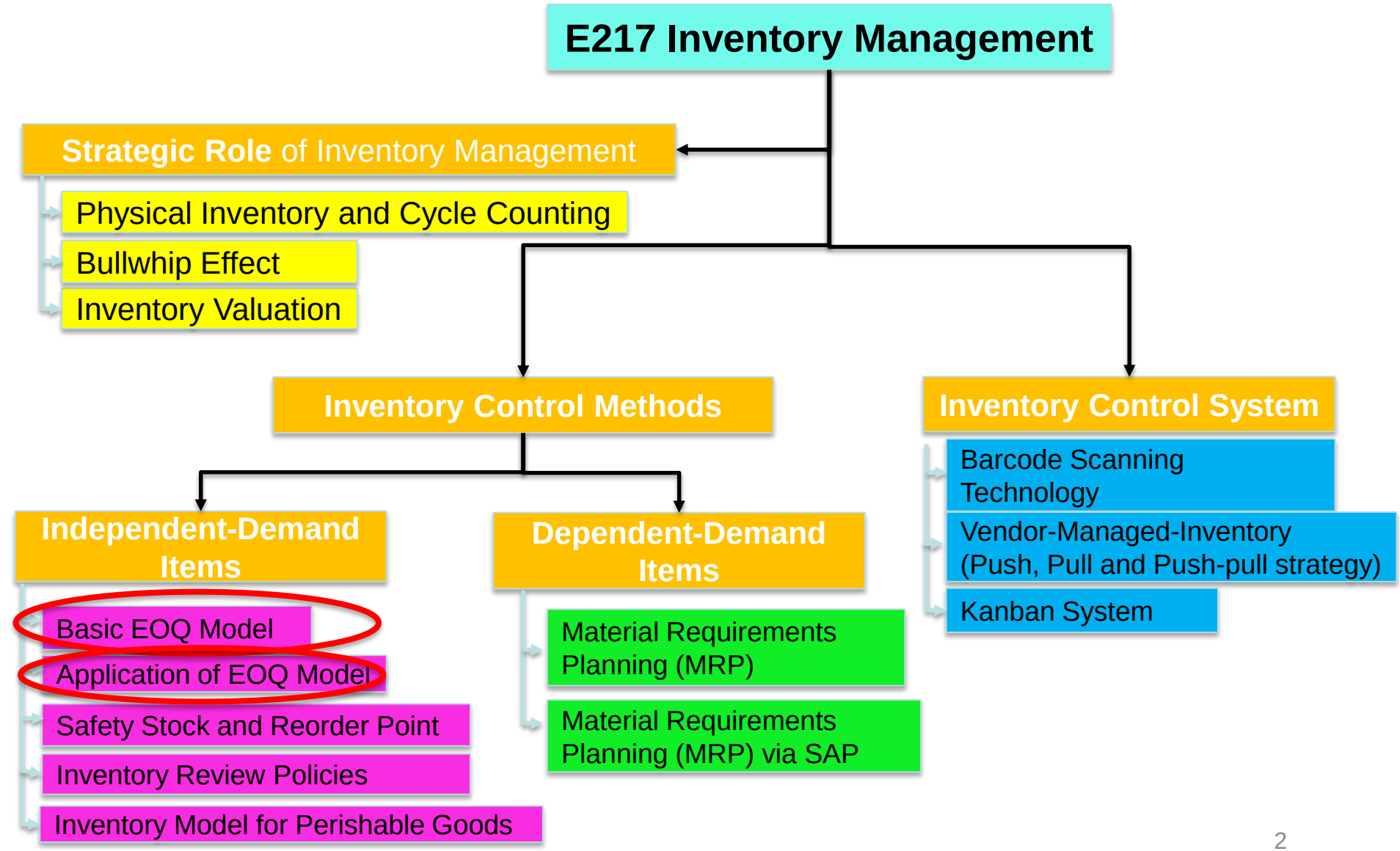
P02

Discount more, buy more?

E217 – Inventory Management

SCHOOL OF ENGINEERING

E217 Inventory Management Topic Tree



Relevancy of The Basic EOQ Model

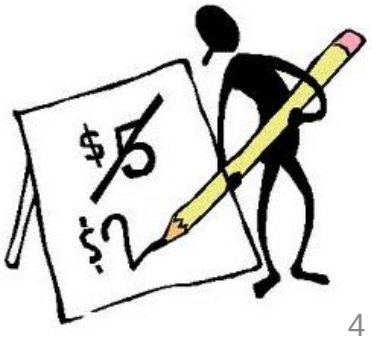
Relating to the assumptions of the EOQ Model that you learnt in Problem 1 and considering today's problem:

- Ordering & holding costs are assumed to be fixed in the basic EOQ model.
  - *But in reality, these costs vary according to the stock and ordering situations*

- Customer demand is assumed to be constant in the basic EOQ model.
  - *But in reality, demand fluctuates and may not be independent over time.*

Relevancy of The Basic EOQ Model

- The basic EOQ model assumes that the unit cost of the item remains unchanged regardless of the ordered quantity.
  - *In reality, quantity discounts may be given for the purchasing price due to bulk purchase or saving in transportation costs.*
  - *Hence, we need to modify the basic EOQ Model to cope with the situations of quantity discounts.*
  - *For today's problem, Tristan could make a comparison of the Total Cost (TC) curves for the quantity discounts offered.*



Pros and Cons of the Basic EOQ Model

Pros of EOQ

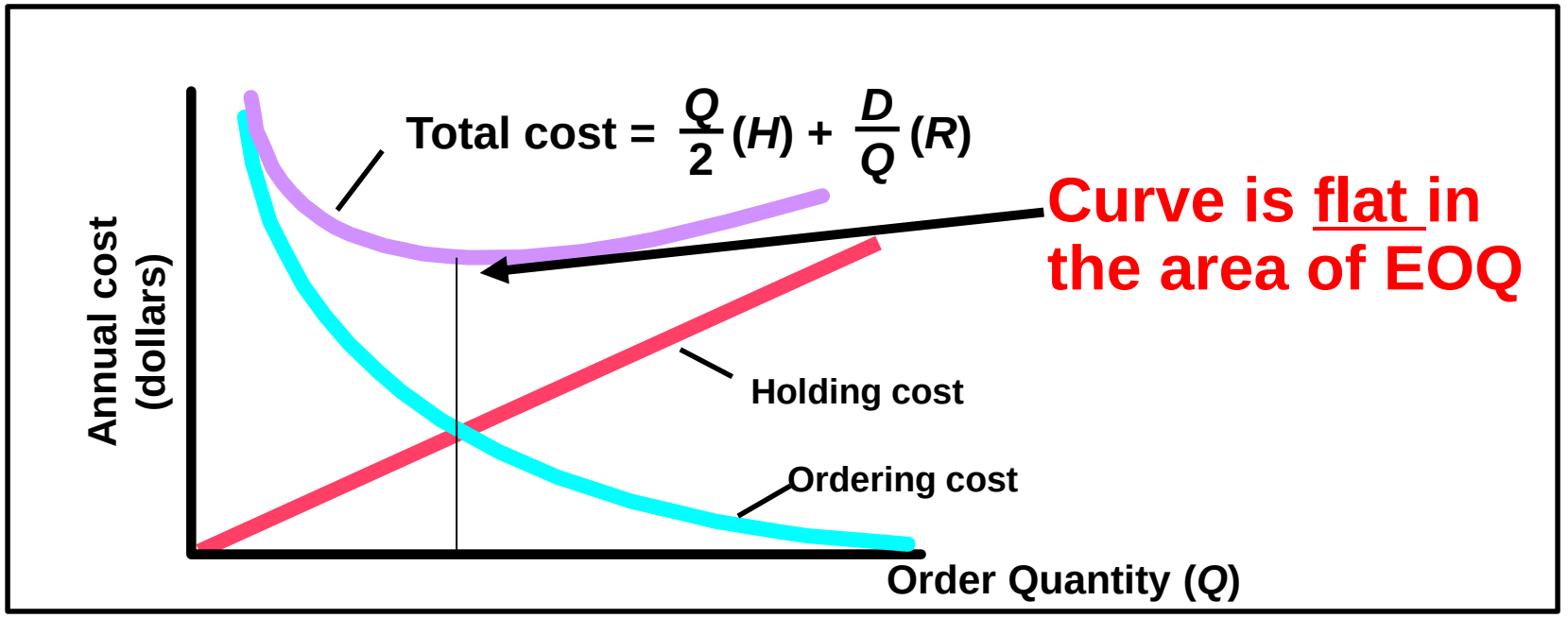
- Suitable for independent demand instead of dependent demand items
- Easy and quick estimate of order size
- Can be modified to take into account things like variable lead time, safety stock, finite replenishment, etc.

Cons of EOQ

- Q* is usually not an integer answer
- Not able to place orders of different items together (to save cost and facilitate procurement)
- Suppliers or manufacturers may supply goods in batches

EOQ Model is Robust!

- The EOQ model is fairly robust.
- It gives satisfactory answers even with substantial variation in its parameters (e.g. order cost – R , demand – D)
- We can observe from the graph that the curve portion for Total Cost around the turning point is **flat** and **not sensitive to changes in order quantity**



MOQ

- MOQ is the minimum order quantity
- Generally it is used when supplier wants customer to order sufficient quantity to justify either setup cost, delivery cost or administration cost.

Common examples are:

0.1mm metal sheet 304 stainless steel plate used in building materials

FOB **Reference** Price: Get Latest Price

US $600-2,000 / Ton | 1 Ton/Tons (Min. Order)

Supply Ability: 250000 Ton/Tons per Year

Port: Qingdao port or Tianjin port

Contact Supplier

Chat Now!

Seller Support: Trade Assurance – To protect your orders from payment to delivery

Payment: VISA TT e-Checking More

Shipping: Less than Container Load (LCL) Service to US Get shipping quote

• Transparent and fair price • 24/7 online support • Online tracking

Alibaba.com Global trade starts here.™ | Products | What are you looking for...

About 12096 results: Keyboards (8616) , Keyboard Mouse Combos (511) , Mouse Pads (262) , Mouse (533)

Home > Products > Computer Hardware & Software > Mouse & Keyboards > Keyboards **(208258)**

2015 Professional Mechanical Gaming Keyboard

FOB Price: Get Latest Price

Min.Order Quantity: 50 Piece/Pieces

Supply Ability: 50000 Piece/Pieces per Month

Port: Guangzhou

Payment Terms: L/C,T/T,Western Union,Paypal

Quantity: 50 Piece/Pieces

Please write your requirement here.

Recommend matching suppliers if this supplier doesn't contact me on Mes
hours.

EOQ Model with Quantity Discount

- Quantity discount is simply a decreased unit cost for an item when it is purchased in larger quantities. Suppliers often offer discounts for large orders to entice buyers to purchase in bulk.
- Buyers must weigh the potential benefits of reduced unit price and fewer orders from larger order quantities against the increased holding cost caused by higher average inventories.
- Include the purchase cost in the basic EOQ model, minimize the following equation:

  Total cost = Holding Costs + Ordering Costs + Material costs
  Total cost = (Q/2)*H + (D/Q)*R + P*D
  where P = per unit cost price

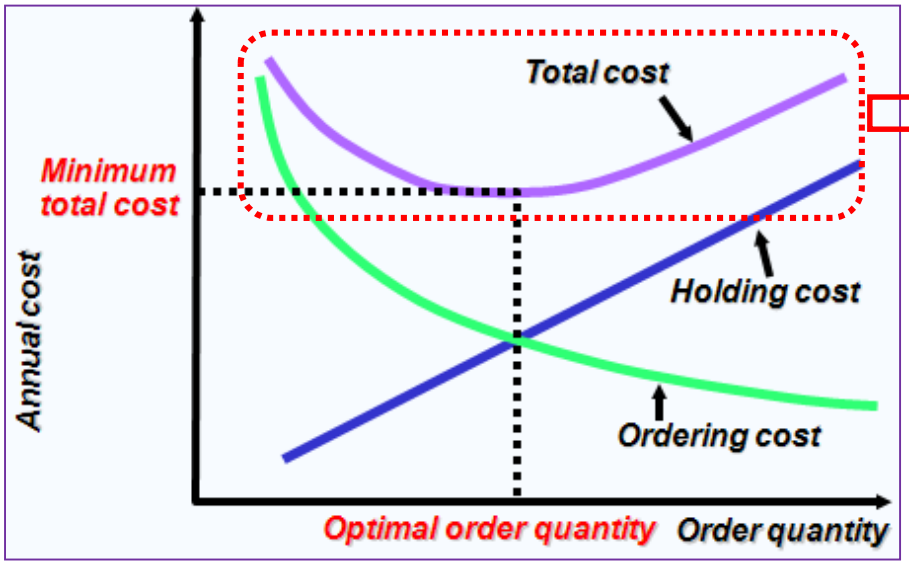
- For the optimal order quantity, the annual holding and ordering costs are not necessarily equal.

EOQ Model with Quantity Discount

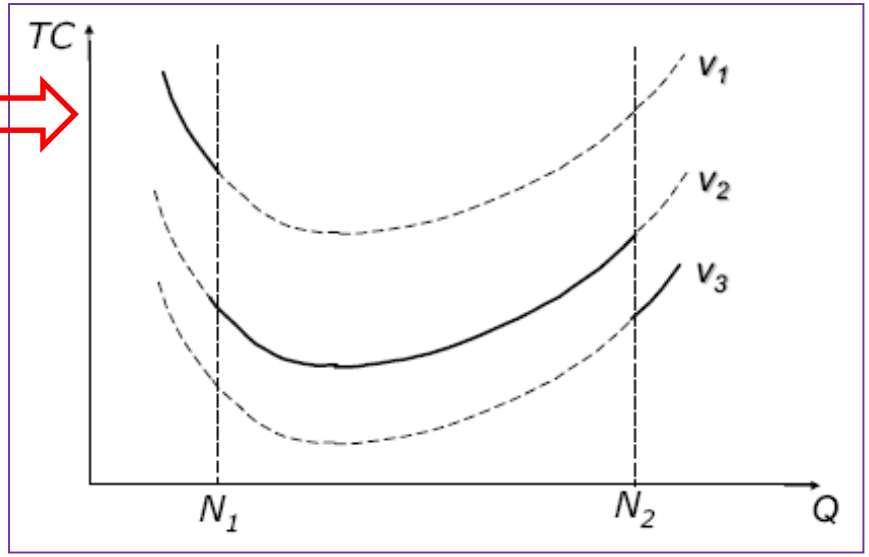
Assumptions:

- Demand occurs at a constant rate per year
- Ordering Cost is constant per order
- Holding Cost is either constant or proportional to unit purchase price
- Purchase Cost varies according to order quantity
- Delivery time (lead time) is constant
- Ordered quantity arrives in full (no shortages).

EOQ Model with Quantity Discount



EOQ curve without Quantity Discount



EOQ curve with Quantity Discount

Suppose the supplier offers price breaks as follows:

- Cost price is V_1 if $Q < N_1$
- Cost price is V_2 if $N_1 \leq Q < N_2$
- Cost price is V_3 if $Q \geq N_2$

where Q is the order quantity

Determining the Q* and Lowest TC*

Step 1.

For each discount offer, calculate Optimal Order Quantity Q* by using $$Q^* = \sqrt{\frac{2RD}{H}}$$

Step 2.

If Q* for a discount doesn't qualify, choose the best possible order size to get the discount

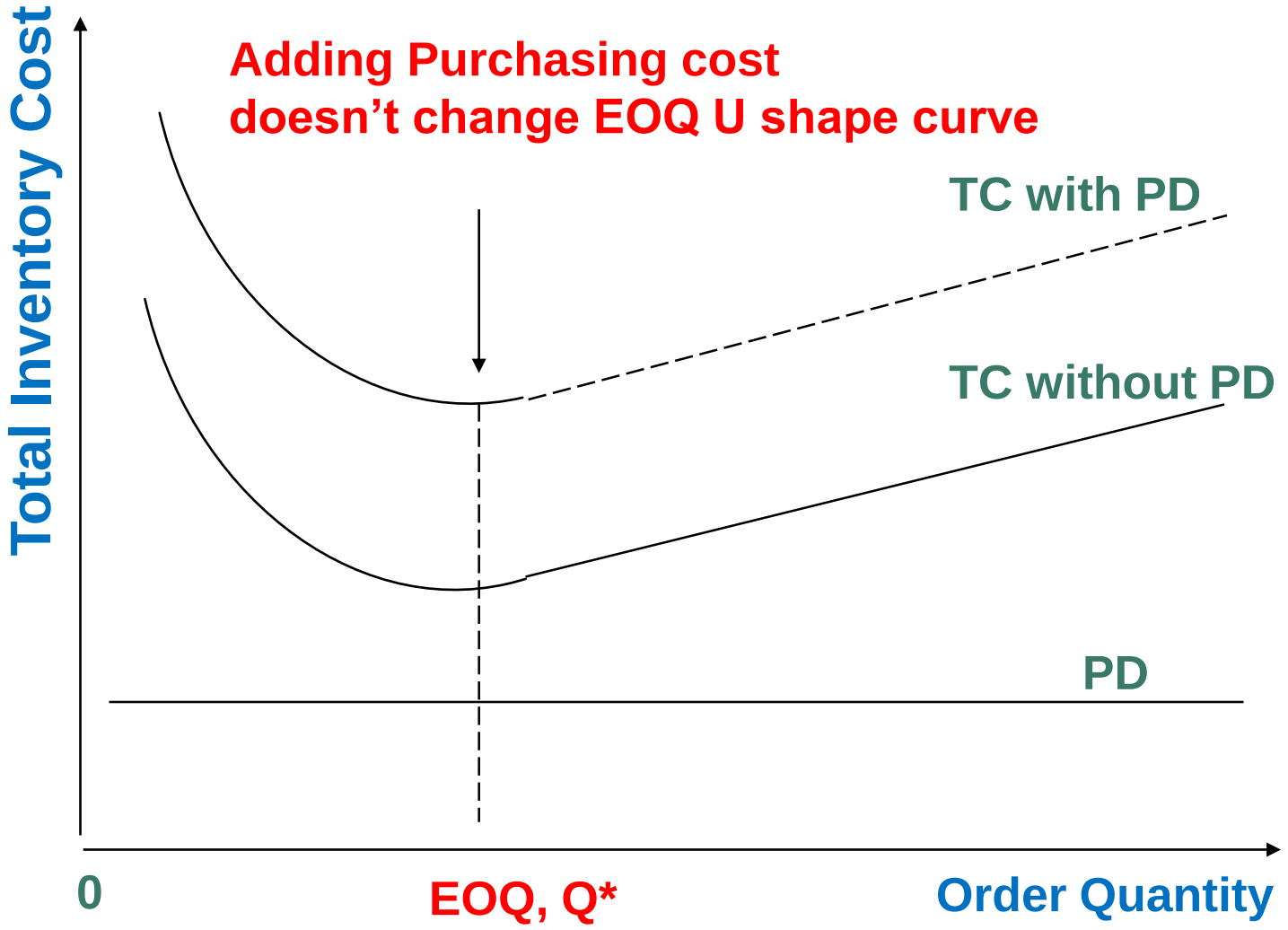
Step 3.

Compute the total cost for each Q* or adjusted order quantity from Step 2 by using $$TC = \frac{D}{Q}R + \frac{Q}{2}H + PD$$

Step 4.

Select the Q* that gives the lowest total cost

Additional study on effect of P*D on Total Inventory Cost (TC)



Recommendations for Today's Problem

$5.00 when Q < 12,500 (≥ 5000 of MOQ)

Optimal Order Quantity,

$$Q_1 = \sqrt{\frac{2RD}{H}} = \sqrt{\frac{2\times 2{,}000\times 20{,}000}{25\%\times 5.00}} = 8{,}000$$

$TC_1^* = (Q_1^*/2)^*H + (D/Q_1^*)^*R + P^*D$

$= (8{,}000/2)^*25\%^*5 + (20{,}000/8{,}000)^*2{,}000 + 5^*20{,}000$

$= \$1100{,}000$

This optimal order quantity is 8,000 (within the quantity-price range)

The lowest total cost for this case is **$110,000** at

$Q_1^* = 8{,}000$

Recommendations for Today's Problem

V_2 = $4.85 when 12,500 ≤ Q < 20,000

Optimal Order Quantity,

$$Q_2 = \sqrt{\frac{2RD}{H}} = \sqrt{\frac{2\times2{,}000\times20{,}000}{25\%\times4.85}} = 8{,}122$$

This optimal order quantity of 8,122 is **NOT feasible** as the price validity applies to quantity range between 12,500 and 20,000.

Adjusted order quantity 12,500 is chosen as it gives the lowest total cost on the curve.

TC_2^* = $(Q_2^*/2)*H + (D/Q_2^*)*R + P*D$
= (12,500/2)*25%*4.85 + (20,000/12,500)*2,000 + 4.85*20,000
= $107,778

Hence, the minimum total cost is **$107,778** at **$Q_2^* = 12{,}500$**

Recommendations for Today's Problem

V_3 = $4.75 when Q ≥ 20,000

Optimal Order Quantity,

$$Q_3 = \sqrt{\frac{2RD}{H}} = \sqrt{\frac{2\times2{,}000\times20{,}000}{25\%\times4.75}} = 8{,}208$$

This optimal order quantity of 8,208 is **NOT feasible** as the price validity applies to quantity range ≥ 20,000.

Adjusted order quantity 20,000 is chosen as it gives the lowest total cost on the curve.

TC_3^* = $(Q_3^*/2)*H + (D/Q_3^*)*R + P*D$
= (20,000/2)*25%*4.75 + (20,000/20,000)*2,000 + 4.75*20,000
= $108,875

Hence, the minimum total cost is **$108,875** at **$Q_3^* = 20,000$**

Recommendations for Today's Problem

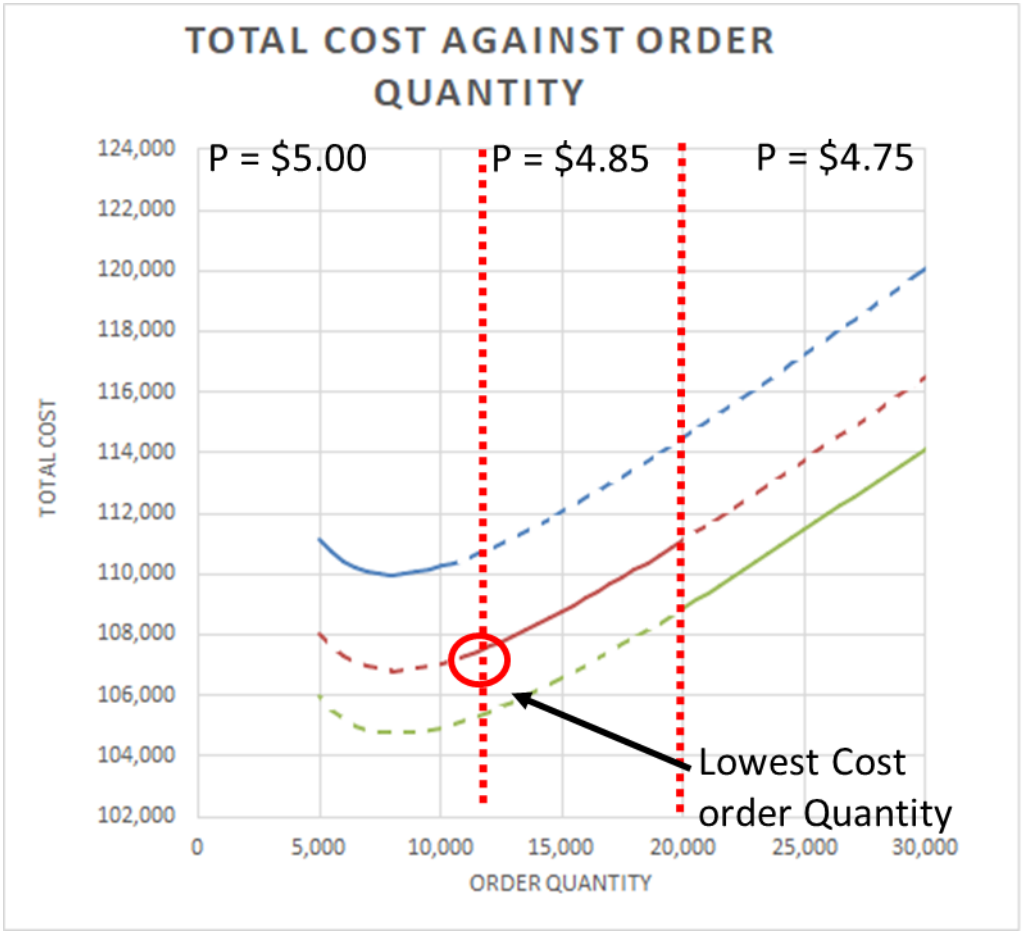
Quantity	MOQ (price breaks)	Unit Purchase Price	Optimal Order Qty	Adjusted order quantity	Ordering Costs	Material Costs	Holding Costs	**Total Costs**
5000~12500	5,000	5	8,000	8,000	5,000	100,000	5,000	$ 110,000
12500~20000	12,500	4.85	8,123	12,500	3,200	97,000	7,578	$ 107,778
≥20000	20,000	4.75	8,208	20,000	2,000	95,000	11,875	$ 108,875

Tristan could follow the below recommendations on the ordering of Grease:

- Overall Optimal Order Quantity is **12,500**
- Lowest Total Inventory Cost is **$107,778**
- Unit Purchase Price is **$4.85**

This example illustrates that the cheapest material cost may not be the overall lowest total cost

Today's Problem: Total Cost Curve



It can be seen clearly from the graph that $4.85, at order quantity 12,500 is the lowest cost.

However, the graph also suggest that if the overall demand grows, Tristan should study again whether to buy more than 20,000kg to get the 5% discount.

Practical Considerations of the EOQ Model

- EOQ is sufficiently robust for most independent demand items with stable demand (trendless) and lead time.
- EOQ is useful despite its highly restrictive assumptions
- Can be used as a quick estimation of the order size and total cost.
- In many practical situations quantity discounts exist, by taking advantage of it can result in substantial savings

Learning Objectives

- Describe the relevancy of the basic EOQ Model
- Describe the limitations of the basic EOQ Model
- Describe the robustness of the basic EOQ Model
- Apply quantity discount to the basic EOQ Model
- Calculate the optimal order quantity and optimal total costs for a given case-study
- Describe the practical considerations of the EOQ Model

E217 Inventory Management Topic Flow