

## FINAL

### Group III

#### Paper 15 : STRATEGIC COST MANAGEMENT – DECISION MAKING (SYLLABUS – 2016)

##### PART – I : MULTIPLE CHOICE QUESTIONS

- (1) Choose the most appropriate answer to the following questions giving justification. Each question carries 2 marks. 1 mark for correct choice, 1 mark for justification.)
- (i) A & Co. manufactures and sales 7500 units of a product. The full cost per unit is ₹ 100/-. The company has fixed its price so as to earn a return of 20% on an investment of ₹ 9,00,000. Target selling price will be -
- (a) 124
  - (b) 100
  - (c) 110
  - (d) 150
- (ii) ABC Limited has current PBIT of ₹ 19.20 lakhs on total assets of ₹ 96 lakhs. The company has decided to increase assets by ₹ 24 lakhs, which is expected to increase the operating profit before depreciation by ₹ 8.40 lakhs. There will be a net increase in depreciation by ₹ 4.80 lakhs. This will result in ROI
- (a) to increase by 1%
  - (b) to decrease by 1%
  - (c) to decrease by 1-5%
  - (d) to remain the same
- (iii) For a Learning Curve percentage of 72%, the time to be taken to complete the 4th unit of a 12-unit job involved in the assembly line, if the initial unit requires 80 hours, will be
- (a) 43.50 hrs
  - (b) 41.47 hrs
  - (c) 46.71 hrs
  - (d) 40.95 hrs
- (iv) When is market skimming pricing appropriate?
- (a) If demand is very elastic
  - (b) If the product is new and different
  - (c) If there is little chance of achieving economies of scale
  - (d) If demand is inelastic
  - (e) If there is little competition and high barriers to entry

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(v) Which of the following would take place if a company is able to reduce its variable cost?

Contribution Margin	Break-Even Point
(a) Increase	Increase
(b) Decrease	Decrease
(c) Increase	Decrease
(d) Decrease	Increase

(vi) A company makes a single product which it sells at ₹10 per unit. Fixed costs are ₹ 48,000 per month and the product has a contribution to sales ratio of 40%. In a period when actual sales were ₹1,40,000, the company's margin of safety in units was:

- (a) 2000
- (b) 3000
- (c) 3500
- (d) 4000

(vii) Which of the following is not suitable for a JIT production system?

- (a) Batch production
- (b) Jobbing production
- (c) Process production
- (d) Service production

(viii) Which of the following is NOT a method of transfer pricing?

- (a) Cost plus transfer price
- (b) Internal price transfer price
- (c) market-based transfer price
- (d) Two part transfer price

(ix) An organisation is considering the costs to be incurred in respect of a special order opportunity.

The order would require 1,250 kgs of material D. This is a material that is readily available and regularly used by the organisation on its normal products. There are 265 kgs of material D in stock which cost ₹795 last week. The current market price is ₹3.24 per kg. Material D is normally used to make product X. Each unit of X requires 3 kgs of material D, and if material D is casted at ₹3 per kg, each unit of X yields a contribution of ₹15.

The relevant cost of material D to be included in the costing of the special order is nearest to:

- (a) ₹3,990
- (b) ₹4,050
- (c) ₹10,000
- (d) ₹10,300

(x) P operates an activity based costing (ABC) system to attribute its overhead costs to cost objects.

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In its budget for the year ending 31 August 2017, the company expected to place a total of 2,895 purchase orders at a total cost of ₹110,010. This activity and its related costs were budgeted to occur at a constant rate throughout the budget year, which is divided into 13 four-week periods.

During the four-week period ended 30 June 2016, a total of 210 purchase orders were placed at a cost of ₹7,650. The over-recovery of these costs for the four-week period was:

- (a) ₹330
- (b) ₹350
- (c) ₹370
- (d) ₹390

(xi) A manufacturing company recorded the following costs in October for Product X:

Direct materials	20,000
Direct labour	6,300
Variable production overhead	4,700
Fixed production overhead	19,750
Variable selling costs	4,500
Fixed distribution costs	16,800
Total costs incurred for Product X	72,050

During October 4,000 units of Product X were produced but only 3,600 units were sold. At the beginning of October there was no inventory.

The value of the inventory of Product X at the end of October using throughput accounting was:

- (a) ₹630
- (b) ₹1,080
- (c) ₹ 1,100
- (d) ₹ 2,000

(xii) A company operates a standard absorption costing system. The budgeted fixed production overheads for the company for the latest year were ₹330,000 and budgeted output was 220,000 units. At the end of the company's financial year the total of the fixed production overheads debited to the Fixed Production Overhead Control Account was ₹260,000 and the actual output achieved was 200,000 units. The under/over absorption of overheads was

- (a) ₹40,000 over absorbed
- (b) ₹40,000 under absorbed
- (c) ₹70,000 over absorbed
- (d) ₹70,000 under absorbed

(xiii) Company B uses a throughput accounting system. The details of product X per unit are as follows:

Selling price	₹ 50
Material cost	₹ 16

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Conversion costs ₹ 20  
Time on bottleneck resource 8 minutes

The return per hour for product X is:

- (a) ₹ 105
- (b) ₹ 225
- (c) ₹ 255
- (d) ₹ 375

(xiv) A company has 2,000 units of an obsolete item which are carried in inventory at the original purchase price of ₹30,000. If these items are reworked for ₹10,000, they can be sold for ₹18,000. Alternatively, they can be sold as scrap for ₹3,000 in the market. In a decision model used to analyze the reworking proposal, the opportunity cost should be taken as:

- (a) ₹ 8,000
- (b) ₹ 12,000
- (c) ₹ 3,000
- (d) ₹ 10,000

(xv) The time taken to produce the first unit of a product is 4000 hrs, what will be the total time taken to produce the 5th to 8th unit of the product, when a 90% learning curve applies?

- (a) 10,500 hours
- (b) 12,968 hours
- (c) 9,560 hours
- (d) 10,368 hours

**Answer:**

(i) (a) Target Sale Price per unit = Full Cost + Target Profit = ₹ 100 + (900000 × 20%)/7500 = 100 + 24.

(ii) (b)

	Before installing new assets	After installing new assets
PBIT	₹ 19.20 lakhs	= ₹ 19.20 lakhs + (₹ 8.40 lakhs – ₹ 4.80 lakhs) = ₹ 22.80 lakhs
Value of Assets	₹ 96.00 lakhs	₹ 96.00 lakhs + ₹ 24.00 lakhs = ₹ 120.00 lakhs
ROT	= 20%	= 19%

Conclusion: There will be a decrease of 1% in ROI under the proposed dispensation.

(iii) (b) At 72% Learning Curve,  
T-4 - Time taken by the 4th Unit = 80 (.72)(.72) = 41.47 hrs.

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Note: In the arithmetic method followed above, every time the number the number of repetitions doubles, the time to perform the activity is reduced by the Learning Curve Coefficient.

- (iv) (b) Here market skimming would be more appropriate. A high price could be changed to the 'opinion leaders' who want to be seen to have the new product and are prepared to pay a high price.
- (v) (c) Contribution margin = Sales Less Variable Cost  
So, reduction in variable cost will increase contribution.  
BEP = FC/Contribution Margin  
Hence, increase in contribution will reduce BEP.
- (vi) (a)  $BEP = FC \div C/S \text{ Ratio} = ₹ 48,000 \div 0.4 = ₹ 1,20,000$  or 12,000 units.  
When sells are ₹ 1,40,000, the volume is  $₹ 1,40,000 \div 10 = ₹ 14,000$  units  
Margin of Safety is  $14,000 - 12,000 = 2,000$  units.
- (vii) (a) Batch production uses stocks to supply customers whilst other products are being produced. Stocks are avoided in a JIT system. Jobbing production makes products to customer order and is ideal for JIT.
- (viii) (b) The internal price is just another name for the TP. So it is not a method of transfer pricing.
- (ix) (b) The material is in regular use by the organization and so would be replaced if it is used on the special order. The material is readily available at a price of 3.24 per kg. Therefore the relevant cost of the material is  $1,250 \text{ kgs} \times 3.24 = 4,050$
- (x) (a) Cost driver rate = Budgeted cost of orders/Budgeted number of orders =  $1,10,000/2895 = 38$  for each order  
Cost recovered:  $210 \text{ orders} \times 38 = 7,980$   
Actual costs incurred = 7650  
Over-recovery of costs for four-week period =  $7980 - 7650 = 330$ .
- (xi) (d) Using throughput accounting inventory is valued at material cost  
Inventory value =  $20,000/4,000 \times 400 \text{ units} = 2,000$
- (xii) (a) OAR =  $3,30,000/2,20,000 = 1.50$  per units  
Overhead absorbed ( $200,000 \text{ units} \times 1.50$ ) = 3,00,000  
Actual Overhead = 2,60,000.  
Over absorbed = 40,000.
- (xiii) (c) Return per minute =  $(\text{Selling price} - \text{material cost})/\text{Time on bottleneck resource} = (50-16)/8 = 4.25$ ; Return per hour =  $4.25 \times 60 = 255$

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(xiv) (c) Original price is not relevant

Rework income	₹ 18,000
Deduct cost of rework	10,000
Net inflow	₹ 8,000 It is relevant

(xv) (d)

Units	Average Time (hours)	Total Time (hours)
1	4000	4000
2	3600	7200
4	3240	12960
8	2916	23328

Total time for 5th to 8 units = 23328 - 12960 = 10368 hrs.

## PART – II : DESCRIPTIVE QUESTIONS

2. (a) Importance of Product Life Cycle Costing.

(b) Sportech Ceramics Ltd. is about to replace its rapidly deteriorating boiler equipment. Three types of boiler system are being considered as a suitable replacement: (A) Coal-fired, (B) Gas-fired, and (C) Oil-fired. The associated costs are as follows:

Boiler system	A (₹)	B (₹)	C (₹)
Cost of boiler (including installation and commissioning)	55,000	74,000	67,000
Annual fuel cost	27,000	23,000	25,000
Annual operating labour costs	8,000	---	---
Annual maintenance costs	4,000	3,000	3,000
Annual electricity costs	1,000	1,000	1,000
Total annual operating costs	40,000	27,000	29,000

The new boiler system is expected to last at least ten years. The company has an opportunity cost of finance of 15% per year. Which system should be chosen?

**Answer:**

2. (a) Product Life Cycle Costing is considered important due to the following reasons —

(a) Time based analysis: Life cycle costing involves tracing of costs and revenues of each product over several calendar periods throughout their life cycle. Costs and revenues can be analysed by time periods. The total magnitude of costs for each individual product can be reported and compared with product revenues generated in various time periods.

(b) Overall Cost Analysis: Production costs are accounted and recognized by the routine accounting system. However non-production costs like R&D; design; marketing; distribution; customer service etc. are less visible on a product — by — product basis.

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- Product Life Cycle Costing focuses on recognizing both production and non-production costs.
- (c) Pre-production costs analysis: the development period of R&D and design is long and costly. A high percentage of total product costs may be incurred before commercial production begin. Hence; the company needs accurate information on such costs for deciding whether to continue with the R&D or not.
- (d) Effective Pricing Decisions: Pricing decisions; in order to be effective; should include market considerations on one hand and cost considerations on the other. Product Life cycle costing and target costing help analyze both these considerations and arrive at optimal price decisions.
- (e) Better Decision Making: Based on a more accurate and realistic assessment of revenues and costs, at least within a particular life cycle stage, better decisions can be taken.
- (f) Long Run Holistic view: Product Life cycle costing can promote long-term rewarding in contrast to short-term profitability rewarding. It provides an overall framework for considering total incremental costs over the entire life span of a product, which in turn facilitates analysis of parts of the whole where cost effectiveness might be improved.
- (g) Life Cycle Budgeting: Life cycle Budgeting, i.e., Life cycle costing with target costing principles, facilitates scope for cost reduction at the design stage itself. Since costs are avoided before they are committed or locked in the Company is benefited. (h) Review: Life Cycle Costing provides scope for analysis of long term picture of product line profitability, feedback on the effectiveness of life cycle planning and cost data to clarify the economic impact of alternatives chosen in the design, engineering phase etc.
- (b) If the decision is taken on the basis of initial cost only, then the Coal-fired boiler system would be selected. However, over its life time (at least ten years) the annual operating costs are much higher than for the Gas-fired and Oil-fired systems. The life cycle costs for ten years are as follows:

Boiler system	A (₹)	B (₹)	C (₹)
Cost of boiler	55,000	74,000	67,000
Operating Costs (Annual Costs × 10 years)	4,00,000	2,70,000	2,90,000
Total costs	4,55,000	3,44,000	3,57,000

However, we need to discount the annual costs at a 15% discount rate to arrive at the present value cost of each system. The discount factor for year 1 -10 at 15% is 5.019.

The present value of each system then is:

Boiler system	A (₹)	B (₹)	C (₹)
Cost of boiler	55,000	74,000	67,000
Operating Costs (Annual Costs × 5.019)	2,01,000	1,36,000	1,46,000
Present value of Total costs	2,56,000	2,10,000	2,13,000

On the basis of financial considerations only, the Gas-fired system is the most economical. Unless there are other important considerations the Gas-fired system should be chosen. A

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more intricate analysis might attempt to forecast the likely changes in each of the annual operating costs (e.g., fuel costs, maintenance costs, etc.). It might be useful, to see how much each of the three fuel costs would need to change to alter the decision. In addition to looking at the importance of fuel costs to the decision, we can also check the sensitivity of the expected system life. For instance, if the expected life is reduced to five years, the Oil-fired system (C) becomes the most economics, as follows:

Boiler system	A (₹)	B (₹)	C (₹)
Cost of boiler	55,000	74,000	67,000
Operating Costs (Annual Costs × 3.353)	1,34,000	91,000	97,000
Present value of Total costs	1,89,000	1,65,000	1,64,000

If the expected life is reckoned to be six years or more, the decision is in favour of the GAS – fired system.

**3. (a) Discuss the role of Cost & Management Accountant in Target Costing.**

**(b) CELO Company has the capacity of production of 80,000 units and presently sells 20,000 units at ₹100 each. The demand is sensitive to Selling Price and it has been observed that for every reduction of 10 in Selling Price, the demand is doubled.**

**Required:**

- 1. What should be the Target Cost at full capacity, if Profit Margin on Sale is 25%?**
- 2. What should be the Cost Reduction Scheme if at present 40% of Cost is variable, with same % of profit?**
- 3. If Rate of Return desired is 15%, what will be the maximum investment at full capacity?**

**Answer:**

**3. (a) Cost Accountant's Role in a Target Costing Environment**

- (i) The cost accountant should be able to provide for the other members of the design team a running series of cost estimates based on initial design sketches and activity-based costing reviews.
- (ii) The cost accountant helps the project team in capital budgeting decisions.
- (iii) The cost accountant works with the design team to help it understand cost-benefit-tradeoffs of using different design or cost options in the new product.
- (iv) The cost accountant continues to compare a product's actual cost to the target cost even after the design is completed.

**(b) (1) Target cost at full capacity**

Selling Price per unit	₹ 100	₹ 90	₹ 80
Demand (Units)	20,000	40,000	80,000 = Full Capacity

Hence, Target Cost at Full capacity = Sale price less profit margin.  
 = ₹ 80 less 25% thereon  
 = ₹ 60 p.u.



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(2) Determination of Target Cost Reduction

(a)	Since Present Price is ₹100 p.u. and Profit is 25% thereon, Present Cost p.u. =75, of which 40% is variable. So, Fixed Cost is 60% of 75 = 45 p.u. So, Total Fixed Cost =	45 × 80,000 = ₹ 36 lakhs
(b)	Variable Cost at Full Capacity = (40% of ₹ 75 p.u.) × 80,000 units =	₹ 24 lakhs
(c)	Estimated Cost at Full Capacity = Fixed Cost (constant at all levels) +Variable Cost (a + b)	₹ 60 lakhs
(d)	Target Cost at Full Capacity = ₹ 60 p.u. for 80,000 units =	₹ 48 lakhs
(e)	Cost Reduction Target/Scheme =Estimated Cost less Target Cost = (c - d)	₹ 12 lakhs

(3) Computation of Investment required

(a)	Profit at full capacity = 25% of ₹ 80 = ₹ 20 p.u.× 80,000 units	₹ 16 lakhs
(b)	Since ROCE desired is 16%, Maximum Required Investment = ₹16 Lakhs/16%	₹ 100 lakhs

- 4) (i) **State the problems associated with Throughput Accounting.**  
 (ii) **K Mnf.Ltd produces three products, X, Y and Z. The capacity of K Mnf. Ltd's plant is restricted by process alpha. Process alpha is expected to be operational for eight hours per day and can produce 1,200 units of X per hour, 1,500 units of Y per hour, and 600 units of Z per hour.**

**Selling prices and material costs for each product are as follows.**

Product	Selling Price ₹ per unit	Material Cost ₹ per unit	Throughput contribution ₹ per unit
X	150	80	70
Y	120	40	80
Z	300	100	200

**Conversion costs are ₹ 720,000 per day.**

**Required:**

- (a) **Calculate the profit per day if daily output achieved is 6,000 units of X, 4,500 units of Y and 1,200 units of Z.**  
 (b) **Calculate the TA ratio for each product.**  
 (c) **In the absence of demand restrictions for the three products, advise K Mnf. Ltd's management on the optimal production plan.**

**Answer:**

4. (i) (1) When throughput accounting is the driving force behind all production scheduling, a customer that has already placed an order for a product, which will result in a sub-optimal profit level for the manufacturing, may find that its order is never filled.  
 (2) The company's ability to create the highest level of profitability is now dependent on the production scheduling staff, who decides, what products are to be manufactured and in what order.

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(3) Another issue is that all costs are totally variable in the long-run since the management then, has the time to adjust them to long-range production volumes.

(ii) (a) Profit per day = throughput contribution – conversion cost  
= [(₹70 × 6,000) + (₹80 × 4,500) + (₹200 × 1,200)] – ₹7,20,000  
= ₹3,00,000

(b) TA ratio = throughput contribution per factory hour / conversion cost per factory hour  
Conversion cost per factory hour = ₹720,000 / 8 = ₹90,000

Product	Throughput contribution per factory hour	Cost per factory hour	TA ratio
X	₹ 70 × 1,200 = ₹84,000	₹90,000	0.93
Y	₹ 80 × 1,500 = ₹120,000	₹ 90,000	1.33
Z	₹ 200 × 600 = ₹ 120,000	₹ 90,000	1.33

(c) An attempt should be made to remove the restriction on output caused by process alpha's capacity. This will probably result in another bottleneck emerging elsewhere. The extra capacity required to remove the restriction could be obtained by working overtime, making process improvements or product specification changes. Until the volume of throughput can be increased, output should be concentrated upon products Y and Z (greatest TA ratios), unless there are good marketing reasons for continuing the current production mix. Product X is losing money every time it is produced so, unless there are good reasons why it is being produced, for example it has only just been introduced and is expected to become more profitable, A Ltd should consider ceasing production of X.

5. (a) **Advantages of Target Costing.**

(b) **Characteristics and Principles of RE-engineering Process.**

(c) **List the general principles relating to decision-making with Key Factor.**

(d) **Socio Economic Costing.**

**Answer:**

5. (a) **Advantages of Target Costing**

(i) **Innovation:** it reinforces top-to-bottom commitment to process and product innovation. It is aimed at identifying issues to be resolved.

(ii) **Competitive Advantage:** it enables a Firm to achieve competitive advantage over other Firms in the industry. The firm which achieves cost reduction targets realistically stands to gain in the long run.

(iii) **Market Driven Management:** it helps to create a company's competitive future with market driven management for designing and manufacturing products that meet the price required for market success.

(iv) **Real Cost Reduction:** it uses management control systems to support and reinforce manufacturing strategies, and to identify market opportunities that can be converted into real savings to achieve the best value rather than simply the lowest cost.

(b) **Characteristics and Principles of Re-engineering Process**

Characteristics of Re-engineering Process:

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- (i) several jobs are combined into one
- (ii) often workers make decisions
- (iii) the steps in the process are performed in a logical order
- (iv) work is performed, where it makes most sense
- (v) quality is built in.
- (vi) manager provides a single point of contact
- (vii) centralized and decentralized operations are combined.

Seven Principles of BPR:

- (a) Processes should be designed to achieve a desired outcome rather than focusing on existing tasks.
- (b) Personnel who use the output from a process should perform the process
- (c) Information processing should be included in the work, which produces the information
- (d) Geographically dispersed resources should be treated; as if they are centralized
- (e) Parallel activities should be linked rather than integrated
- (f) Doers should be allowed to be self-managing
- (g) Information should be captured once at source.

(c) **List the general principles relating to decision-making with Key Factor.**

1. If Availability < Requirement, that Resource is called a Key Factor or Key Resource.
2. If Availability > Requirement, that Resource is called as an Idle Resource.
3. Key Resource and Idle Resource are mutually exclusive terms, i.e. they do not refer to the same resource as such.
4. Key Resource should not be kept idle, and an Idle Resource will always have spare capacity.
5. Key Resource has Opportunity Costs, while Idle Resources have no Opportunity Costs.
6. A Key Resource, if kept idle, will erode/reduce Contribution.
7. For identifying Key Resource, Availability = Normal Resource Availability at Normal Costs. Any additional resource availability at higher cost (e.g. additional labour hours due to Overtime Work and Premium) will not be considered.
8. For identifying Key Resource, Requirement = Requirement at 100% capacity Levels, i.e. Maximum Output.
9. In case of minimum production condition, minimum resource requirements should be allocated independent of the Key factor Ranking priority. Additional Resource requirements only should be allocated based on Key Factor Ranking.
10. In case of Multiple Products and Multiple Key Factors with difference in ranking priority, Linear Programming (LPP) Techniques may be applied for Resource Allocation decision.
11. Application of Key Factor Principles is subject to - (a) feasibility, and (b) Company policy.

(d) **Socio Economics** (also known as social economics) is the social science that studies how economic activity affects and is shaped by social processes. In general it analyzes how societies progress, stagnate, or regress because of their local or regional economy, or the global economy.

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Socioeconomics is sometimes used as an umbrella term with different usages. The term "social economics" may refer broadly to the — use of economics in the study of society. In many cases, socioeconomics focus on the social impact of some sort of economic change, such changes might include a closing factory, market manipulation, the signing of international trade treaties, new natural gas regulation, etc. such social effects can be wide-ranging in size, anywhere from local effects on a small community to changes to an entire society. Examples of causes of socioeconomic impacts include new technologies such as cars or mobile phones, changes in laws, changes in the physical environment (such as increasing crowding within cities), and ecological changes (such as prolonged drought or declining fish stocks). These may affect patterns of consumption, the distribution of incomes and wealth, the way in which people behave (both in terms of purchase decisions and the way in which they choose to spend their time), and the overall quality of life.

Companies are increasingly interested in measuring socio-economic impact as part of maintaining their license to operate, improving the business enabling environment, strengthening their value chains, and fuelling product and service innovation.

- 6) **A product can be manufactured at 50 units per hour in a semi-automatic machine and 100 units in an automatic machine. Manufacture is undertaken on job basis according to customer's order.**

**The cost of setting-up per order: ₹ 200 in semi-automatic line and ₹ 1,000 in automatic line. Daily cost of labour: Semi-automatic method ₹ 400; automatic method ₹ 200. Cost of power semi-automatic ₹ 50 and automatic ₹ 300 per day. In case of semi-automatic machines fixed overhead would be ₹ 500 per day.**

**Variable overheads may be taken at 40 per cent of wages in case of automatic machine and 10 per cent of wages in semi-automatic machine. Fixed overheads will increase by ₹ 2,50,000 p.a. in case of automatic machine apart from depreciation and interest. Cost of automatic machine is ₹ 200,000 higher than that of semiautomatic machine. Semi - automatic machine can be purchased at ₹ 3,00,000.**

**Market or material is not a limiting factor.**

**10 per cent depreciation and 15 per cent interest on capital per annum are to be taken into consideration.**

**Daily working hours are 8, and on average 25 working days are available per month. 20 per cent of the net working time is lost in both the cases for setting up, change of jigs, rest etc. The factory is booked in advance for a few years.**

**Which method will be preferable, if the average order size is?**

**(i) 1,000 units (ii) 10,000 units**

**Determine the order size at which we may be indifferent as to whether we should have automatic or semiautomatic machine.**

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**Answer:**

6. Market is not the key factor. It means whatever is produced, that will be sold. It means any machine that will install will work only at full capacity.

**Statement showing cost per unit (other than the setting up cost) under each of two machines**

Annual output	1,00,000	2,00,000
Costs:		
Labour	$400 \times 25 \times 12 = 1,20,000$	$200 \times 25 \times 12 = 60,000$
Power	$50 \times 25 \times 12 = 15,000$	$300 \times 25 \times 12 = 90,000$
Variable overhead	$120,000 \times 0.10 = 12,000$	$60,000 \times 0.40 = 24,000$
Fixed overhead	$500 \times 25 \times 12 = 1,50,000$	4,00,000
Depreciation + interest	$25\% \text{ of } 3,00,000 = 75,000$	$25\% \text{ of } 5,00,000 = 1,25,000$
Total cost	3,72,000	6,99,000
Cost per unit (exclusive of setting up cost)	3.72	3.495

Order size 1000 units

Statement showing total cost for 1000 units made from each of the two machines

Setting cost	200	1000
Other costs	3720	3495
Total cost	3920	4495

Recommendation: Semi-automatic machine is recommended if the expected order size is 1000 units.

Order size 10000 units

Statement showing total cost for 10000 units made from each of the two machines

Setting cost	200	1000
Other costs	37200	34950
Total cost	37400	35950

**Recommendation:** Automatic machine is recommended if the expected order size is 10000 units.

Let indifference point is  $y$  units order size.

$$200 + 3.72y = 1000 + 3.495y$$

$$y = 3555.55 \text{ units.}$$

If the order size is up to 3555 units, semi-automatic may be preferred. For order size of 3556 or more, automatic is recommended.

7. A company uses absorption costing system based on standard costs. The total variable manufacturing cost is ₹ 6 per unit. The standard production rate is 10 units per machine hour. Total budgeted and actual fixed production overhead costs are ₹ 8,40,000 p.a. Fixed production overhead is allocated at ₹ 14 per machine hour. Selling price is ₹ 10 per unit.

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Variable selling overheads are ₹ 2 per unit and fixed selling costs are ₹ 2,40,000 p.a. Opening inventory was 30,000 units and the closing inventory was 40,000 units.

- (i) Compute the breakeven point under absorption costing system assuming that under/over recovery of fixed overheads are charged against cost of goods sold.
- (ii) Compute Breakeven point under marginal costing.
- (iii) Assuming that sales were at break-even level computed under (ii) above, and that under recovery or over recovery of fixed overheads is written off against cost of goods sold, find the profit under absorption costing system.

**Answer:**

7. (i) Reconciliation of profit under variable costing approach to that under absorption costing approach

Profit/Loss under absorption costing approach (Profit/Loss in case of Breakeven point is zero)	Nil	
- Higher value of closing stock under absorption costing approach		56,000 (40000 units @ ₹ 1.40)
- Higher value of opening stock under absorption costing approach	42,000 (30000 units @ ₹ 1.40)	
<b>Total</b>	<b>42,000</b>	<b>56,000</b>
Loss under variable costing approach	<b>₹ 14,000</b>	

Sales for ₹ 14,000 Loss (under variable costing approach)

$$= \frac{\text{Fixed Cost} - \text{Loss}}{\text{Contribution per unit}} = \frac{10,80,000}{10 - 6 - 2} = 5,33,000 \text{ units}$$

Breakeven point under absorption costing = sale of 5,33,000 units (Production: 5,43,000 units)

- (ii) BEP (under marginal costing approach)

$$= \frac{\text{Fixed Cost}}{\text{Contribution per unit}} = \frac{10,80,000}{10 - 6 - 2} = 5,40,000 \text{ units}$$

BEP (under marginal costing approach) = sale of 5,40,000 units (Production: 5,50,000 units)

**Working Notes:**

Total fixed overheads ₹ 8,40,000  
 Fixed overheads per machine hour = ₹ 14  
 Production rate per machine hour = 10  
 Fixed overhead per unit = ₹ 1.40

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Value of stock under variable costing = Variable production cost = ₹ 6 per unit  
 Value of stock under absorption costing  
 = Variable production cost + fixed production cost  
 = ₹ 6 per unit + ₹ 1.40 per unit  
 = ₹ 7.40 per unit

(iii) Calculation of profit under absorption costing approach if the sales being 5,40,000 units  
 Variable costing profit at 5,40,000 units sales : Nil  
 Under absorption costing profit will be higher by ₹ 14,000 on account of higher values of opening and closing stock.  
 Hence, profit under absorption costing = ₹ 14,000.

**8. Modern Tiles Ltd. makes plastic tiles of standard size of 6" x 6" x 1/8". From the following information, you are required to calculate direct materials:**

- (i) the cost variance in total
- (ii) the cost variance sub-divided into (a) price; and (b) usage
- (iii) the usage variance analyzed as (a) mix; (b) yield

A standard mix of the compound required to produce an output of 20,000 square feet of tiles 1/8" thick as follows:

Direct Materials	Quantity (kgs.)	Price per kg. (₹)
A	600	0.90
B	400	0.65
C	500	0.40

During December, 2016, 8 mixes were processed and actual materials consumed were:

Direct Materials	Quantity (kgs.)	Price per kg. (₹)
A	5,000	0.85
B	2,900	0.60
C	4,400	0.45

Actual production for December was 6,20,000 tiles.

Answer:

**8. Working Notes:**

(1) One mix of 20,000 sq. ft. to tiles would produce 80,000 tiles, i.e.  $(20,000 \times 144) / (6 \times 6)$

(2) Standard Quantity for Actual Output

		(Kg.)
A	$(600 \times 6,20,000/80,000)$	4,650
B	$(400 \times 6,20,000/80,000)$	3,100
C	$(500 \times 6,20,000/80,000)$	3,875

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(3) Standard Cost = Standard quantity x Standard price

		(₹)
A	(4,650 x ₹ 0.90)	4,185
B	(3,100 x ₹ 0.65)	2,015
C	(3,875 x ₹ 0.40)	1,550
		7,750

(4) Actual Cost = Actual quantity x Actual

		(₹)
A	(5,000 x ₹ 0.85)	4,250
B	(2,900 x ₹ 0.60)	1,740
C	(4,400 x ₹ 0.45)	1,980
		7,970

Calculation of Material Variances

(1) Material Cost Variance = Std. cost - Actual cost = ₹ 7,750 - ₹ 7,970 = ₹ 220 (A)

(2) Material Price Variance = Actual qty. (Std. price - Actual price)

A = 5,000 (₹ 0.90 - ₹ 0.85)	= ₹ 250 (F)	
B = 2,900 (₹ 0.65 - ₹ 0.60)	= ₹ 145 (F)	
C = 4,400 (₹ 0.40 - ₹ 0.45)	= ₹ 220 (A)	= ₹ 175 (F)

(3) Material Usage Variance = Standard price (Standard quantity - Actual quantity)

A = ₹ 0.90 (4,650 - 5,000)	= ₹ 315 (A)	
B = ₹ 0.65 (3,100 - 2,900)	= ₹ 130 (F)	
C = ₹ 0.40 (3,875 - 4,400)	= ₹ 210 (A)	= ₹ 395 (A)

Revised Standard Quantity = (Total actual mix/Total standard mix) Standard quantity

A = (12,300/11,625)4,650	= 4,920
B = (12,300/11,625)3,100	= 3,280
C = (12,300/11,625)3,875	= 4,100

(4) Material Mix Variance = Std. price (Revised std. quantity - Actual quantity)

A = ₹ 0.90 (4,920 - 5,000)	= ₹ 72 (A)	
B = ₹ 0.65 (3,280 - 2,900)	= ₹ 247 (F)	
C = ₹ 0.40 (4,100 - 4,400)	= ₹ 120 (A)	= ₹ 55 (F)

(5) Material Yield Variance = Standard cost/unit (Standard yield - Actual yield)

(a) Standard cost per unit = 7,750/6,20,000	= ₹ 0.0125
(b) Standard Yield for Actual input = (80,000/1,500)12,300	= 6,56,000 files

Therefore, Material Yield Variance = ₹ 0.0125 (6,56,000 - 6,20,000) = ₹ 450 (A)



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## Summary of Material Variances

		₹
Price variance		175(F)
Usage variance		
(a) Mix variance		
(b) Yield variance	55F	
Material Cost variance	450 (A)	395 (A)
		220 (A)

9. (a) What do you mean by Dual-Rate Transfer Pricing System?

(b) A Company is organized on decentralized lines, with each manufacturing division operating as a separate profit centre. Each Division Manager has full authority to decide on sale of division's output to outsiders or to other divisions. Division A manufactures a single standardized product. Some output is sold externally and remaining is transferred to Division X where n is a sub-assembly in the manufacture of that Division's product. The unit cost of Division A and Division X is as follows:

Particulars	Division A	Division X
Transfer from Division A to X	-	₹ 42.00
Direct Material	₹ 6.00	₹ 35.00
Direct Labour	₹ 3.00	₹ 4.50
Direct Expenses	₹ 3.00	---
Variable Manufacturing Overheads	₹ 3.00	₹ 18.00
Fixed Manufacturing Overheads	₹ 6.00	₹ 18.00
Variable Selling & Packing Expenses	₹ 3.00	₹ 2.50
<b>Total</b>	<b>₹ 24.00</b>	<b>₹ 120.00</b>

Division A sold 40,000 units annually at the Standard Price of ₹ 45 in the external market. In addition to the external sales 10,000 units are transferred annually to Division X at an internal price of ₹ 42 per unit. Variable Selling and Packing Expenses are not incurred by the supplying divisions for the internal transfer of the product. Division X incorporates the transferred goods into a more advanced product. The Manager of Division X disagrees with the basis used to set the Transfer Price. He argues that Transfer Price should be made at Variable Cost, since he claims that his Division is taking output that Division A should be unable to sell at a price of – ₹ 45.

He also submitted a report of the relationship between Selling Price and demand, to support of his disagreement.

The report of customer demand at various Selling Prices for Division A and for Division X is as follows –

<b>Division A</b>	Selling Price per unit	₹ 30	₹ 45	₹ 60
	Demand	60,000 units	40,000 units	20,000 units
<b>Division X</b>	Selling Price per unit	₹ 120	₹ 135	₹ 150
	Demand	15,000 units	10,000 units	5,000 units

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The Company has sufficient capacity to meet demand at various Selling Prices. Internal transfer demanded units will be decided by X Division. Required:

1. To calculate Divisional Overall Profitability, if Division A transfers demanded units to X at a price of ₹ 42.
2. To calculate Divisional and Overall Profitability, if Division A transfers demanded units to X at Variable Cost.
3. In place of Internal Transfers, Division A can sell 10,000 units of its product in a new external market without affecting existing market, at a price of ₹ 32 per unit and X Division can purchase these units at the rate of ₹ 31 in the open market. Calculate Company's Profit by following the above strategies.

**Answer:**

9. (a) 1. Dual-Rate Transfer Pricing uses two separate Transfer Prices to price each inter-divisional transaction, as under-

Dual Rate Transfer Pricing Method

Debit Cost in Recipient Division Cost = Relevant Costs, i.e. Variable Cost + Opportunity Cost, if any	Credit Income in Transferring Division Income = Market Price, or Full Cost plus mark-up (whether or not Intermediate Product is marketable)
--	---

Under this method, Company Profits = Total of Divisional Profits Less Inter-Divisional Mark-up,

2. Advantages:
  - (a) Incentive to Transferring Division: The Transferring Division Manager is motivated to transfer the Intermediate Product internally, since each unit transferred generates a profit (due to mark-up).
  - (b) No Unjust Enrichment: If the Transfer Price is set at the Transferring Division's Marginal Cost for the Intermediate Product, that division will not have any contribution from internal transfers. All the total contribution from inter-divisional trading will be assigned to the Recipient Division. Such unjust enrichment is avoided through the use of mark-up.
- (c) Optimal Decisions: Since Relevant Cost is used as the second Transfer Price, (for debiting Cost in Recipient Division) the Transfer Pricing system automatically promotes goal congruence by leading to optimal decisions.
3. Disadvantages:
  - (a) Confusing: Use of different Transfer Prices causes confusion, particularly when more than two divisions are involved.
  - (b) Artificial: Dual Transfer Prices are considered to be artificial.
  - (c) No incentive: Fixed Price with mark-up protects Transferring Divisions from competition. It gives them little incentive to improve their productivity.
  - (d) Misleading: Dual Transfer Prices can result in misleading information and create a false impression of divisional profits. There is a possibility of double-counting of profits. At the extreme, all divisions may report profits, when the Company as a whole is losing money.

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(b) (1) Computation of Variable Costs per unit in different cases

Particulars	Direct Material	Direct Labour	Direct Expenses	Var POH	Var SOH	Total Variable Cost
(a) Division A (or Ext. Sale)	₹ 6.00	₹ 3.00	₹ 3.00	₹ 3.00	₹ 3.00	₹ 18.00
(b) Division A (for Int Tfr)	₹ 6.00	₹ 3.00	₹ 3.00	₹ 3.00	---	₹ 15.00
(c) Division X (Own Variable Cost)	₹ 35.00	₹ 4.50	---	₹ 18.00	₹ 2.50	₹ 60.00

Note: Fixed Costs of –

(i) Divn A = (50,000 units × ₹ 6) = ₹ 3,00,000

(ii) Divn X = (10,000 units × ₹ 18) = ₹ 1,80,000

(2) Determination of Internal Transfer quantity, i.e., Demand by X division

When TP = ₹ 42						When TP = VC = ₹ 15 p.u.					
Qty	SP p.u.	Own VC	TP p.u.	Cn p.u.	Total Cn	Qty	SP P.U.	Own VC	TP p.u.	Cn p.u.	Total Cn
5,000	₹ 150	₹ 60	₹ 42	₹ 48	₹ 2,40,000	5,000	₹ 150	₹ 60	₹ 15	₹ 75	₹ 3,75,000
10,000	₹ 135	₹ 60	₹ 42	₹ 33	₹ 3,30,000 (maximum)	10,000	₹ 135	₹ 60	₹ 15	₹ 60	₹ 6,00,000 (maximum)
15,000	₹ 120	₹ 60	₹ 42	₹ 18	₹ 2,70,000	15,000	₹ 120	₹ 60	₹ 15	₹ 45	₹ 6,75,000
So, Demanded Internal Transfer Qty = 10,000 units						So, Demanded Internal Transfer Qty = 15,000 units					

(3) Profit Statement at various Transfer Prices and Output levels

Particulars	Transfer from A to X at TP = 42 p.u			Transfer from A to X at TP = VC 15		
	Division A		Division X	Division A		Divn X
	Sale	Transfer	Sale	Sale	Transfer	Sale
(a) Qty (units)	40,000	10,000	10,000	40,000	15,000	15,000
(b) Sale Price p.u.	45	42	135	45	15	120
(c) VC p.u.: Own	18	15	60	18	15	60
Transfer in	--	--	42	--	--	15
Total VC pu	18	15	102	18	15	75
(d) Contribution pu	27	27	33	27	-	45
(e) Total	10,80,000	2,70,000	3,30,000	10,80,000	-	6,75,000
Contribution (a×d)	13,50,000		3,30,000	10,80,000		6,75,000
(f) Fixed Cost (WN1)	(3,00,000)		(1,80,000)	(3,00,000)		(1,80,000)
(g) Profit (e - f)	10,50,000		1,50,000	7,80,000		4,95,000
(h) Company Profit	(10,50,000 + 1,50,000) = 12,00,000			(7,80,000 + 4,95,000) = 12,75,000		

Note: Both Departments have enough capacity to meet Internal & external demands.

(4) Profit Statement when Division X procures its materials from external market

Particulars	Division A		Division X
(a) Sale Quantity (units)	Given 40,000 units	New 10,000 units	10,000 units
(b) Selling Price p.u	45	32	135
(c) Variable Cost p.u	18	18	(60 + 31) = 91
(d) Contribution p.u	27	14	44

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(e) Total Contribution (a × d)	10,80,000	1,40,000	4,40,000
	12,20,000		
(f) Fixed Cost (WN 1)	3,00,000		1,80,000
(g) Profit	9,20,000		2,60,000
(h) Company Profit	(9,20,000 + 2,60,000) = 11,80,000		

10. (i) Explain how CVP based Sensitivity Analysis, can help Managers with uncertainty.

(ii) MN Agarwal owns a Gift-Shop, a Restaurant and a Lodge in Shillong. Typically, he operates these only during the season period of 4 months in a year. For the past season the occupancy rate in the Lodge was 90% and level of activity in case of Gift-Shop and Restaurant at 80%. The relevant data for the past season were as under-

	Gift Shop		Restaurant		Lodge	
	Amount	%	Amount	%	Amount	%
1. Receipts/Sales	48,000	100	64,000	100	1,80,000	100
2. Expenditure:						
Cost of sales	26,400	55	35,200	55	---	---
Supplies	2,400	5	6,400	10	14,400	8
Insurance & Taxes	1,920	4	6,400	10	36,000	20
Depreciation	2,880	6	8,000	12(1/2)	39,600	22
Salaries	4,800	10	4,800	7(1/2)	25,200	14
Electricity Charges	960	2	3,200	5	13,500	7(1/2)
Total	39,360	82	64,000	100	1,28,700	71(1/2)
3. Profit	8,640	18	---	---	51,300	28(1/2)

**Additional information:**

- (a) Cost of Sales and Supplies vary directly with the occupancy rate In case of Lodge and level of activity In case of Gift Shop and Restaurant.
- (b) Insurances and Taxes and Depreciation are for the entire period of twelve months.
- (c) Salaries paid are for the season period except a Chowkidar for the Lodge who is paid for the full year at ₹ 400 per month.
- (d) Electricity Charges include Fixed Charges of ₹ 640, ₹ 1,920 and ₹ 9,900 for Gift-shop, Restaurant and Lodge respectively.

The balance amount varies directly with occupancy rate in case of Lodge and level of activity in case of Gift-Shop and Restaurant. Fixed Electric Charges are for the season except in case of Lodge where ₹ 6,900 is for the season and ₹ 3,000 for the entire period of twelve months.

Agarwal is interested in increasing his Net Income. The following options are under his consideration -

- (a) To continue the operations during the season period only by inserting advertisement in newspapers thereby occupancy rate to reach 100% in case of Lodge and 90% level of activity in respect of Gift-Shop and Restaurant. The costs of advertisement are estimated at ₹ 12,000).

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(b) To continue operations throughout the entire period of twelve months comprising season period of four months and off-season period of eight months. The occupancy rate is expected at 90% and 40% during season period and off-season period respectively in case of the Lodge. The room rents are bound to be reduced to 50% of the original rates during off-season period. The level of activity of Gift-Shop and Restaurant is expected at 80% and 30% during season and off- season period respectively but 5% discount on the original rates will have to be offered during off-season period.

**Which option is profitable? As a Cost Accountant would you like to suggest him any other alternative based upon the above figures, which can be adopted to earn more net profit? (Use Incremental Revenue and Cost Approach.)**

**Answer:**

10. (i) **CVP based Sensitivity Analysis help Managers to cope with uncertainty.**

1. Sensitivity Analysis refers to analysis of the change in one factor on the other related factors. For example, what will be the effect of a 10% increase in Selling Price, on Sales Volume and Profits?
2. Sensitivity Analysis focusses on how a result will be changed if the original estimates of the underlying assumptions change.
3. CVP-based Sensitivity analysis will help top Management to get answers to questions like - What will be the Total Profit if the Sales Mix is changed to include more of Product L and less of Product M? or What will be the Profit if Fixed Costs increase by 30% and Variable Costs decline by 5%?, etc.
4. CVP-based Sensitivity analysis can be performed in a Spreadsheet package, i.e. computerized CVP Models. Computers will quickly show changes both graphically and numerically based on data keyed in.
5. Managers can study various combinations of changes in Selling Prices, Fixed Costs, Variable Costs and Product Mix, and can react quickly without waiting for formal MIS Reports from the Financial Officer.
6. Therefore, use of CVP-based Sensitivity analysis, helps Managers to cope up with uncertainty.

(ii) (1) Additional Revenues and Costs under Option 1: Operate during Season only

(Amounts in ₹)

Particulars	Gift Shop	Restaurant	Lodge	Total
1. Additional Revenue	Given = 48,000 at 80%. So, for extra 10% = $48,000 \times (10/80) = 6,000$	Given = 48,000 at 80%. So, for extra 10% = $48,000 \times (10/80) = 6,000$	Given = 48,000 at 80%. So, for extra 10% = $48,000 \times (10/80) = 6,000$	Given = 48,000 at 80%. So, for extra 10% = $48,000 \times (10/80) = 6,000$
2. Additional Costs				
(a) Cost of Sales	$6,000 \times 55\% = 3,300$	$8,000 \times 55\% = 4,400$	Nil	7,700
(b) Supplies	$6,000 \times 5\% = 300$	$8,000 \times 10\% = 800$	$20,000 \times 8\% = 1,600$	2,700

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(c) Electricity Charges	$(960 - 640) \times (10/80) = 40$	$(3,200 - 1,920) \times (10/80) = 160$	$(13,500 - 9,900) \times (10/90) = 400$	600
(d) Advertisement				12,000
Sub-Total				23,000
3. Additional Profit				11,000

(2) Additional revenues and costs under Option 2: Operate during all 12 months

(Amounts in ₹)

Particulars	Gift Shop	Restaurant	Lodge	Total
1. Additional Revenue	$48,000 \times 2 \times (30\%/80\%) \times 95\% = 34,200$	$64,000 \times 2 \times (30\%/80\%) \times 95\% = 45,600$	$1,80,000 \times 2 \times (40\%/90\%) \times 50\% = 80,000$	1,59,800
2. Additional Costs				
(a) Cost of Sales	$36,000 \times 55\% = 19,800$	$48,000 \times 55\% = 26,400$		46,200
(b) Supplies	$36,000 \times 5\% = 1,800$	$48,000 \times 10\% = 4,800$	$1,60,000 \times 8\% = 12,800$	19,400
(c) Salaries	$4,800 \times 2 = 9,600$	$4,800 \times 2 = 9,600$	$(25,200 - 4,800) \times 2 = 40,800$	60,000
(d) Electricity (Fixed)	$640 \times 2 = 1,280$	$1,920 \times 2 = 3,840$	$6,900 \times 2 = 13,800$	18,920
(e) Electricity (Variable)	$(960 - 640) \times 2 \times (30\%/80\%) = 240$	$(3,200 - 1,920) \times 2 \times (30\%/80\%) = 960$	$(13,500 - 9,900) \times 2 \times (40\%/90\%) = 3,200$	4,400
Sub-Total				1,48,920
3. Additional Profit				10,880

(3) Decision: Both options are desirable since there is an Additional Net Income. Option 1 is slightly better than Option 2 by ₹ 120. However, it is suggested that the Firm should adopt a combination of both options in which case, the Total Additional Profit will be ₹ 11,000 + ₹ 10,880 = ₹ 21,880.

11. V Ltd. produces two products P and Q. The draft budget for the next month is as under:

Budgeted production and sale (units)	40,000	80,000
Selling price ₹/unit	25	50
Total costs ₹/unit	20	40
Machine hours/unit	2	1
Max. sale potential (units)	60,000	1,00,000

The fixed expenses are estimated at ₹9,60,000 per month. The co. absorbs fixed Oh's on the basis of machine hours which are fully utilised by the budgeted production and cannot be further increased.

When the budget was discussed, the managing director states that the product mix should be altered to yield optimum profit. The marketing director suggests that he could introduce a new product C each unit of which take 1.5 machine hours. However a processing vat involving a capital outlay of ₹2,00,000 is to be installed for processing product C. The additional fixed overheads relating to the processing vat was estimated at ₹60,000 per month. The variable costs are product C was estimated at ₹21 per unit.

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**Required:**

- (i) Calculate the profit as per draft budget for the next month.
- (ii) Revise the product mix based on data given P and Q to yield optimum profit.
- (iii) The company decides to discontinue either product P or Q whichever is giving lower profit and proposes to substitute product C instead. Fix the selling price of C in such a way to yield 15% return on additional capital employed besides maintaining the same overall profit as envisaged in (ii) above.

**Answer:**

## 11. Computation of profit as per draft budget:

	P	Q	Total
	₹	₹	₹
SP	25	50	
Total Cost	20	40	
Profit	5	10	
Budgeted Units	40,000	80,000	
Profit	2,00,000	8,00,000	10,00,000
Total Cost	8,00,000	32,00,000	40,00,000
(-) FC			9,60,000
VC			30,40,000
FC P u	12	6	
VC P u	8	34	
C P u	17	16	
C Per machine hour	8.5	16	
	II	I	

## Statement showing optimum mix and relevant profit:

		P	Q	Total
No. of units		30,000	1,00,000	
C P. u.	₹	17	16	
Total C	₹	5,10,000	16,00,000	21,10,000
FC	₹			9,60,000
Profit	₹			11,50,000

## Working Notes:

$$\begin{aligned} \text{Available hours} &= (40,000 \times 2) + (80,000 \times 1) = && ₹ 1,60,000 \\ \text{(-) Utilised for Q} &&& ₹ 1,00,000 \\ &&& ₹ \underline{60,000} \end{aligned}$$

$$\text{No. of units of P} = \frac{60,000}{2} = 30,000 \text{ units}$$

## Computation of SP of product C:

Out of products P & Q, P is less profitable and hence can be replaced by C.

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Variable Cost ₹ 21  
 FC ₹ 60,000  
 Machine hours released = 60,000 hrs.  
 No. of units of C =  $\frac{60,000}{1.5} = 40,000$  units

In order to get the profit as above, the contribution to be recovered is as follows:

	₹
Total Contribution	21,00,000
(+) Fixed Cost (addnl.)	60,000
(+) Return on capital employed	30,000
	22,00,000
(-) Recovered from Q	16,00,000
	6,00,000

$$C \text{ per unit} = \frac{60,000}{40,000} = ₹15$$

(+) VC 21 ₹  
 Selling Price 36 ₹

12. As a Cost Accountant, you decide to experiment by applying the principles of ABC to the four products currently made and sold by your company. Details of the four products and relevant information are given below for one period:

Product	A	B	C	D
Output in units	120	100	80	120
Costs per units:				
Direct material (₹)	40	50	30	60
Direct labour (₹)	28	21	14	21
Machine hours (per unit)	4	3	2	3

The four products are similar and are usually produced in production runs of 20 units and sold in batches of 10 units.

The production overhead is currently absorbed by using a machine hour rate, and the total of the production overhead for the period has been analysed as follows:

**Machine department costs (rent, business, rates, depreciation and supervision) ₹ 10,430**

	₹
Set-up costs	5,250
Stores receiving	3,600
Inspection/Quality control	2,100
Materials handling and dispatch	4,620



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You have ascertained that the 'cost drivers' to be used are as listed below for the overhead costs shown:

Cost	Cost Driver
Set-up costs	Number of production runs
Stores receiving	Requisitions raised
Inspection/Quality control	Number of production runs
Materials handling and dispatch	Orders executed

The number of requisitions raised on the stores, was 20 for each product and the number of orders executed as 42, each order being for a batch of 10 of a product. You are required:

- (a) to calculate the total costs for each product if all overhead costs are absorbed on a machine hour basis.
- (b) to calculate the total costs for each product, using activity - based costing.
- (c) to calculate and list the unit product costs from your figures in (a) and (b) above, to show the difference and to comment briefly on any conclusions which may be drawn which could have pricing and profit implications.

**Answer:**

12. (a) Statement showing total cost of different products, assuming absorption overhead on a machine hour basis:

	Product A	Product B	Product C	Product D
Direct material	40	50	30	60
Direct labour	28	21	14	21
Overhead*	80	60	40	60
Cost of production per unit	148	131	84	141
Output in units	120	100	80	120
Total Cost (₹)	17,760	13,100	6,720	16,920

\*Rate per machine hr. = 26,000/1300hrs = ₹ 20;

Machine hours = 480+300+160+360 = 1,300

(b)

Cost	₹	Driver	No.	Cost/Unit of driver
Set-ups	5,250	Prod. Runs	21*	₹ 250
Stores/receiving	3,600	Requisitions	80@	45
Inspection / quality	2,100	Prod. Runs	21	100
Handling /dispatch	4,620	Orders	42	110

\* Production runs= (120 + 20) + (100 + 20) + (80 + 20) + (120 + 20)

@ Requisitions = 20 for each product or 80 in total.

It may be pointed out that machine department cost of ₹ 10,430 will continue to be absorbed on a machine hour basis as before. The relevant absorption rate will be ₹ 10,430 ÷ 1,300 = ₹ 8.02 per machine hour.

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	Total Cost (₹)			
	Product A	Product B	Product C	Product D
Direct material	4,800	5,000	2,400	7,200
Direct labour	3,360	2,100	1,120	2,520
Set-ups	1,500	1,250	1,000	1,500
Stores/receiving	900	900	900	900
Inspection / quality	600	500	400	600
Handling/dispatch	1,320	1,100	880	1,320
Machine Deptt. Costs	3,851	2,407	1,284	2,888
	16,331	13,257	7,984	16,928
Cost per unit	136.09	132.57	99.80	141.07
(c) Cost per unit (a)	148.00	131.00	84.00	141.00
Cost per unit (b)	136.09	132.57	99.80	141.07
Difference	(11.91)	1.57	15.80	0.07

The total overheads which are spread over the four products have been apportioned on different bases, causing the product cost to differ substantially in respect of products A and C. A change from traditional machine hour rate to an activity-based system may have effect on:

- (i) Pricing and profits to the extent that pricing is based on a 'cost-plus' approach
- (ii) Reported profits to the extent that stock levels fluctuate between reporting periods.

**13. HRO Cycles Ltd has 2 divisions, A and B which manufacture bicycle. Division A produces the bicycle frame and Division B assembles rest of the bicycle on the frame. There is a market for both the sub-assembly and the final product. Each division has been treated as a profit center. The Transfer Price for the sub-assembly has been set at the long run average market price. The following data are available to each division -**

<b>Estimated Selling Price for Final Product</b>	<b>₹ 3,000 p.u.</b>
<b>Long-run Average Market Price for sub-assembly</b>	<b>₹ 2,000 p.u.</b>
<b>Incremental Costs of completion sub-assembly in Division B</b>	<b>₹ 1,500 p.u.</b>
<b>Incremental Costs in Division A</b>	<b>₹ 1,200 p.u.</b>

**Required:**

- 1. If Division A's maximum capacity is 1,000 units per month and sales to the intermediate market are now 800 units. Should 200 units be transferred to Division B at the long run average price basis?**
- 2. What would be the Transfer Price, if the Manager of Division B should be kept motivated?**
- 3. If outside market increases to 1,000 units, should Division A continue to transfer 200 units to Division B or sell entire production to outside market?**

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**Answer:**

13. 1. When External Sales = 800 units
- (a) Since External Sales of Sub-Assembly by Division A is only 800 units, there is a spare capacity of 200 units, which does not involve any Opportunity Costs.
- (b) Cost of Final Product from Company angle = Variable Costs of A + Variable Costs of B = ₹1,200 + ₹1,500 = ₹2,700 p.u. Since Final Selling Price (3,000) is above cost ₹2,700, there is a Net Contribution of ₹300 p.u. of the Final product. Hence, 200 units may be transferred by Division A.
2. Range of Transfer Prices will be as under -
- (a) Minimum TP (from Divn. A viewpoint) = Variable Costs only = ₹1,200.
- (b) Maximum TP (from Divn. B viewpoint) = Least of- (i) Market Price of Sub-Assembly [or] (ii) Ability to pay = ₹2,000 [or] (₹3,000 - ₹1,500) = ₹1,500.
- (c) A Transfer Price in the range of ₹1,200 to ₹1,500 will be agreeable to both Managers.
- (d) To keep the Manager of Division B motivated, the profit earned ₹300 per unit may be shared equally between the two Divisions. Hence, the appropriate Transfer Price for motivating Division B may be Variable Cost of Division A + 50% Share of Profit to be given to Division A = ₹1,200 + ₹150 = ₹1,350.
3. When External Sales = 1,000 units
- (a) If External Sales by Division A increases to 1,000 units, Internal Transfer would involve Opportunity Costs. Hence Relevant Cost of Internal Transfer = Variable Costs ₹1,200 + Opportunity Costs ₹800 (being Contribution foregone on External Sales) = ₹2,000.
- (b) Cost of Final Product from Company angle = Relevant Costs of A + Relevant Costs of B = ₹2,000 + ₹1,500 = ₹3,500 p.u. Since Final Selling Price (₹3,000) is below Relevant Cost (₹3,500), there is a Net Loss of ₹500 p.u. of the Final Product. Hence, Internal Transfers are not worthwhile. Division A has to sell the entire output of 1,000 units to the outside market only.

**14. ABC Limited manufactures product Min addition to other products by using the same machines in Departments A and B. The cost data are as under:**

**Direct Material P : 4 kg @ ₹6 per kg used in Dept. A;**

**Q : 8 kg @ ₹ 2.50 per kg added in Dept B**

**Direct Labour: 2 hours @ ₹ 4 per hour in Dept. A;**

**3 hours @ 3 per hour in Dept. B**

**Overheads:**

Basis of overheads recovery	Dept. A per rupee of direct material P (₹)	Dept. B per direct labour hour (₹)
<b>Recovery rates at 80% of practical capacity</b>		
<b>Variable</b>	<b>0.80</b>	<b>2.00</b>
<b>Fixed</b>	<b>2.20</b>	<b>3.00</b>
<b>Depreciation component of fixed overhead rate</b>	<b>0.80</b>	<b>0.10</b>
<b>Other relevant data:</b>		
<b>Net plant and equipment value</b>	<b>70,00,000</b>	<b>1,20,000</b>
<b>Total depreciation per month</b>	<b>80,000</b>	<b>1,000</b>

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The working capital requirement of Product M based on a target volume of output of 1,000 units per month is estimated at ₹1,24,000 per month is estimated at ₹24,000 per annum.  
Required:

- (A) Indicate the bottom line selling price of Product M assuming that:
- Price is adequate to ensure contribution equivalent to 30% on investment made.
  - The product is a new product about to be introduced in market.
- (B) Calculate the selling price in a situation where Product is well established in the market so as to yield return of 18% on investment.

Answer:

14. (A) It is given in the question that contribution equivalent to 30% on investment is adequate. Therefore, for arriving at the bottom line price of product M, it is necessary to work out the cost of production and capital employed (consisting of net fixed assets and working capital).

Statement showing cost of production of product M

Direct material	- Dept. A (P - 4 × ₹ 6)	₹ 24.00	44
	- Dept. B (Q- 8 × ₹ 2.5)	20.00	
Direct labour	- Dept. A (2 × ₹ 4)	8	17
	- Dept. B (3 × ₹ 3)	9	
Variable overheads:	- Dept. A (₹ 24 × ₹ 0.8)	19.20	
	- Dept. B (3 hrs × 2)	6.00	25.20
Total variable costs			86.20
Fixed overheads	- Dept. A (₹24 × 2.20)	52.80	
	- Dept. B (3 hrs 13)	9.00	61.80
Total cost of production			148.00

Statement Showing capital employed

	Dept. A	Dept. B
Depreciation per unit of M	₹ 24 × 0.8 = 19.20	3 hrs. × 0.1 = 0.30
Net Fixed Assets	₹ 70, 00,000	₹ 1,20,000
Depreciation p.a.	9,60,000	12,000
NFA for 12, 000 units p.a.	16,80,000*	36,000@

Total N.F.A.

(₹16,80,000 + ₹ 36,000) = ₹17,16,000

Working Capital                     1,24,000

Total capital employed             18,40,000

- (A) (i) Bottom line price (contribution 30% on investment) = ₹18,40,000 × 0.3 = ₹5,52,000  
Contribution per unit = ₹5,52,000 ÷ ₹ 12,000 = ₹46  
Bottom line price as per (a) = ₹86.20 + 46.00 = ₹132.20  
Bottom line price as per  
(ii) i.e., for new product (variable cost only) = 86.20.

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- (B) Selling price of the well established product = Total cost + 18% on investment  
 = ₹148 + 18% of (18,40,000 + 12,000) = ₹175.60.  
 \*(₹70 lakhs ÷ ₹ 9.60 lakhs) × 19.20 × 12,000  
 @ (₹1.20 lakhs ÷ 0.12 lakhs) × 0.30 × 12,000

15. A Company following Standard Marginal Costing system has the following Interim Trading Statement for the quarter ending 30'th June, which reveals a loss off ₹17,000, detailed below-

<b>Income:</b>		
<b>Sales</b>	<b>4,99,200</b>	
<b>Closing Stock (at Prime Cost)</b>	<b>18,000</b>	<b>5,17,200</b>
<b>Costs:</b>		
<b>Direct Material</b>	<b>1,68,000</b>	
<b>Direct Labour</b>	<b>1,05,000</b>	
<b>Variable Overhead</b>	<b>42,000</b>	<b>3,15,000</b>
<b>Fixed Overhead</b>	<b>1,20,000</b>	
<b>Fixed Administration OH</b>	<b>40,000</b>	
<b>Variable Distribution OH</b>	<b>19,200</b>	
<b>Fixed Selling OH</b>	<b>40,000</b>	<b>2,19,200</b>
<b>Total Costs</b>		<b>5,34,200</b>
<b>Loss</b>		<b>17000</b>

Additional Information is as follows:

- Sales for the quarter were 1,200 units. Production was 1,400 units, of which 100 units were scrapped after complete manufacture. The factory capacity is estimated at 2,000 units.
- Because of low production, Labour Efficiency during the quarter is estimated to be 20% below normal level. You are required to analyse the above and report to the Management, giving the reasons for the loss.

**Answer:**

15. (1) Analysis of the Profit and Loss Account to compute Standards

Particulars	Total (₹)	Standards Per Unit
Sales	4,99,200	₹4,99,200/ 1,200 units = ₹416
Less: Cost of Production:		
Materials	1,68,000	1,68,000 /1,400 units =₹120
Labour Cost (at 20% below normal level)	1,05,000	(1,05,000 × 80%)/1,400 units = 60
VOH(at 20% below normal efficiency)	42,000	(42,000 × 80%)/1,400 units = 24
Less: Closing Stock (120 + 60) ×100 units	(18,000)	(see Note)
Gross Contribution	2,02,200	₹212
Less: Variable Distribution OH	19,200	19,200 / 1,200 units =₹16
Net Contribution	1,83,000	₹196
Less: Fixed Costs(1,20,000 +40,000+40,000)	2,00,000	
Loss	(17,000)	
Note: Production 1,400 units - Sales 1,200 units - Scrapped 100 units = 100 units		

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(2) Assumptions /Working Notes in analyzing Variances

(a) Sales Variances: Budgeted Capacity = 2,000 units is taken as Budgeted Sales Quantity. Also, it is assumed that

Budgeted Sale Price = Actual Sale Price = ₹416 per unit.

- Sales Price Variance = Nil.
- Sales Volume Variance (Effect on Contribution)  
= (2,000 units- 1,200 units) × 196 = ₹1,56,800A

(b) Material Cost Variances: In the absence of information, Material Cost Variances = Nil.

(c) Labour Cost Variances:

- Labour Rate Variance = Nil.
- Labour Efficiency Variance = 1,05,000 × 20% Efficiency Loss = ₹21,000A

(d) Variable OH Cost Variances:

- VOH Expenditure Variance = Nil.
- VOH Efficiency Variance = 42,000 × 20% Efficiency Loss = ₹8,400A.

(e) FOH Cost Variances: In the absence of information, FOH Cost Variances = Nil.

(f) Effect of Abnormal Loss: Variable Cost of Output scrapped after complete manufacture = (120 + 60 + 24) = 204 × 100 units = ₹20,400A.

(g) Stock Valuation Effect: Since Marginal Costing System in use, the inventories are to be carried at total variable cost. However, since the Company has valued its inventories on Prime Cost basis, i.e. excluding VOH, to that extent, profits will be under--stated. Hence, effect of VOH not included in Stock Valuation = 24 × 100 units = ₹2,400A.

3. Explanation of factors causing Loss during the period

Particulars	₹	₹
Budgeted Contribution for 2,000 units at ₹196	3,92,000	
Less: Budgeted Fixed Costs (1,20,000 + 40,000 + 40,000)	2,00,000	
Budgeted Profit		1,92,000
Less: Effect of Variances		
Sales Volume Variance	1,56,800A	
Labour Efficiency Variance	21,000A	
VOH Efficiency Variance	8400A	
Abnormal/Loss I Scrap	20,400A	
Stock Valuation Difference	2,400A	(2,09,000)
Loss for the period		(17,000)

Alternative treatment: In the above calculations, Labour Efficiency has been taken to have an impact on VOH, i.e. time related OH also. If such impact is not considered in VOH, Standard Contribution; per unit will be ₹196 (instead of ₹190). All calculations will stand modified accordingly.

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16. A Small retailer has studied the weekly receipts and payments over the past 200 weeks and has developed the following set of information:

Weekly Receipts (₹)	Probability	Weekly Payments (₹)	Probability
3000	0.20	4000	0.30
5000	0.30	6000	0.40
7000	0.40	8000	0.20
12000	0.10	10000	0.10

Using the following set of random numbers, simulate the weekly pattern of receipts and payments for the 12 weeks of the next quarter, assuming further that the beginning bank balance is ₹ 8000. What is the estimated balance at the end of the 12 weekly period? What is the highest weekly balance during the quarter? What is the average weekly balance for the quarter?

**Random Numbers**

For Receipts	03	91	38	55	17	46	32	43	69	72	24	22
For payments	61	96	30	32	03	88	48	28	88	18	71	99

According to the given information, the random number interval is assigned to both the receipts and the payments.

Answer:

16.

Range of random numbers							
Receipt (₹)	Probability	Cumulative probability	Range	Payments (₹)	Probability	Cumulative probability	Range
3000	0.20	0.20	0-19	4000	0.30	0.30	0-29
5000	0.30	0.50	20-49	6000	0.40	0.70	30-69
7000	0.40	0.90	50-89	8000	0.20	0.90	70-89
12000	0.10	1.00	90-99	10000	0.10	1.00	90-99

Simulation of Data for a period of 12 weeks					
Week	Random No. for receipt	Expected Receipt (₹)	Random No. for payment	Expected Payment (₹)	Week end Balance (₹)
Opening Balance					8000
1	03	3000	61	6000	5000 (8000 + 3000 – 6000)
2	91	12000	96	10000	7000
3	38	5000	30	6000	6000
4	55	7000	32	6000	7000
5	17	3000	03	4000	6000
6	46	5000	88	8000	3000
7	32	5000	48	6000	2000
8	43	5000	28	4000	3000
9	69	7000	88	8000	2000
10	72	7000	18	4000	5000
11	24	5000	71	8000	2000
12	22	5000	99	10000	(3000)

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Estimated balance at the end of 12 <sup>th</sup> week	=	₹ (3,000)
Highest balance	=	₹ 7,000
Average balance during the quarter	=	45,000/12 = ₹ 3,750

**17. To stimulate interest and provide an atmosphere for intellectual discussion, a finance faculty in a management school decides to hold special seminars to four contemporary topics- leasing, portfolio management, private mutual funds, swaps and options. Such seminars should be held once in a week in the afternoons. However, scheduling these seminars (one for each topic, and not more than one seminar per afternoon) has to be done carefully so that the number of students unable to attend is kept to a minimum. A careful study indicates that the number of students who cannot attend a particular seminar on a specific day is as follows:**

	Leasing	Portfolio management	Private mutual funds	Swaps and Options
<b>Monday</b>	<b>50</b>	<b>40</b>	<b>60</b>	<b>20</b>
<b>Tuesday</b>	<b>40</b>	<b>30</b>	<b>40</b>	<b>30</b>
<b>Wednesday</b>	<b>60</b>	<b>20</b>	<b>30</b>	<b>20</b>
<b>Thursday</b>	<b>30</b>	<b>30</b>	<b>20</b>	<b>30</b>
<b>Friday</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>30</b>

**Find an optimum schedule of the seminars. Also find out the total number of students who will be missing at least one seminar.**

**Answer:**

**17. This is an unbalanced minimisation assignment problem. We first of all balance it by adding a dummy topic.**

	Leasing	Portfolio Management	Private Mutual funds	Swaps and options	Dummy
Monday	50	40	60	20	0
Tuesday	40	30	40	30	0
Wednesday	60	20	30	20	0
Thursday	30	30	20	30	0
Friday	10	20	10	30	0

Subtracting the minimum element of each column from all elements of that column, we get the following matrix.

	Leasing	Portfolio Management	Private Mutual funds	Swaps and options	Dummy
Monday	40	20	50	0	0
Tuesday	30	10	30	10	0
Wednesday	50	0	20	0	0
Thursday	20	10	10	10	0
Friday	0	0	0	10	0

The minimum number of lines to cover all zeros is 4, which is less than the order of the matrix (i.e., 5), the above matrix will not give the optimal solution. Subtract the minimum uncovered



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element (i.e., 10) from all uncovered elements and add it to the elements lying on the intersection, we get the following matrix:

	Leasing	Portfolio Management	Private Mutual funds	Swaps and options	Dummy
Monday	30	20	40	0	0
Tuesday	20	10	20	10	0
Wednesday	40	0	10	0	0
Thursday	10	10	0	10	0
Friday	0	10	0	20	10

Since the minimum number of lines to cover all zeros is 5, which is equal to order of the matrix, the above matrix will give the optimum solution which is given below:

Leasing portfolio Private Swaps and management mutual funds options Dummy

Monday	30	20	40	0	0
Tuesday	20	10	20	10	0
Wednesday	40	0	10	0	0
Thursday	10	10	0	10	0
Friday	0	10	0	20	10

The optimal schedule is:

Day	Contemporary topics	No. of students missing
Monday	Swaps and options	20
Tuesday	No seminar	0
Wednesday	Portfolio	20
Thursday	Private mutual funds	20
Friday	Leasing	10
	Total	70

Thus number of students, who will be missing at least one seminar is 70.

- 18. A farmer has a farm with 125 acres. He produces Carrot, Beetroot and Potato. Whatever he produces is fully sold in the market. He gets ₹ 5 per kg for Carrot, ₹ 4 per kg for Beetroot and ₹ 5 per kg for Potato. The average yield is 1500 kg of Carrot per acre, 1800 kg of Beetroot per acre and 1200 kg of Potato per acre. To produce each 100 kg of Carrot and Beetroot and 80 kg of Potato, a sum of ₹ 12.50 has to be spent for manure. Labour required for each acre to raise the crop is 6 man-days for Carrot and Potato each and 5 man-days for Beetroot. A total of 500 man-days of labour at the rate of ₹ 40 per man-day are available. Formulate a LPP to maximise the farmer's total profit.**

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**Answer:**

18. Let C, B and P be the number of acres allotted for cultivating Carrot, Beetroot and Potato respectively. The profit from the produces is determined in the following manner –

Particulars per acre	Carrot	Beetroot	Potato
Selling Price	₹ 5 / Kg x 1500 kgs = ₹ 7500	₹ 4 / kg x 1800 kgs = ₹ 7200	₹ 5 / kg x 1200 kgs = ₹ 6000
Less: Manure Cost	1500 kgs x ₹ 12.50/100 = ₹ 187.50	1800 kgs x ₹ 12.50/100 = ₹ 225.00	1200 kgs x ₹ 12.50/80 = ₹ 187.50
Less: Labour Cost	₹ 40 x 6 = ₹ 240	₹ 40 x 5 = ₹ 200	₹ 40 x 6 = ₹ 240
Profit per acre	₹ 7072.50	₹ 6775	₹ 5572.50

Maximise Profit  $Z = 7072.50 C + 6775 B + 5572.5 P$

subject to

$$\begin{aligned}
 C + B + P &\leq 125 && \text{(Land Availability)} \\
 6C + 5B + 6P &\leq 500 && \text{(Man Days Availability)} \\
 C, B, P &\geq 0 && \text{(Non-Negativity Assumption)}
 \end{aligned}$$

19. The following matrix gives the unit cost of transporting a product from production plants P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub> to destinations D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub>. Plants P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub> have a maximum production of 65, 24 and 111 respectively and destinations D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub> must receive at least 60, 65 and 75 units respectively:

To From	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	Supply
P <sub>1</sub>	400	600	800	65
P <sub>2</sub>	1,000	1,200	1,400	24
P <sub>3</sub>	500	900	700	111
Demand	60	65	75	200

You are required to formulate the above as a Linear Programming Problem. (Only formulation is needed. Please do not solve.)

**Answer:**

19. Let  $p_{ij}d_j$  be the variable to denote the number of units of product from the  $i^{\text{th}}$  Plant to the  $j^{\text{th}}$  destination, so that  $p_{1d_1}$  = Transport Cost from Plant P<sub>1</sub> to Destination D<sub>1</sub>, and  $p_{2d_2}$  = transport from Plant P<sub>2</sub> to Destination D<sub>2</sub>, etc.

Objective Function:

$$\text{Minimize } Z = 400 p_{1d_1} + 600 p_{1d_2} + 800 p_{1d_3} + 1000 p_{2d_1} + 1200 p_{2d_2} + 1400 p_{2d_3} + 500 p_{3d_1} + 900 p_{3d_2} + 700 p_{3d_3}$$

Subject to:

$$\left. \begin{aligned}
 p_{1d_1} + p_{1d_2} + p_{1d_3} &\leq 65 \\
 p_{2d_1} + p_{2d_2} + p_{2d_3} &\leq 24 \\
 p_{3d_1} + p_{3d_2} + p_{3d_3} &\leq 111
 \end{aligned} \right\} \text{(Plant Constraints)}$$

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and

$$\left. \begin{aligned} p_1d_1 + p_2d_1 + p_3d_1 &\geq 60 \\ p_1d_2 + p_2d_2 + p_3d_2 &\geq 65 \\ p_1d_3 + p_2d_3 + p_3d_3 &\geq 75 \end{aligned} \right\} \quad \text{(Destination Constraints)}$$

$$\text{all } p_i d_j \geq 0 \quad \text{(Non-Negativity Assumption)}$$

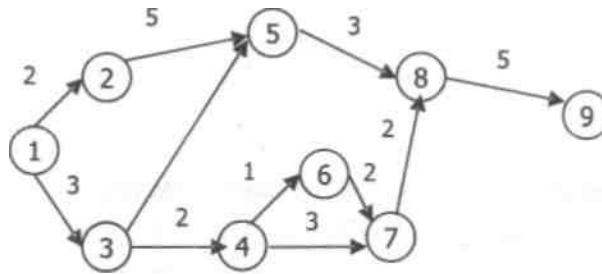
20. A Network is given below-

- Name the Paths and give their total duration.
- Give three different ways of reducing the above project duration by four weeks.

Activity	Duration	Activity	Duration
1 – 2	2 weeks	4 – 7	3 weeks
1 – 3	3 weeks	5 – 8	3 weeks
2 – 5	5 weeks	6 – 7	2 weeks
3 – 4	2 weeks	7 – 8	2 weeks
4 – 6	1 weeks	8 – 9	5 weeks

Answer:

20.



Path	1-2-5-8-9	1-3-5-8-9	1-3-4-6-7-8-9	1-3-4-7-8-9
Path No.	I	II	III	IV
Duration	2+5+3+5 = 15 weeks	3+0+3+5 = 11 weeks	3+2+1+2+2+5 = 15 weeks	3+2+3+2+5 = 15 weeks

The different ways of reducing the Project Duration by four weeks are –

1. Reduce duration of Activity 8- 9 by 4 weeks (presently 5 weeks), since this is a common activity on all Paths.
2. Reduce duration of Activity 1- 3 (Common for Paths II, III and IV), and any one of Activities 1 - 2 and 2- 5 (on Path I) such that total time reduction is 4 weeks.
3. Reduce duration of Activity 3-4 or 7- 8 (Common for Paths III & IV), and Activity 5-8 (Common for Paths I & II).