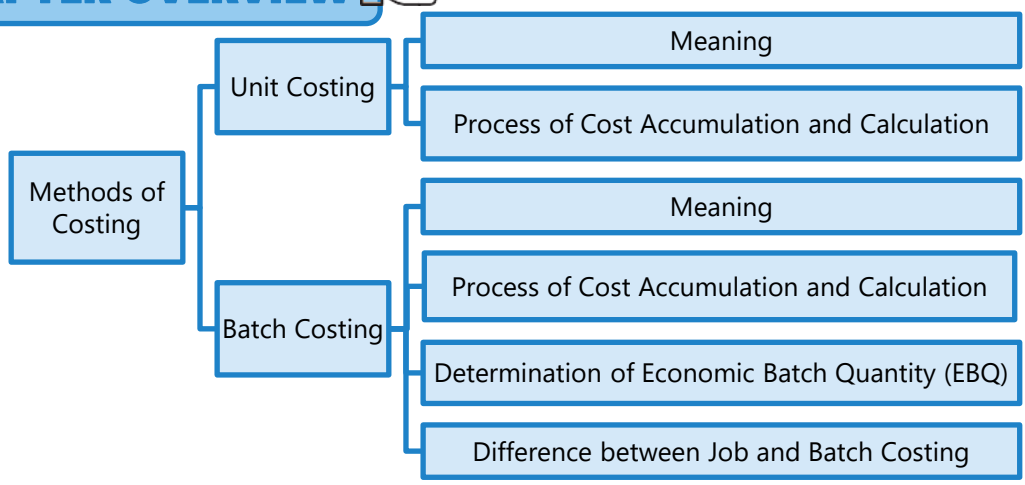
CHAPTER 8

UNIT & BATCH COSTING

LEARNING OUTCOMES

- Describe Unit Costing method.
- Prepare and calculate the cost under Unit Costing.
- Describe Batch Costing methods.
- Explain the accounting entries for cost elements under the method.
- Determine the cost for a batch
- Differentiate between Job Costing and Batch Costing.

CHAPTER OVERVIEW



1. INTRODUCTION

So far, we have discussed in earlier chapters, the element wise cost collection, calculation and its accounting under integral and non- integral accounting systems. Now we will discuss how the cost accounting information can be presented and used according the needs of the management. To fulfil the need of the users of the cost accounting information, different methods of costing are followed. Costing methods enable the users to have customized information of any cost object according to the need and suitability. Different methods of costing have been developed according to the needs and nature of industries. For the sake of simplicity, industries can be grouped into two basic types i.e. Industries doing job work and industries engaged in mass production of a single product or identical products.

1.1 For industry doing job work

An entity which is engaged in the execution of special orders, each order being distinguishable from each other, such a concern is thought of involved in performing job works. Jobs are worked strictly in accordance with the customer's specifications and requirements, thus, each job order is unique. Examples of job order types of production are: ship building, construction of road and bridges, manufacturing of heavy electrical machineries and tools, wood and furniture works etc. Here, each job or unit of production is treated as a separate identity for the purpose of costing. The methods of costing for ascertaining cost of each job are known as a job costing, contract costing and batch costing.

1.2 For continuous or process type of industries

The continuous or process type of industries are characterised by the continuous production of uniform products according to the standard specifications. In such a case the successive lots are generally indistinguishable as to size and form and, even if there is some variation in specifications, it is of a minor character. Examples of continuous type of industries are chemical and pharmaceutical products, paper/food products, canning, paints and varnish oil, rubber, textile etc. Here the methods of costing used for the purpose of ascertaining costs are: process costing; single output costing; operating costing etc.

In this chapter two methods of costing are being discussed and distinguished from each type. Other methods will also be discussed in subsequent chapters.

2. UNIT COSTING

Unit costing is that method of costing where the output produced is identical and each unit of output requires identical cost. Unit costing is synonymously known as single or output costing, but these are sub-division of unit costing method. This method of costing is followed by industries which produce single output or few variants of a single output. Under this method costs, are collected and analysed element wise and then total cost per unit is ascertained by dividing the total cost with the number of units produced. If we have to state it in the form of a formula, then

$$\text{Cost per unit} = \frac{\text{Total Cost of Production}}{\text{No. of units produced}}$$

This method of costing, therefore finds its application in industries like paper, cement, steel works, mining, breweries etc. These types of industries produce identical products and therefore have identical costs.

3. COST COLLECTION PROCEDURE IN UNIT COSTING

The cost for production of output is collected element wise and posted in the cost accounting system for cost ascertainment. The element-wise collection is done as below:

Collection of Materials Cost

Cost of materials issued for production are collected from Material Requisition notes and accumulated for a certain period or volume of activity. The cost of material so accumulated is posted in cost accounting system. Through the cost accounting system, cost sheet for the period or activity is prepared to know cost for the period element-wise and functions-wise.

Collection of Employees (Labour) Cost

All **direct employee (labour) cost is collected from job time cards or sheets** and accumulated for a certain period or volume of activity. The time booked or recorded in the job time and idle time cards is valued at appropriate rates and entered in the cost accounting system. Other items of indirect employee (labour) costs are collected from the payrolls books for the purpose of posting against standing order or expenses code numbers in the overhead expenses ledger.

Collection of Overheads

Overheads are collected under suitable standing orders numbers, and selling and distribution overheads against cost accounts numbers. Total overhead expenses so collected are apportioned to service and production departments on some suitable basis. The expenses of service departments are finally transferred to production departments. The total overhead of production departments is then applied to products on some realistic basis, *e.g.* machine hour; labour hour; percentage of direct wages; percentage of direct materials; etc.

3.1 Treatment of spoiled and defective work

Circumstances	Treatment
(1) Loss due to normal reasons	When a normal rate of defectives has already been established and actual number of defectives is within the normal limit, **the cost of rectification or loss will be charged to the entire output**. If, on the other hand, the number of defective units substantially exceeds the normal limits, the cost of rectification or loss beyond normal limits are written off in Costing Profit and Loss Account.
(2) Loss due to abnormal reasons	In this case cost of rectification and loss is treated as abnormal cost and the **cost of rectification or loss is written off as loss in Costing Profit and Loss Account.**

ILLUSTRATION 1

The following data relate to the manufacture of a standard product during the 4-week ended 28th February:

Raw Materials Consumed	*₹ 4,00,000*
Direct Wages	*₹ 2,40,000*
Machine Hours Worked	*3,200 hours*
Machine Hour Rate	*₹ 40*
Office Overheads	*10% of works cost*
Selling Overheads	*₹ 20 per unit*
Units produced and sold	*10,000 at ₹ 120 each*

You are required to FIND OUT the cost per unit and profit for the 4-week ended 28th February.

SOLUTION

Statement of Cost per Unit **No. of units produced: 10,000 units**

Particulars	**Cost per unit (₹)**	**Amount (₹)**
Raw Materials Consumed	40.00	4,00,000
Direct Wages	24.00	2,40,000
Prime cost	64.00	6,40,000
Add: Manufacturing Overheads (3,200 hours × ₹ 40)	12.80	1,28,000
Works cost	76.80	7,68,000
Add: Office Overheads (10% of Works Cost)	7.68	76,800
Cost of goods sold	84.48	8,44,800
Add: Selling Overheads (10,000 units × ₹ 20)	20.00	2,00,000
Cost of sales / Total cost	104.48	10,44,800
Add: Profit (Bal Figure)	15.52	1,55,200
Sales	120.00	12,00,000

ILLUSTRATION 2

Atharva Pharmacare Limited produced a uniform type of product and has a manufacturing capacity of 3,000 units per week of 48 hours. From the records of the company, the following data are available relating to output and cost of 3 consecutive weeks

Week Number	Units Manufactured	Direct Material (₹)	Direct Wages (₹)	Factory Overheads (₹)
1	1,200	9,000	3,600	31,000
2	1,600	12,000	4,800	33,000
3	1,800	13,500	5,400	34,000

Assuming that the company charges a profit of 20% on selling price, FIND OUT the selling price per unit when the weekly output is 2,000 units

SOLUTION

Statement of Cost and Selling price for 2,000 units of output

Particulars	Cost per unit (₹)	Total Cost (₹)
Direct Materials	7.50	15,000
Direct Labour	3.00	6,000
Prime cost	10.50	21,000
Add: Factory Overheads (Refer working note-2)	17.50	35,000
Total cost	28.00	56,000
Add: Profit (20% of Sales is equivalent to 25% of Cost)	7.00	14,000
Sales	35.00	70,000

Working Notes:

(1) Direct Material and Direct Labour cost is varying directly in proportion to units produced and shall remain same per unit of output. Thus, direct material cost is equal to ₹ 9000 ÷ 1200 units = ₹ 7.50 per unit and labour cost is equal to ₹ 3600 ÷ 1200 units = ₹ 3 per unit.

(2) Calculation of Factory Overheads- An observation of cost related to different output levels for factory overheads shall reveal 2 things

a. Total cost increases from ₹31,000 to ₹34,000 along with increase in output from 1,200 units to 1,800 units but cost per unit is not constant. Thus it is not a variable cost.Cost per unit is reducing along with increase in output from ₹ 25.83 (₹ 31,000 ÷ 1,200 units) to ₹ 18.89 (₹34,000 ÷ 1,800 units)

b. Since the cost is varying with the output, it is also not a fixed cost.

Hence, we can see that the cost is a semi- variable cost and has to be calculated for 2,000 units by analysing its fixed and variable components

Week Number	Units Manufactured	Factory Overheads
1	1,200	31,000
2	1,600	33,000
Difference	400	2,000

Therefore, Variable Cost per unit = Change in Factory Overheads ÷ Change in output

= ₹2,000 ÷ 400 = ₹5

Now total factory overheads for week 2 = ₹33,000

Out of this, Variable Overheads = 1,600 units × ₹5 = ₹ 8,000

Thus, fixed component = ₹ 33,000 – ₹ 8,000 = ₹ 25,000

Therefore, Variable Cost for 2,000 units = 2,000 units × ₹5 = ₹ 10,000

Fixed Cost will not change and hence will be = ₹25,000

Therefore, Total Factory Cost = Variable Overheads + Fixed Overheads

Overheads for 2,000 units = ₹10,000 + ₹25,000 = ₹ 35,000

4. BATCH COSTING

Batch Costing is a type of specific order costing where articles are manufactured in predetermined lots, known as batch. Under this costing method, the cost object for cost determination is a batch for production rather output as seen in unit costing method.

A batch consists of certain number of units which are processed simultaneously to be for manufacturing operation. Under this method of manufacturing, the inputs are accumulated in the assembly line till it reaches minimum batch size. Soon after a batch size is reached, all inputs in a batch is processed for further operations. Reasons for batch manufacturing may be either technical or economical or both. For example, in pen manufacturing industry, it would be too costly to manufacture one pen of a particular design at a time to meet the demand of one customer. On the other hand, the production, of say 10,000 pens, of the same design will reduce the cost to a sizeable extent.

To initiate production process, an entity has to incur expenditures on engaging workers for production and supervision, setting-up of machine to run for production etc. These are the minimum level of expenditures which have to be incurred each time a batch is run irrespective of number of units produced.

5. Costing Procedure in Batch Costing

To facilitate convenient cost determination, one number is allotted for each batch. Material cost for the batch is arrived at on the basis of material requisitions for the batch and labour cost is arrived at by multiplying the time spent on the batch by direct workers as ascertained from time cards or job tickets. Overheads are absorbed on some suitable basis like machine hours, direct labour hours etc.

ILLUSTRATION 3

Arnav Confectioners (AC) owns a bakery which is used to make bakery items like pastries, cakes and muffins. AC use to bake at most 50 units of any item at a time. A customer has given an order for 600 muffins. To process a batch of 50 muffins, the following cost would be incurred:

Direct materials- ₹ 500

Direct wages- ₹ 50

Oven set- up cost ₹ 150

AC absorbs production overheads at a rate of 20% of direct wages cost. 10% is added to the total production cost of each batch to allow for selling, distribution and administration overheads.

AC requires a profit margin of 25% of sales value.

DETERMINE the selling price for 600 muffins.

SOLUTION

Statement of cost per batch and per order

No. of batch = 600 units ÷ 50 units = 12 batches

Particulars	Cost per batch (₹)	Total Cost (₹)
Direct Material Cost	500.00	6,000
Direct Wages	50.00	600
Oven set-up cost	150.00	1,800
Add: Production Overheads (20% of Direct wages)	10.00	120
Total Production cost	710.00	8,520
Add: S&D and Administration overheads (10% of Total production cost)	71.00	852
Total Cost	781.00	9,372
Add: Profit (1/3rd of total cost)	260.33	3,124
Selling price	1,041.33	12,496
Selling Price per unit = 1041.33÷ 50 = ₹ 20.83		

ILLUSTRATION 4

A jobbing factory has undertaken to supply 200 pieces of a component per month for the ensuing six months. Every month a batch order is opened against which materials and labour hours are booked at actual. Overheads are levied at a rate equal to per labour hour. The selling price contracted for is ₹ 8 per piece. From the following data CALCULATE the cost and profit per piece of each batch order and overall position of the order for 1,200 pieces.

Month	Batch Output	Material cost (₹)	Direct wages (₹)	Direct labour hours
January	*210*	*650*	*120*	*240*
February	*200*	*640*	*140*	*280*
March	*220*	*680*	*150*	*280*
April	*180*	*630*	*140*	*270*
May	*200*	*700*	*150*	*300*
June	*220*	*720*	*160*	*320*

The other details are:

Month	Overheads (₹)	Direct labour hours
January	*12,000*	*4,800*
February	*10,560*	*4,400*
March	*12,000*	*5,000*
April	*10,580*	*4,600*
May	*13,000*	*5,000*
June	*12,000*	*4,800*

SOLUTION

Particulars	Jan.	Feb.	March	April	May	June	Total
Batch output (in units)	210	200	220	180	200	220	1,230
Sale value (₹)	1,680	1,600	1,760	1,440	1,600	1,760	9,840
Material cost (₹)	650	640	680	630	700	720	4,020
Direct wages (₹)	120	140	150	140	150	160	860
Overheads* (₹)	600	672	672	621	780	800	4,145
Total cost (₹)	1,370	1,452	1,502	1,391	1,630	1,680	9,025
Profit per batch (₹)	310	148	258	49	(30)	80	815
Total cost per unit (₹)	6.52	7.26	6.83	7.73	8.15	7.64	7.34
Profit per unit (₹)	1.48	0.74	1.17	0.27	(0.15)	0.36	0.66

Overall position of the order for 1,200 units

Sales value of 1,200 units @ ₹ 8 per unit	₹ 9,600
Total cost of 1,200 units @ ₹ 7.34 per unit	₹ 8,808
Profit	₹ 792

$$* \frac{\text{Overheads}}{\text{Direct labour hour for the month}} \times \text{Direct labour hours for batch}$$

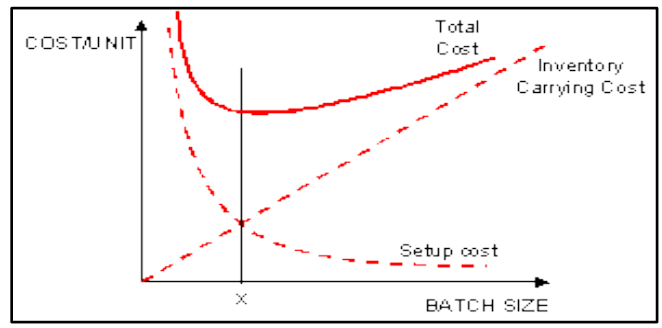
6. ECONOMIC BATCH QUANTITY (EBQ)

As the product is produced in batches or lots, the lot size chosen will be critical in achieving least cost of operation. Primarily, the total production cost under batch production comprises of two main costs, namely,

1. Machine Set Up Costs and
2. Inventory holding costs.

If the size is higher, the set up cost may decline due to lesser number of set ups required; but units in inventory will go up leading to higher holding costs. If the lot size is lower, lower inventory holding costs are accomplished but only with higher set up costs. **Economic batch quantity is the size of a batch where total cost of set-up and holding costs are at minimum.**

This relationship is explained with the help of following diagram



As can be seen in the above diagram, costs are shown on the Y axis and Batch size or batch quantity is shown on the X axis. With the higher batch size, holding cost shows a tendency to increase whereas set-up costs show a declining trend. The point where both the cost lines intersect each other represents the lowest cost combination.

The economic batch size or Economic Batch Quantity may be determined by calculating the total cost for a series of possible batch sizes and checking which batch size gives the minimum cost. Alternatively, a formula can be derived which is similar to determination of Economic Order Quantity (EOQ). The objective here being to determine the production lot (Batch size) that optimizes on both set up and inventory holding cots formula. The mathematical formula usually used for its determination is as follows:

$$EBQ = \sqrt{\frac{2DS}{C}}$$

Where, D = Annual demand for the product

S = Setting up cost per batch

C = Carrying cost per unit of production

ILLUSTRATION 5

Monthly demand for a product	*500 units*
Setting-up cost per batch	*₹ 60*
Cost of manufacturing per unit	*₹ 20*
Rate of interest	*10% p.a.*

DETERMINE economic batch quantity.

SOLUTION

$$EBQ = \sqrt{\frac{2DS}{C}} = \sqrt{\frac{2 \times 500 \times 12 \times 60}{0.1 \times 20}} = 600 \text{ units.}$$

ILLUSTRATION 6

M/s. KBC Bearings Ltd. is committed to supply 48,000 bearings per annum to M/s. KMR Fans on a steady daily basis. It is estimated that it costs ₹ 1 as inventory holding cost per bearing per month and that the set up cost per run of bearing manufacture is ₹ 3,200

(i) DETERMINE the optimum run size of bearing manufacture.

(ii) STATE what would be the interval between two consecutive optimum runs.

(iii) FIND OUT the minimum inventory holding cost.

SOLUTION

(i) Optimum batch size or Economic Batch Quantity (EBQ):

$$EBQ = \sqrt{\frac{2DS}{C}} = \sqrt{\frac{2 \times 48{,}000 \times 3{,}200}{12}} = 5{,}060 \text{ units.}$$

(ii) Number of Optimum runs = 48,000 ÷ 5,060 = 9.49 or 10 run

Interval between 2 runs (in days) = 365 days ÷ 10 = 36.5 days

(iii) Minimum Inventory Cost = Average Inventory × Inventory Carrying Cost per unit per annum

Average Inventory = 5,060 units ÷ 2 = 2,530 units

Carrying Cost per unit per annum= ₹1 × 12 months = ₹ 12

Minimum Inventory Holding Costs = 2,530 units × ₹ 12 = ₹ 30,360

ILLUSTRATION 7

A Company has an annual demand from a single customer for 50,000 litres of a paint product. The total demand can be made up of a range of colour to be produced in a continuous production run after which a set-up of the machinery will be required to accommodate the colour change. The total output of each colour will be stored and then delivered to the customer as single load immediately before production of the next colour commences.

The Set up costs are ₹ 100 per set up. The Service is supplied by an outside company as required.

The Holding costs are incurred on rented storage space which costs ₹ 50 per sq. meter per annum. Each square meter can hold 250 Litres suitably stacked.

You are required to:

(i) CALCULATE the total cost per year where batches may range from 4,000 to 10,000 litres in multiples of 1,000 litres and hence choose the production batch size which will minimize the cost.

(ii) Use the economic batch size formula to CALCULATE the batch size which will minimise total cost.

SOLUTION

(i)

Production Batch Size (Lt.)	Set-up costs per annum (₹)	Holding Costs per annum (₹)	Total Costs per annum (₹)
4,000	1,250	400	1,650
5,000	1,000	500	1,500
6,000	833	600	1,433
7,000	714	700	1,414
8,000	625	800	1,425
9,000	556	900	1,456
10,000	500	1000	1,500

As the total cost is minimum at 7,000 ltr. i.e. ₹ 1,414, thus economic production lot would be 7,000 Litres

(ii) Economic Batch Quantity (EBQ):

$$EBQ = \sqrt{\frac{2DS}{C}}$$

Where, D = Annual demand for the product = 50,000 Litres

S = Setting up cost per batch = ₹100 per set-up

C = Carrying cost per unit of production

= ₹ 50 / 250 litres = 0.20 per litre per annum

$$= \sqrt{\frac{2 \times 50,000 \times 100}{0.2 \times 1}} = 7,071 \text{ Litres}$$

Working Note:

1. For Production batch size of 7,000 litres

Number of set ups per year = 50,000 ÷ 7,000 = 7.14 or 8 set-ups

Hence, annual set up cost per year = 8 × ₹100 = ₹800

Average Quantity = 7,000 ÷ 2 = 3,500 litres

Holding Costs = 3,500 ltr. ÷250 × 50 = ₹ 700

2. It can be seen that EBQ determined with mathematical formula (7,071 litres) slightly varies from the one determined by trial and error method (7,000 Litres)

7. DIFFERENCE BETWEEN JOB AND BATCH COSTING

Sr. No	Job Costing	Batch Costing
1	Method of costing used for non- standard and non-repetitive products produced as per customer specifications and against specific orders.	Homogeneous products produced in a continuous production flow in lots.
2	Cost determined for each Job	Cost determined in aggregate for the entire Batch and then arrived at on per unit basis.
3	Jobs are different from each other and independent of each other. Each Job is unique.	Products produced in a batch are homogeneous and lack of individuality

SUMMARY

- **Unit Costing:** Unit costing is that method of costing where the output produced by an entity is identical and each unit of output require identical cost.
- **Job Costing:** Job costing is the method of costing required to be done for unique products manufacturing done against specific orders.
- **Batch Costing:** Batch Costing is a type of specific order costing where articles are manufactured in predetermined lots, known as batch. Under this costing method, the cost object for cost determination is a batch for production rather output as seen in unit costing.
- **Economic Batch Quantity (EBQ):** Economic batch quantity is the size of a batch where total cost of set-up and holding costs are at minimum.

$$EBQ = \sqrt{\frac{2DS}{C}}$$

TEST YOUR KNOWLEDGE

Multiple Choice Questions (MCQ)

1. *Different businesses in order to determine cost of their product or service offering follow:*

   (a) Different methods of Costing

   (b) Uniform Costing

   (c) Different techniques of costing

   (d) None of the above

2. *In order to determine cost of the product or service, following are used:*

   (a) Techniques of costing like Marginal, Standard etc.

   (b) Methods of Costing

   (c) Comparatives

   (d) All of the above

3. *Unit Costing is applicable where:*

   (a) Product produced are unique and no 2 products are same

   (b) Dissimilar articles are produced as per customer specification

   (c) homogeneous articles are produced on large scale

   (d) Products made require different raw materials

4. *In case product produced or jobs undertaken are of diverse nature, the system of costing to be used should be:*

   (a) Process costing

   (b) Operating costing

   (c) Job costing

   (d) None of the above

5. *Job Costing is:*

   (a) *Applicable to all industries regardless of the products or services provided*

   (b) *Technique of costing*

   (c) *Suitable where similar products are produced on mass scale*

   (d) *Method of costing used for non- standard and non- repetitive products.*

6. *The production planning department prepares a list of materials and stores required for the completion of a specific job order, this list is known as:*

   (a) *Bin card*

   (b) *Bill of material*

   (c) *Material requisition slip*

   (d) *None of the above*

7. *Batch costing is a type of:*

   (a) *Process costing*

   (b) *Job Costing*

   (c) *Differential costing*

   (d) *Direct costing*

8. *Batch costing is similar to that under job costing except with the difference that a:*

   (a) *Job becomes a cost unit.*

   (b) *Batch becomes the cost unit instead of a job*

   (c) *Process becomes a cost unit*

   (d) *None of the above*

9. *The main points of distinction between job and contract costing includes:*

   (a) *Length of time to complete.*

   (b) *Big jobs*

(c) *Activities to be done outside the factory area*

(d) *All of the above*

10. *Economic batch quantity is that size of the batch of production where:*

(a) *Average cost is minimum*

(b) *Set-up cost of machine is minimum*

(c) *Carrying cost is minimum*

(d) *Both (b) and (c)*

Theoretical Questions

1. *DESCRIBE Unit Costing and Batch Costing giving example of industries where these are used.*
2. *DISTINGUISH between Job Costing & Batch Costing.*
3. *In Batch Costing, STATE how is Economic Batch Quantity determined.*
4. *Z Ltd. produces product ZZ in batches, management of the Z Ltd. wants to know the number of batches of product ZZ to be produced where the cost incurred on batch setup and carrying cost of production is at optimum level. How will they DETERMINE the optimum batch number?*

Practical Problems

1. *Wonder Ltd. has a capacity of 120,000 units per annum as its optimum capacity. The production costs are as under:*

Direct Material – ₹ 90 per unit

Direct Labour- ₹ 60 per unit

Overheads:

Fixed: ₹ 30,00,000 per annum

Variable: ₹ 100 per unit

Semi Variable: ₹ 20,00,000 per annum up to 50% capacity and an extra amount of ₹ 4,00,000 for every 25% increase in capacity or part thereof

The production is made to order and not for stocks.

If the production programme of the factory is as indicated below and the management desires a profit of ₹20,00,000 for the year DETERMINE the average selling price at which each unit should be quoted.

First 3 months: 50% capacity

Remaining 9 months: 80% capacity

Ignore Administration, Selling and Distribution overheads.

2. *Rio Limited undertakes to supply 1000 units of a component per month for the months of January, February and March. Every month a batch order is opened against which materials and labour cost are booked at actual. Overheads are levied at a rate per labour hour. The selling price is contracted at ₹ 15 per unit.*

From the following data, CALCULATE the profit per unit of each batch order and the overall position of the order for the 3,000 units.

Month	Batch Output (Numbers)	Material Cost (₹)	Labour Cost (₹)
January	1,250	6,250	2,500
February	1,500	9,000	3,000
March	1,000	5,000	2,000

Labour is paid at the rate of ₹ 2 per hour. The other details are:

Month	Overheads (₹)	Total Labour Hours
January	12,000	4,000
February	9,000	4,500
March	15,000	5,000

3. *X Ltd. is committed to supply 24,000 bearings per annum to Y Ltd. on steady basis. It is estimated that it costs 10 paise as inventory holding cost per bearing per month and that the set-up cost per run of bearing manufacture is ₹ 324.*

   (a) COMPUTE what would be the optimum run size for bearing manufacture?

   (b) Assuming that the company has a policy of manufacturing 6,000 bearings per run, CALCULATE how much extra costs the company would be incurring as compared to the optimum run suggested in (a) above?

   (c) CALCULATE the holding cost at optimum inventory level?

4. *A customer has been ordering 90,000 special design metal columns at the rate of 18,000 columns per order during the past years. The production cost per unit comprises ₹2,120 for material, ₹60 for labour and ₹20 for fixed overheads. It costs ₹1,500 to set up for one run of 18,000 column and inventory carrying cost is 5%.*

   (i) FIND the most economic production run.

   (ii) CALCULATE the extra cost that company incur due to processing of 18,000 columns in a batch.

5. *XYZ Ltd. has obtained an order to supply 48000 bearings per year from a concern. On a steady basis, it is estimated that it costs ₹0.20 as inventory holding cost per bearing per month and the set-up cost per run of bearing manufacture is ₹384.*

   You are required to:

   (i) compute the optimum run size and number of runs for bearing manufacture.

   (ii) compute the interval between two consecutive runs.

   (iii) find out the extra costs to be incurred, if company adopts a policy to manufacture 8000 bearings per run as compared to optimum run Size.

   (iv) give your opinion regarding run size of bearing manufacture.

   Assume 365 days in a year.

Case Scenarios

1. *Arnav Ltd. operates in beverages industry where it manufactures soft-drink in three sizes of Large (3 litres), Medium (1.5 litres) and Small (600 ml) bottles. The products are processed in batches. The 5,000 litres capacity processing plant consumes electricity of 90 Kilowatts per hour and a batch takes 1 hour 45 minutes to complete. Only symmetric size of products can be processed at a time. The machine set-up takes 15 minutes to get ready for next batch processing. During the set-up power consumption is only 20%.*

   (i) The current price of Large, Medium and Small are ₹150, ₹90 and ₹50 respectively.

(ii) To produce a litre of beverage, 14 litres of raw material-W and 25 ml of Material-C are required which costs ₹0.50 and ₹1,000 per litre respectively.

(iii) 20 direct workers are required. The workers are paid ₹880 for 8 hours shift of work.

(iv) The average packing cost per bottle is ₹3

(v) Power cost is ₹7 per Kilowatt -hour (Kwh)

(vi) Other variable cost is ₹30,000 per batch.

(vii) Fixed cost (Administration and marketing) is ₹4,90,00,000.

(viii) The holding cost is ₹1 per bottle per annum.

The marketing team has surveyed the following demand (bottle) of the product:

Large	*Medium*	*Small*
3,00,000	*7,50,000*	*20,00,000*

The following information has been sought from you for the purpose of performance review meeting:

(i) Number of large size bottles that can be processed in a batch?

(a) 5,000 bottles

(b) 1,666 bottles

(c) 3,333 bottles

(d) 8,333 bottles

(ii) Total number of batches to be run to process medium size bottles

(a) 180

(b) 225

(c) 240

(d) 645

(iii) Material -W required for small size bottles

(a) 1,26,00,000 ltrs

(b) 1,68,00,000 ltrs

(c) 1,57,50,000 ltrs

(d) 1,51,50,000 ltrs

(iv) Calculate total profit/ loss per batch.

(a) ₹ 3,46,28,460

(b) ₹ 2,56,28,360

(c) ₹ 2,82,17,370

(d) ₹ 1,88,56,360

(v) Compute Economic Batch Quantity (EBQ) for small size bottles.

(a) 1,34,234 ltrs

(b) 2,12,243 ltrs

(c) 1,57,882 ltrs

(d) 3,46,592 ltrs

ANSWERS/ SOLUTIONS

Answers to the MCQs

1.	(a)	**2.**	(b)	**3.**	(c)	**4.**	(c)	**5.**	(d)	**6.**	(b)
7.	(b)	**8.**	(b)	**9.**	(d)	**10.**	(d)				

Answers to the Theoretical Questions

1. Please refer paragraph 2 & 4

2. Please refer paragraph 7

3. Please refer paragraph 6

4. Please refer paragraph 6

Answers to the Practical Problems

1. Statement of Cost and Total Sales **Amount (₹)**

Particulars	First 3 months	Next 9 months	Total
Capacity Utilisation (No of units)	120,000x3/12x50% =15,000	120,000x9/12x80% =72,000	87,000
Direct Material	13,50,000	64,80,000	78,30,000
Direct Labour	9,00,000	43,20,000	52,20,000
Add: Overheads:			
- Fixed (1:3)	7,50,000	22,50,000	30,00,000
- Variable	15,00,000	72,00,000	87,00,000
Semi Variable	5,00,000 (For first 3 months at the rate of ₹ 20,00,000)	21,00,000 (at the rate of ₹ 28,00,000 for 9 months)	26,00,000
Total cost	50,00,000	2,23,50,000	2,73,50,000
Add: Profit			20,00,000
Sales			2,93,50,000

Average Selling Price = ₹2,93,50,000 ÷ 87,000 units = ₹ 337.356

2. Statement of Cost and Profit per unit of each batch

	January	February	March	Total
a) Batch Output (Nos.)	1,250	1,500	1,000	3,750
b) Sales Value (@ ₹ 15 per unit)	(₹) 18,750	(₹) 22,500	(₹) 15,000	(₹) 56,250
Cost				
Material	6,250	9,000	5,000	20,250
Wages	2,500	3,000	2,000	7,500
Overheads	3,750	3,000	3,000	9,750
c) Total	12,500	15,000	10,000	37,500
d) Profit per batch (b) – (c)	6,250	7,500	5,000	18,750

e)	Cost per unit (c) ÷ (a)	10	10	10	
f)	Profit per unit (d) ÷ (a)	5	5	5	

Overall Position of the Order for 3,000 Units

Sales value (3,000 units × ₹ 15)	₹45,000
Less: Total cost (3,000 units × ₹ 10)	30,000
Profit	15,000

Calculation of overhead per hour:

	January	February	March
i. Labour hours:			
$= \frac{\text{Labour cost}}{\text{Labour rates per hour}}$	$\frac{₹2,500}{2} = 1,250$	$\frac{₹3,000}{2} = 1,500$	$\frac{₹2,000}{2} = 1,000$
ii. Overhead per hour:			
$= \frac{\text{Total Overheads}}{\text{Total labour hour}}$	$\frac{₹12,000}{4,000} = ₹ 3$	$\frac{₹9,000}{4,500} = ₹ 2$	$\frac{₹15,000}{5,000} = ₹ 3$
iii. Overhead for batch (i) × (ii)	₹ 3,750	₹ 3,000	₹ 3,000

3. (a) Optimum production run size (Q) = $\sqrt{\frac{2DS}{C}}$

where,

D = No. of units to be produced within one year.

S = Set-up cost per production run

C = Carrying cost per unit per annum.

$= \sqrt{\frac{2DS}{C}} = \sqrt{\frac{2 \times 24,000 \times ₹324}{0.10 \times 12}}$ = 3,600 bearings.

(b) Total Cost (of maintaining the inventories) when production run size (Q) are 3,600 and 6,000 bearings respectively

Total cost = Total set-up cost + Total carrying cost.

	When run size is 3,600 bearings	When run size is 6,000 bearings
Total set up cost	$= \frac{24,000}{3,600} \times$ ₹ 324 = ₹2,160 Or, No. of setups = 6.67 (7 setups) = 7 x 324 = ₹ 2,268	$= \frac{24,000}{6,000} \times$ ₹ 324= ₹ 1,296
Total Carrying cost	1/2×3,600 × 0.10P × 12 = ₹ 2,160	1/2 × 6,000 × 0.10P × 12 = ₹ 3,600
Total Cost	₹ 4,320/ ₹ 4,428	₹ 4,896

₹ 576/ ₹ 468 is the excess cost borne by the firm due to run size not being economic batch quantity.

(c) Inventory holding cost at EBQ = 1/2 Q × C

(when Q = 3,600 bearings) = 1/2 × 3,600 bearings × 0.10P × 12

= ₹ 2,160

4. (i) Total Cost of production = ₹ 2,120 + 60 + 20 = ₹ 2,200

Calculation of Economic Batch Quantity (EBQ):

$$EBQ = \sqrt{\frac{2 \times 90,000 \times ₹1,500}{5\% \text{ of } ₹2,200}} = \sqrt{\frac{27,00,00,000}{₹110}} = 1,567 \text{ columns.}$$

(ii) Calculation of Extra Cost due to processing of 18,000 columns in a batch

	When run size is 1,567 columns	When run size is 18,000 columns
Total set up cost	No. of setups = 90,000/1567 = 57.43(58 setups) $= \frac{90,000}{1,567} \times$ ₹ 1,500 = ₹ 87,000	$= \frac{90,000}{18,000} \times$ ₹ 1,500 = ₹ 7,500

Total Carrying cost	½ × 1,567 × ₹ 110 = ₹ 86,185	½ × 18,000 × ₹ 110 = ₹ 9,90,000
Total Cost	₹ 1,73,185	₹ 9,97,500

Thus, extra cost = ₹ 9,97,500 – ₹ 1,73,185 = ₹ 8,24,315

5. (i) Optimum batch size or Economic Batch Quantity (EBQ):

$$EBQ = \sqrt{\frac{2DS}{C}} = \sqrt{\frac{2\times 48,000\times 384}{2.4}} = 3919.18 \text{ or } 3,920 \text{ units}$$

Number of Optimum runs = 48,000 ÷ 3,920 = 12.245 or 13 run

(ii) Interval between 2 runs (in days) = 365 days ÷ 13 = 28 days

Or 365÷12.24=29.82 days

(iii) Statement showing Total Cost at Production Run size of 3,600 and 8,000 bearings

A.	Annual requirement	48,000	48,000
B.	Run Size	3,920	8,000
C.	No. of runs (A/B)	12.245	6
D.	Set up cost per run	₹ 384	₹ 384
E.	Total set up cost (CxD)	₹. 4,702	₹ 2,304
F.	Average inventory (B/2)	1,960	4,000
G.	Carrying cost per unit p.a.	2.40	2.40
H.	Total Carrying cost (FxG)	4,704	9,600
I.	Total cost (E+H)	9,406	11,904

Extra cost incurred, if run size is of 8,000=₹11,904-9,406= ₹. 2,498

(iv) To save cost the company should run at optimum batch size ie 3,920 Units. It saves ₹ 2,498. Run size should match with the Economic production run of bearing manufacture. When managers of a manufacturing operation make decisions about the number of units to produce for each production run, they must consider the costs related to setting up the production process and the costs of holding inventory

Answers to the Case Scenarios

1.

i.	**(b)**	**ii.**	**(b)**	**iii.**	**(b)**	**iv.**	**(c)**	**v.**	**(d)**

(i) (b) Working note 1: Maximum number of bottles that can be processed in a batch:

$$\frac{5{,}000 \text{ ltrs}}{\text{Bottle volume}}$$

Large		Medium		Small	
Qty (ltr)	**Max bottles**	**Qty (ltr)**	**Max bottles**	**Qty (ml)**	**Max bottles**
3	1,666	1.5	3,333	600	8,333

***For simplicity of calculation small fractions has been ignored.**

(ii) (b) Working note 2: Number of batches to be run:

		Large	Medium	Small	Total
A	Demand	3,00,000	7,50,000	20,00,000	
B	Bottles per batch (Refer WN-1)	1,666	3,333	8,333	
C	No. of batches [A÷B]	180	225	240	645

*For simplicity of calculation small fractions has been ignored.

(iii) (b) Working note 3:

Quantity of Material-W and Material C required to meet demand:

	Particulars	Large	Medium	Small	Total
A	Demand (bottle)	3,00,000	7,50,000	20,00,000	
B	Qty per bottle (Litre)	3	1.5	0.6	
C	Output (Litre) [A×B]	9,00,000	11,25,000	12,00,000	32,25,000
D	Material-W per litre of output (Litre)	14	14	14	

E	Material-W required (Litre) [C×D]	**1,26,00,000**	**1,57,50,000**	**1,68,00,000**	**4,51,50,000**
F	Material-C required per litre of output (ml)	25	25	25	
G	Material-C required (Litre) [(C×F)÷1000]	**22,500**	**28,125**	**30,000**	**80,625**

(iv) (c) Workings:

4. No. of Man-shift required:

		Large	Medium	Small	Total
A	No. of batches	180	225	240	645
B	Hours required per batch (Hours)	2	2	2	
C	Total hours required (Hours) [A×B]	360	450	480	1,290
D	No. of shifts required [C÷8]	45	57	60	162
E	**Total manshift [D×20 workers]**	**900**	**1,140**	**1,200**	**3,240**

5. Power consumption in Kwh

		Large	Medium	Small	Total
For processing					
A	No. of batches	180	225	240	645
B	Hours required per batch (Hours)	1.75	1.75	1.75	1.75
C	Total hours required (Hours) [A×B]	315	393.75	420	1,128.75
D	Power consumption per hour	90	90	90	90
E	Power consumption in Kwh [C×D]	28,350	35,437.5	37,800	1,01,587.5

F	Per batch consumption (Kwh) [E÷A]	157.5	157.5	157.5	157.5
For set-up					
G	Hours required per batch (Hours)	0.25	0.25	0.25	0.25
H	Total hours required (Hours) [A×G]	45	56.25	60	161.25
I	Power consumption per hour [20%×90]	18	18	18	18
J	Power consumption in Kwh [H×I]	810	1,012.5	1,080	2,902.5
K	Per batch consumption (Kwh) [J÷A]	4.5	4.5	4.5	4.5

Calculation of Profit/ loss per batch:

	Particulars	**Large**	**Medium**	**Small**	**Total**
A	Demand (bottle)	3,00,000	7,50,000	20,00,000	30,50,000
B	Price per bottle (₹)	150	90	50	
C	**Sales value (₹) [A×B]**	**4,50,00,000**	**6,75,00,000**	**10,00,00,000**	**21,25,00,000**
	Direct Material cost:				
E	Material-W (₹) [Qty in WN-3 × ₹0.50]	63,00,000	78,75,000	84,00,000	2,25,75,000
F	Material-C (₹) [Qty in WN-3 × ₹1,000]	2,25,00,000	2,81,25,000	3,00,00,000	8,06,25,000
G	[E+F]	**2,88,00,000**	**3,60,00,000**	**3,84,00,000**	**10,32,00,000**
H	Direct Wages (₹) [Man-shift in WN-4 × × ₹880]	7,92,000	10,03,200	10,56,000	28,51,200
I	Packing cost (₹) [A×₹3]	9,00,000	22,50,000	60,00,000	91,50,000
	Power cost (₹)				
J	For processing (₹) [WN-5 × ₹7]	1,98,450	2,48,062.5	2,64,600	7,11,112.5

K	For set-up time (₹) [WN-5 × ₹7]	5,670	7,087.5	7,560	20,317.5
L	[J+K]	**2,04,120**	**2,55,150**	**2,72,160**	**7,31,430**
M	Other variable cost (₹) [No. of batch in WN-2 × ₹30,000]	54,00,000	67,50,000	72,00,000	1,93,50,000
N	**Total Variable cost per batch [G+H+I+L+M]**	**3,60,96,120**	**4,62,58,350**	**5,29,28,160**	**13,52,82,630**
O	**Profit/ loss before fixed cost [C-N]**	**89,03,880**	**2,12,41,650**	**4,70,71,840**	**7,72,17,370**
P	Fixed Cost				4,90,00,000
Q	**Total Profit [O-P]**				**2,82,17,370**

(v) (d) Computation of Economic Batch Quantity (EBQ):

$$EBQ = \sqrt{\frac{2 \times D \times S}{C}}$$

D = Annual Demand for the Product = Refer A below

S = Set-up cost per batch = Refer D below

C = Carrying cost per unit per annum =Refer E below

	Particulars	**Large**	**Medium**	**Small**
A	Annual Demand (bottle)	3,00,000	7,50,000	20,00,000
Set-up Cost:				
B	Power cost for set-up time (₹) [Consumption per batch in WN-5 × ₹7]	31.50	31.50	31.50
C	Other variable cost (₹)	30,000	30,000	30,000
D	Total Set-up cost [B+C]	30,031.50	30,031.50	30,031.50
E	Holding cost:	1.00	1.00	1.00
F	**EBQ (Bottle)**	**1,34,234**	**2,12,243**	**3,46,592**