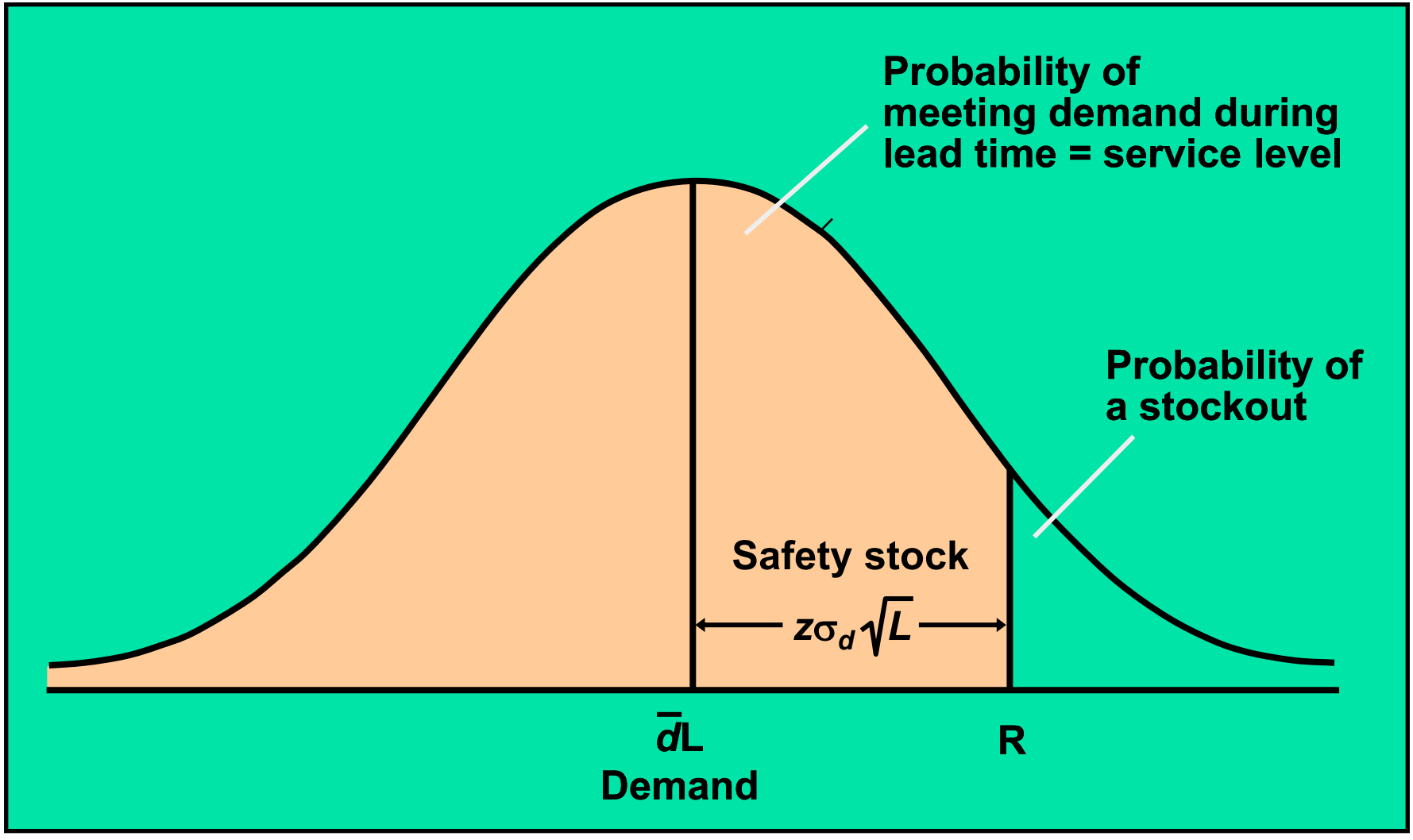
L = lead time

σ_d = the standard deviation of daily demand

z = number of standard deviations corresponding to the service level probability

$z\sigma_d\sqrt{L}$ = safety stock

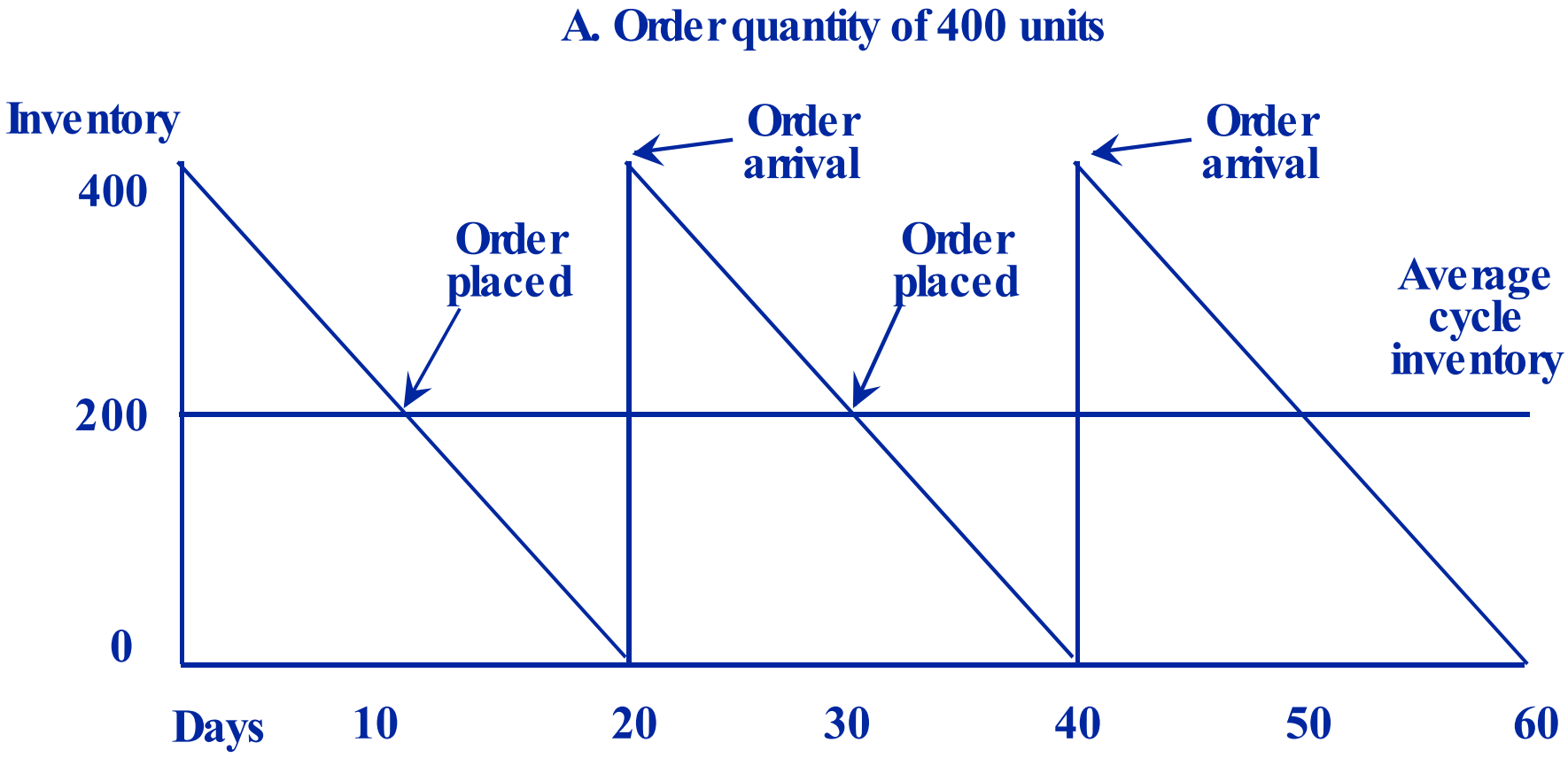
Reorder Point for a Service Level



Economic Order Quantity (EOQ) Model

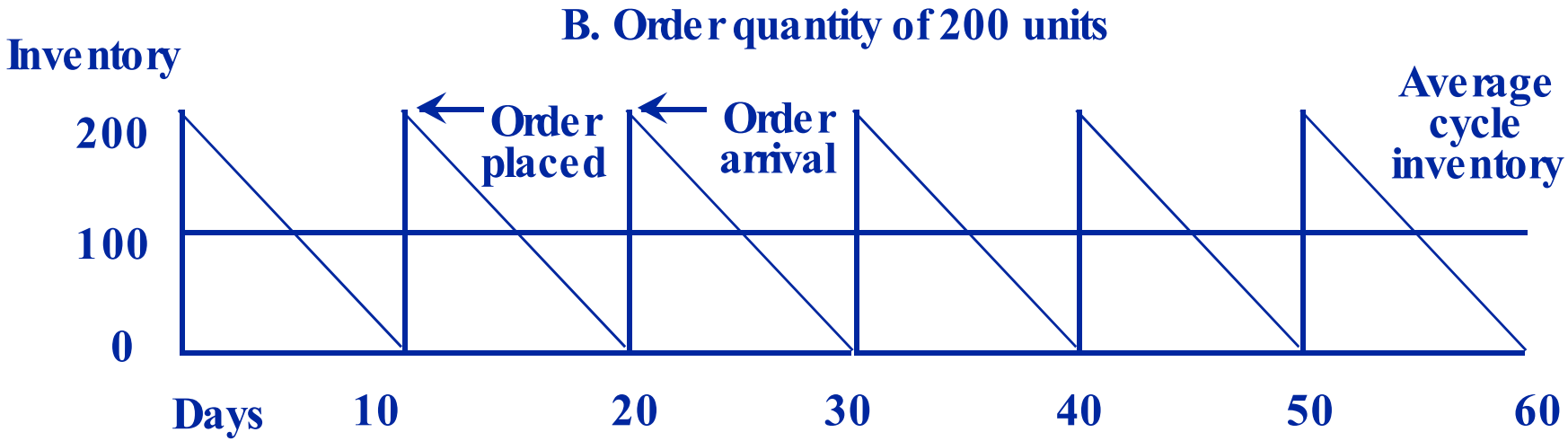
The Effect of Reorder Quantity on Average Inventory Investment with Constant Demand and Lead Time

Demand = 20 units/day

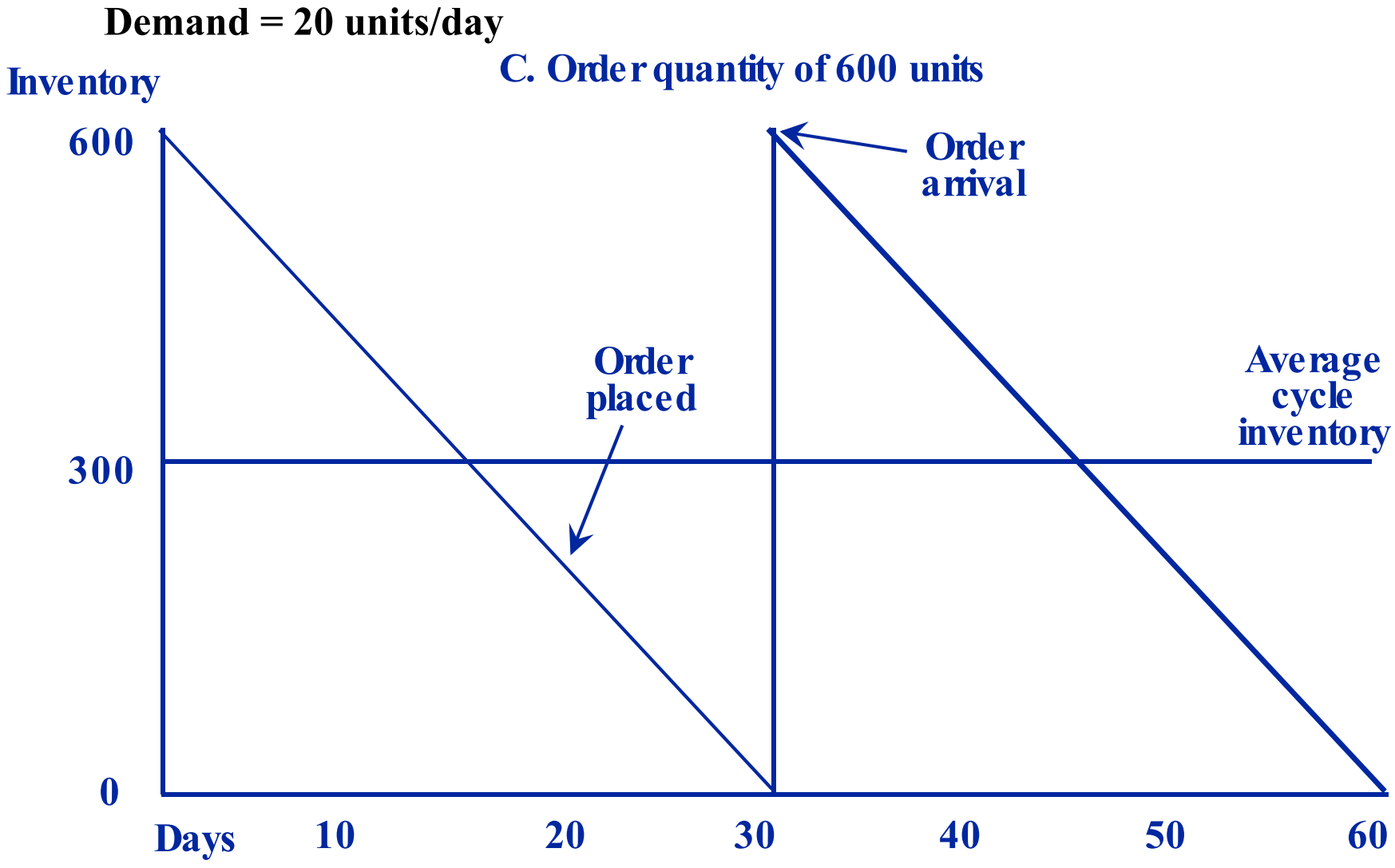


The Effect of Reorder Quantity on Average Inventory Investment with Constant Demand and Lead Time

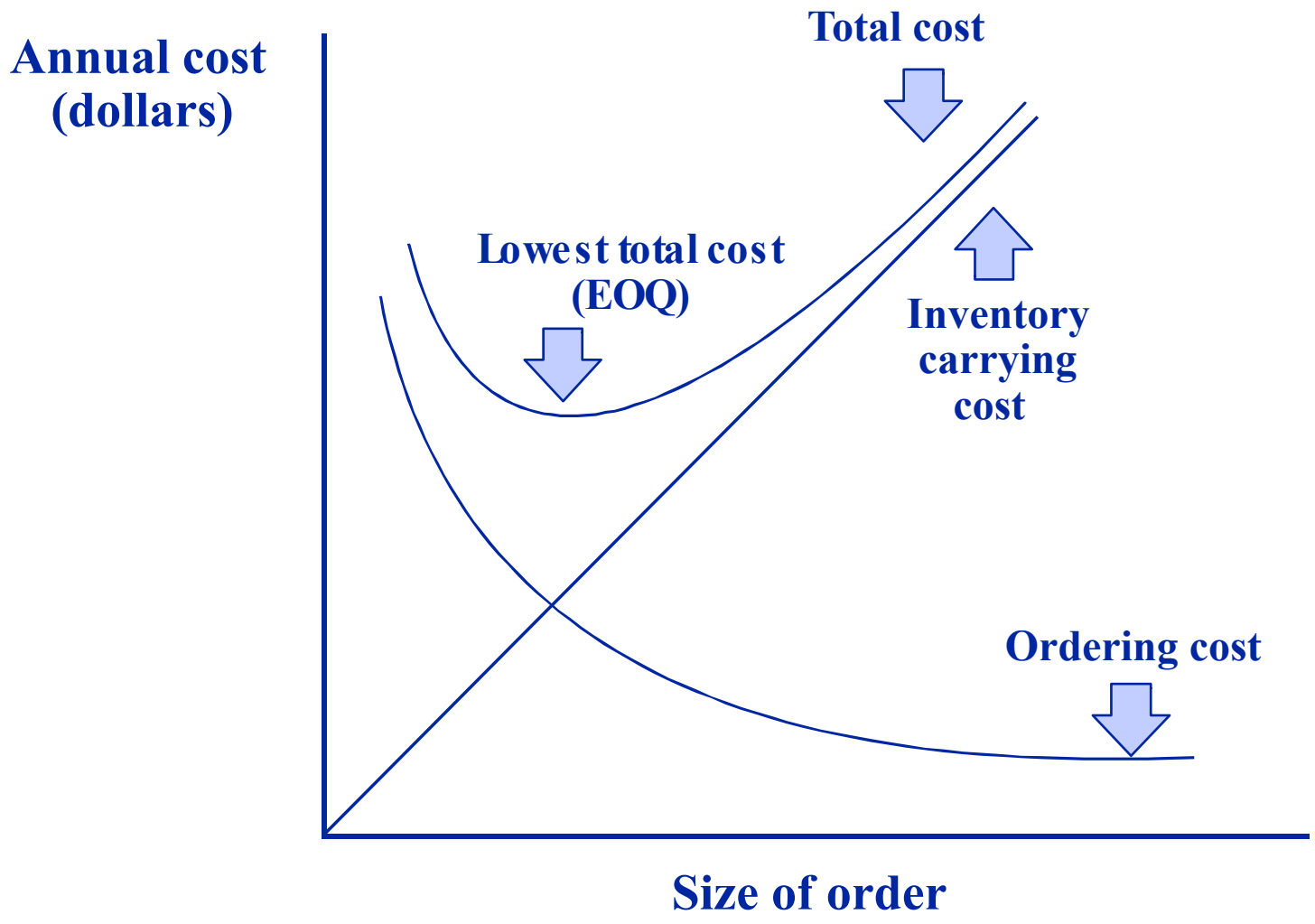
Demand = 20 units/day



The Effect of Reorder Quantity on Average Inventory Investment with Constant Demand and Lead Time



Cost Trade-offs Required to Determine the Most Economic Order Quantity



Inventory Carrying Costing: based on % of Product Value

Cost	Percentage of Product Value
Opportunity	12 %
Shrinkage	8
Tax/Insurance	3
Storage/Handling	2
Total	25 %

EOQ Cost Model

C_o - cost of placing order
C_c - annual per-unit carrying cost
D - annual demand
Q - order quantity

$$\text{Annual ordering cost} = \frac{C_o D}{Q}$$

$$\text{Annual carrying cost} = \frac{C_c Q}{2}$$

$$\text{Total cost} = \frac{C_o D}{Q} + \frac{C_c Q}{2}$$

EOQ Cost Model

Deriving Q_{opt}

$$TC = \frac{C_o D}{Q} + \frac{C_c Q}{2}$$

$$\frac{\partial TC}{\partial Q} = \frac{C_o D}{Q^2} + \frac{C_c}{2}$$

$$0 = \frac{C_0 D}{Q^2} + \frac{C_c}{2}$$

$$Q_{opt} = \sqrt{\frac{2C_o D}{C_c}}$$

Proving equality of costs at optimal point

$$\frac{C_o D}{Q} = \frac{C_c Q}{2}$$

$$Q^2 = \frac{2C_o D}{C_c}$$

$$Q_{opt} = \sqrt{\frac{2C_o D}{C_c}}$$

EOQ Example

C_c = \$0.75 per yard C_o = \$150 D = 10,000 yards

$$Q_{opt} = \sqrt{\frac{2C_oD}{C_c}}$$

$$TC_{min} = \frac{C_oD}{Q} + \frac{C_cQ}{2}$$

$$Q_{opt} = \sqrt{\frac{2(150)(10{,}000)}{(0.75)}}$$

$$TC_{min} = \frac{(150)(10{,}000)}{2{,}000} + \frac{(0.75)(2{,}000)}{2}$$

Q_{opt} = 2,000 yards

TC_{min} = \$750 + \$750 = \$1,500

Orders per year = D/Q_{opt}
= 10,000/2,000
= 5 orders/year

Order cycle time = 311 days/(D/Q_{opt})
= 311/5
= 62.2 store days

Economic Order Quantity (EOQ) Models

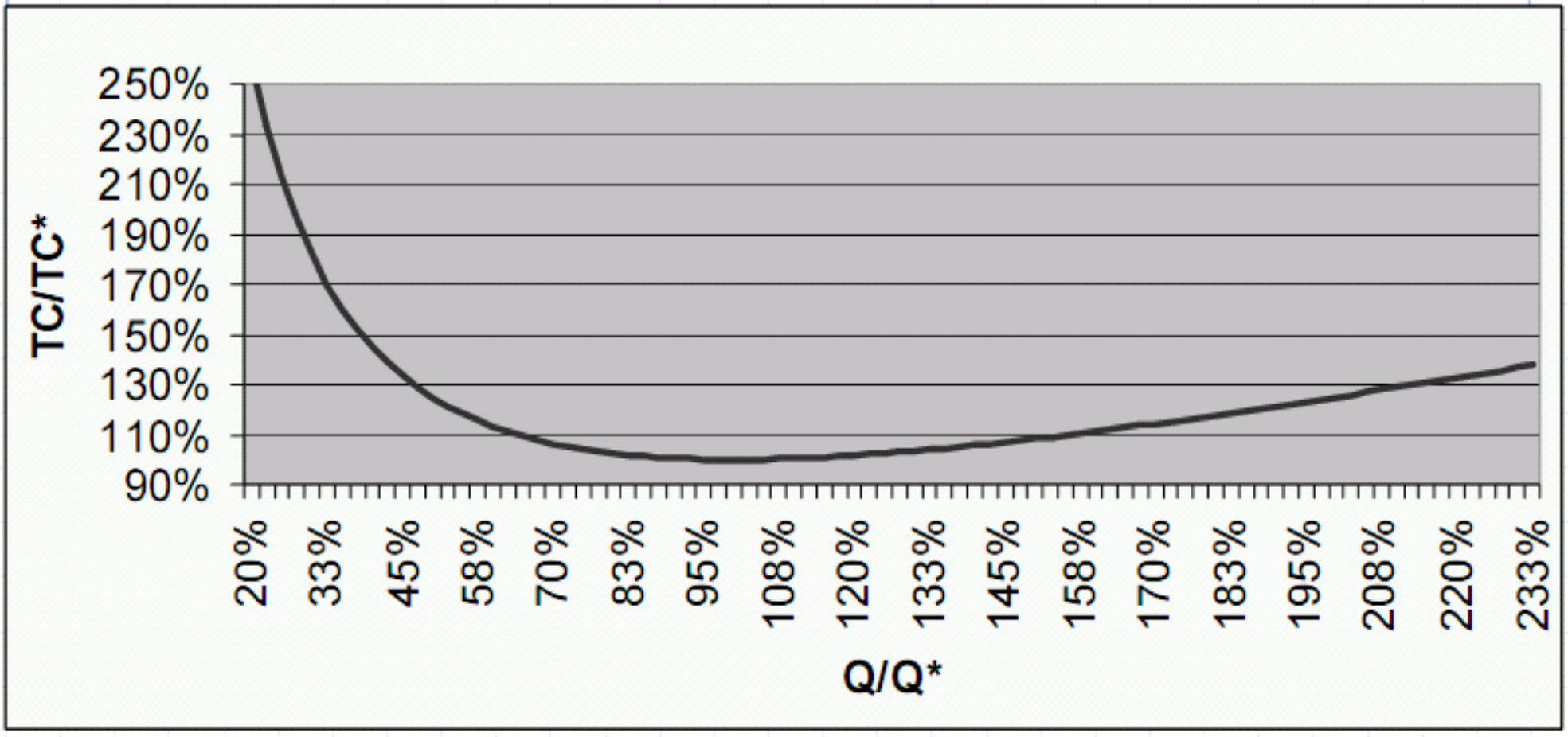
➢ *Basic EOQ Model: assumptions*

- *Orders arrive in a single shipment*
- *No quantity discounts (i.e., single price)*
- *Demand rate is constant*
- *No constraints on order size*
- *relevant costs include only holding and ordering/setup*
- *Ordering decisions for items are independent from other items.*
- *No uncertainty in lead time or supply*

Cost Trade-offs Required to Determine the Most Economic Order Quantity

Order Quantity	Number of Orders (D/Q)	Ordering Cost P*(D/Q)	Inventory Carrying Cost 1/2 (Q*C*V)	Total Cost
40	120	$ 4,800	$ 500	$ 5,300
60	80	3,200	750	3,950
80	60	2,400	1,000	3,400
100	48	1,920	1,250	3,170
120	40	1,600	1,500	3,100
140	35	1,400	1,750	3,150
160	30	1,200	2,000	3,200
200	24	960	2,500	4,460
300	18	720	3,750	4,470
400	12	480	5,000	5,480

Sensitivity Analysis of EOQ

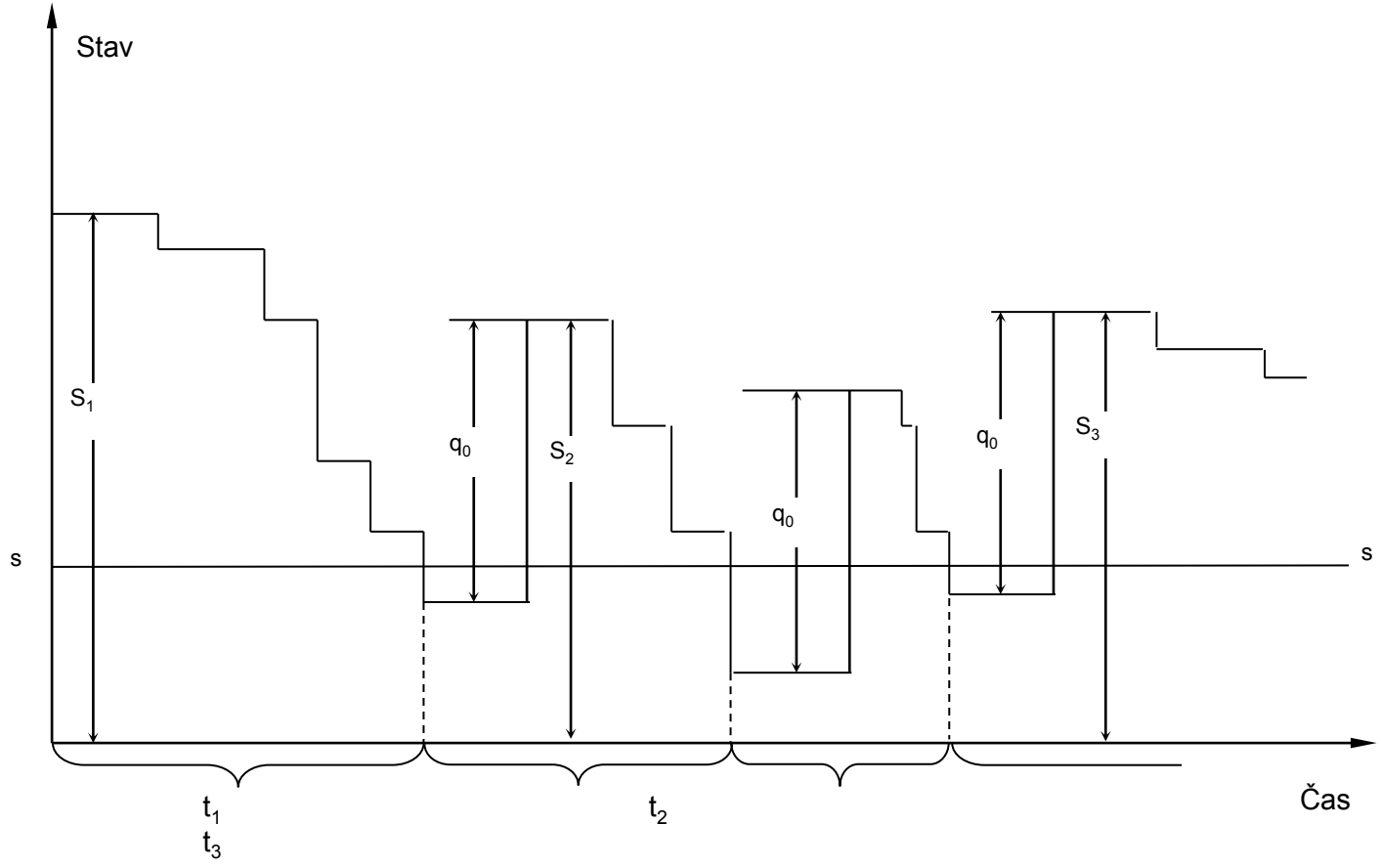


How much will TC change if I order lot size 50% larger than optimal?
How much will TC change if I order lot size 50% smaller than optimal?

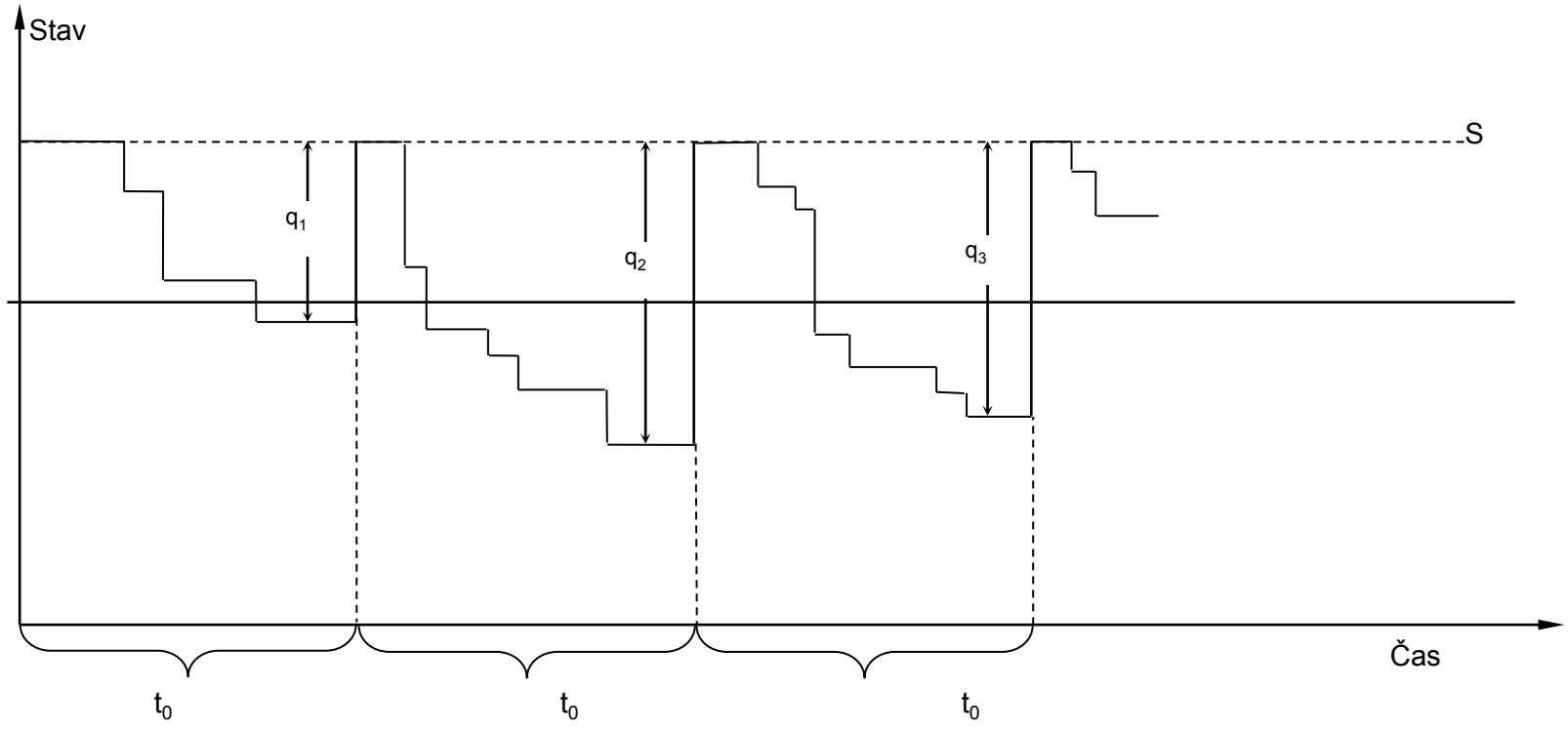
Inventory Control Systems

- Continuous system (fixed-order-quantity)
  - constant amount ordered when inventory declines to predetermined level
- Periodic system (fixed-time-period)
  - order placed for variable amount after fixed passage of time

Objednávání fixního množství k proměnlivému okamžiku Continuous system - označení (B,Q) nebo (s,Q)



Objednávání variabilního množství k pevně stanovenému okamžiku označení Periodic system - (s,S) nebo (R,S)



Two Forms of Demand

- Dependent
  - Demand for items used to produce fina products
  - Tires stored at a Goodyear plant are ar example of a dependent demand item
- Independent
  - Demand for items used by external customers
  - Cars, appliances, computers, and houses are examples of independent demand inventory