

PAPER – 5 : COST MANAGEMENT

QUESTIONS

1. (a) What do you understand by MRP? What are its objectives?
(b) "In case of a multi product company, Pareto Analysis is of immense help for pricing purposes". Discuss.
(c) Describe the concept of Back flushing as used in the JIT system. What problems need to be addressed before implementing such a concept? Briefly discuss.

Marginal Costing – Calculation of BEP

2. (a) Somesh plans to open a Rest house which shall be able to accommodate 6 to 15 guests at a charge of Rs 100 per week. Somesh estimates to earn a contribution margin of Rs 57 per guest and shall have to pay fixed expenses relating to rent equaling Rs 4,000 per annum. In addition Rs 1,000 per annum shall be paid to an outside contractor for general maintenance. Somesh estimates that as long as 10 guests are accommodated, the fixed cost of supervision would be Rs. 11,000 for 30 weeks. However, in case guests exceed 10 numbers, addition fixed cost of Rs. 200 per week will have to be incurred for the entire 30 week period

You are required to tabulate the figures to find out the Break-even Point.

- (b) Two manufacturing companies which have the following operating details decide to merge:

	Company 1	Company 2
Capacity utilization %	90	60
Sales (Rs. lakhs)	540	300
Variable Costs (Rs. lakhs)	396	225
Fixed Costs (Rs. lakhs)	80	50

Assuming that the proposal is implemented, calculate:

- (i) Break even sales of the merged plant and the capacity utilization at that stage.
- (ii) Profitability of the merged plant at 80% capacity utilization.
- (iii) Sales turnover of the merged plant to earn a profit of Rs.75 lakhs.
- (iv) When the merged plant is working at a capacity to earn a profit of Rs. 75 lakhs, what percentage increase in selling price is required to sustain an increase of 5% in fixed overheads.

Marginal Costing – Find of BEP

3. (a) The investment for a project is Rs. 20 crores. The selling price per unit shall be Rs 400 with a variable cost of Rs.240 and fixed cost of Rs. 23, 00,000 per annum. If the required rate of return is 12%, what will be the BEP for a life span of 6 years?

- (b) If the project building period is 2 years with 60% of capital invested in the 1st year, what is the project BEP production & sale volume?
4. What do you understand by a Balanced Scorecard? Give reasons why Balanced Scorecards sometimes fail to provide for the desired results. Do you think that such a scorecard is useful for external reporting purposes?

Standard Costing : Variance Analysis

5. ABC Ltd manufactures Product S for national distribution in India. The standard and actual costs for the manufacture of Product S are as follows:

	Standard Costs	Actual Costs
Direct materials	1,500 kgs at Rs. 35	1,600 kgs at Rs. 32
Direct labour	4,800 hours at Rs. 11	4,500 hours at Rs. 11.80
Factory overhead	Rates per labour hour, based on 100% of normal capacity of 5,500 labour hours:	
	Variable cost, Rs. 2.40	Rs. 12,300 variable cost
	Fixed cost, Rs. 3.50	Rs. 19,250 fixed cost

Instructions:

- Determine the quantity variance, price variance, and total direct materials cost variance for Product S.
 - Determine the time variance, rate variance, and total direct labour cost variance for Product S.
 - Determine the controllable variance, volume variance, and total factory overhead cost variance for Product S.
6. What do you understand by CVP analysis. Discuss briefly the assumptions underlying the concept.

Total Quality Programme – Output & Loss relationship

7. Opaque Ltd makes and sells a single product; the unit specifications are as follows:

Direct Materials A	8 sq. metre at Rs. 40 per square metre
Machine time	0.6 Running hours
Machine cost per gross hour	Rs. 400
Selling price	Rs. 1000

Opaque Ltd required to fulfill orders for 5000 product units per period. There are no stock of product units at the beginning or end of the period under review. The stock level of material A remains unchanged throughout the period.

Opaque Ltd is planning to implement a Quality Management Programme (QPM). The following additional information regarding costs and revenue are given as of now and after implementation of Quality Management Programme.

Before the implementation of AMP	After the implementation
1. 5% of incoming material from suppliers scrapped due to poor receipt and storage organization.	1. Reduced to 3%
2. 4% of material A input to the machine process is wasted due to processing problems.	2. Reduced to 2.5%
3. Inspection and storage of Material A costs Rs. 1 per square metre purchased.	3. No change in the unit rate
4. Inspection during the production cycle, calibration checks on inspection equipment, vendor rating and other checks cost Rs. 250000 per period.	4. Reduction of 40% of the existing cost.
5. Production Qty is increased to allow for the downgrading of 12.5% of the production units at the final inspection stage. Down graded units are sold as seconds at a discount of 30% of the standard selling price	5. Reduction to 7.5%
6. Production quantity is increased to allow for return from customers (these are replaced free of charge) due to specification failure and account for 5% of units actually delivered to customer.	6. Reduction to 2.5%
7. Product liability and other claims by customers is estimated at 3% of sales revenue form standard product sale.	7. Reduction to 1%
8. Machine idle time is 20% of gross machine hrs used (i.e. running hour = 80% of gross/hrs.)	8. Reduction to 12.5%
9. Sundry costs of Administration, selling and Distribution total – Rs. 600000 per period.	9. Reduction by 10% of the existing.
10. Prevention programme costs Rs. 200000	10. Increase to Rs. 600000

The Total Quality Management Programme will have a reduction in Machine Run Time required per product unit to 0.5 hrs.

Required:

- a. Prepare summaries showing the calculation of (i) total production units (pre inspection), (ii) Purchase of Materials A (square metres), (iii) Gross Machine Hours.
- b. In each case, the figures are required for the situation both before and after the implementation of the Quality Management Programme so that orders for 5000 product units can be fulfilled.

Prepare Profit and Loss Account for Opaque Ltd for the period showing the profit earned both before and after the implementation of the Total Quality Programme.

Target Costing

8. You are the manager of a paper mill (XYZ Ltd) and have recently come across a particular type of paper, which is being sold at a substantially lower rate by another company, ABC Ltd, than the price charged by your own mill. The value chain for one use of one tonne of such paper for ABC Ltd is as follows,

ABC Ltd. → Merchant → Printer → Customer

ABC Ltd sells this particular paper to the merchant at the rate of Rs. 1,466 per tonne. ABC Ltd pays for the freight which amounts to Rs. 30 per tonne. Average returns and allowances amount to 4% of sales and approximately equals Rs. 60 per tonne.

The value chain of your company, through which the paper reaches the ultimate customer is similar to the one of ABC Ltd. However, your mill does not sell directly to the merchant, the latter receiving the paper from a huge distribution center maintained by your company at Haryana. Shipment costs from the mill to the Distribution Center amount to Rs. 11 per tonne while the operating costs in the Distribution Center have been estimated to be Rs. 25 per tonne. The return on investments required by the Distribution Center for the investments made amount to an estimated Rs. 58 per tonne.

You are required to compute the "Mill manufacturing Target Cost" for this particular paper for your company. You may assume that the return on the investment expected by your company equals Rs. 120 per tonne of such paper.

Cost Concept in Decision Making

9. Noida Camera Company has received a special order for photographic equipment it does not normally produce. The company has excess capacity, and the order could be manufactured without reducing production of the firm's regular products. Discuss the relevance of each of the following items in computing the cost of the special order
 1. Equipment to be used in producing the order has a book value of Rs. 2,000. The equipment has no other use for Noida Camera Company. If the order is not accepted, the equipment will be sold for Rs. 1,500. If the equipment is used in producing the order, it can be sold in three months for Rs. 800.
 2. If the special order is accepted, the operation will require some of the storage space in the company's plant. If the space is used for this purpose, the company will rent

storage space temporarily in a nearby warehouse at a cost of Rs. 18,000. The building depreciation allocated to the storage space to be used in producing the special order is Rs. 12,000.

3. If the special order is accepted, it will require a subassembly. Noida Camera can purchase the subassembly for Rs. 24.00 per unit from an outside supplier or make it for Rs. 30.00 per unit. The Rs. 30.00 cost per unit was determined as follows:

	Rs.
Direct material	10.00
Direct labour	6.00
Variable overhead	6.00
Allocated fixed overhead	<u>8.00</u>
Total unit cost of subassembly	<u>30.00</u>

10. (a) Discuss briefly the various methods of Transfer Pricing known to you.

Transfer Pricing – Calculation of Transfer Price

- (b) Stellar Systems Company's Microprocessor Division sells a computer module to the company's Guidance Assembly Division, which assembles completed guidance systems. The Microprocessor Division has no excess capacity. The computer module costs Rs. 10,000 to manufacture, and it can be sold in the external market to companies in the computer industry for Rs. 13,500.

You are required to compute the transfer price for the computer module using the general transfer-pricing rule.

Cost Centre & Responsibility Centre Report

11. Jimmedar Works Ltd has at the factory three Production Departments, Machine Shop, Fabrication and Assembly which are the responsibility of the shop Superintendent. The Shop Superintendent along with Materials Manger, Planning Superintendent and Maintenance Engineer Report to the Works Manager at the factory. The office administration, sales and publicity come under the Sales Manager who along with the Works Manger report to the Managing Director of the company. The following data relating to a month's performance are called out from the books of the company.

	Budget (Rs.)	Variance from Budget
Sales commission	800	Rs. 50A
Raw Material and Components – Machine shop	900	20 A
Publicity Expenses	1100	100 A
Printing and Stationery	3200	200 F
Travelling expenses	4000	200 A
Wages – Machine shop	800	10 F

- Fabrication	600	20 A
- Assembly	720	10 A
Material – Assembly	760	40 A
- Fabrication	460	10 A
Utilities – Assembly Shop	320	10 A
- Assembly	470	60 F
- Fabrication	560	30 F
- Maintenance	400	20 A
- Stores	210	40 F
- Planning	180	20 A
Shop Superintendent's Office		
- Salaries and Expenses	1100	22 F
Depreciation – Factory	3880	40 A
Works Manager's Office Salaries and Administration	3810	40 A
General Office Salaries and Administration	4270	30 A
Managing Director's Salary and Administration	2800	20 F

(A = Adverse, F = Favourable)

- (i) Treating the Machine Shop, Fabrication and Assembly as Cost Centres, prepare Cost Sheets for each centre with the help of the this additional information:
The Shop Superintendent devotes his time amongst Machine Shop, Fabrication and Assembly in the ratio 4:3: 4. Other Factory Overheads are absorbed on the basis of Direct Labour in each Cost Centre. Office, Administration, Selling and Distribution Overheads are, borne equally by the Cost Centres.
- (ii) Treating the Machine Shop, Fabrication and Assembly as Responsibility Centres, prepare a Responsibility Accounting report for the Shop Superintendent.
12. (a) Indicate the possible disadvantages of treating divisions as profit centres.
(b) Explain the role of bench marking in continuous improvement in an organisation.

Standard Costing & Variance Analysis

13. ABC Ltd manufactures a product '1+7 ASCS' at its plant at Faridabad, the maximum capacity of which is 200 units per month. Details of raw material which go into the making of 1 unit of '1+7 ASCS' are provided to you below:

S. No.	Raw Material description	Standard quantity per finished unit (No)	Standard purchase price per unit (Rs 00)
1	A	1	6
2	B	2	5
3	C	3	4

4	D	4	3
5	E	5	2
6	F	6	1

Standard Fixed overheads are Rs. 20,00,000 per month whereas the standard variable overhead rate has been estimated as equal to Rs. 1,400 per unit of finished good. You are required to compute the

- standard cost of the product
- compute the production volume variance in case the company produces and sells only 100 units of finished goods in the concerned month.
- compute the usage and material price variances considering the following actual data(actual production and sale: 100 units)

Raw material description	Actual quantity consumed (Nos.)	Actual price (Rs' 00)
A	102	7
B	201	6
C	310	5
D	415	4
E	540	3
F	610	2

- Assuming no deviations in the actual selling price (Rs 30,000) and the actual overheads from what was projected in standards, you are required to compute actual profits.

Quality Management

- At the beginning of the year, Kare Company initiated a quality-improvement program. Considerable effort was expended to reduce the number of defective units produced. By the end of the year, reports from the production manager revealed that scrap and rework had both decreased. The president of the company was pleased to hear of the success but wanted some assessment of the financial impact of the improvements. To make this assessment, the following financial data were collected for the current and preceding years:

	Preceding year	Current year
	Rs.	Rs.
Sales	10,000,000	10,000,000
Scrap	4,00,000	3,00,000
Rework	6,00,000	4,00,000
Product inspection	1,00,000	1,25,000

Product warranty	8,00,000	6,00,000
Quality training	40,000	80,000
Materials inspection	60,000	40,000

Required:

1. Classify the costs as prevention, appraisal, internal failure, or external failure.
2. Compute quality cost as a percentage of sales for each of the two years. By how much has profit increased because of quality improvements? Assuming that quality costs can be reduced to 2.5 per cent of sales, how much additional profit is available through quality improvements (assume that sales revenues will remain the same)?

Transportation

15. A company has four factories situated in four different locations in the country and four sales agencies located in four other locations in the country. The cost of production (Rs. per unit), the sale price (Rs. per unit), shipping cost (Rs. per unit) in the cells of matrix, monthly capacities and monthly requirements are given below:

Factory	Sales Agency				Monthly Capacity (Units)	Cost of Production
	1	2	3	4		
A	7	5	6	4	10	10
B	3	5	4	2	15	15
C	4	6	4	5	20	16
D	8	7	6	5	15	15
Monthly Requirements						
(Units)	8	12	18	22		
Sales Price	20	22	25	18		

Find the monthly production and distribution schedule which will maximize profit.

Activity Based Costing

16. IBM Ltd. Manufactures and sells computers peripherals to several retail outlets throughout the country. Amar is the manager of the printer division. Its two largest-selling printers are P1 & P2.

The manufacturing cost of each printer is calculated using IBM's activity based costing system. IBM has one direct manufacturing cost category (direct materials) and the following five indirect manufacturing cost pools.

Indirect manufacturing cost pool	Allocation Base	Allocation Rate (Rs.)
1. Materials handling	No. of parts	Rs. 1.20 per part
2. Assembly management assembly	Hours of assembly time	Rs. 40 per hour of time
3. Machine insertion of parts	No. of machine inserted parts	Rs. 0.70 per machine inserted part
4. Manual insertion of parts manually	No. of manually inserted parts	Rs. 2.10 per inserted part
5. Quality testing hour.	Hours of quality testing time	Rs. 25 per testing hour.

Product characteristics of P1 and P2 are as follows:

Product	P1	P2
Direct materials costs	Rs. 407.50	Rs. 292.10
Number of parts	85	46
Hours of assembly time	3.2	1.9
Number of machine – inserted parts	48	31
Number of manually inserted parts	36	15
Hours of quality testing time	1.4	1.1

A foreign competitor has introduced products very similar to P1 and P2. Given their announced selling prices and to maintain his company's market share and profits, Amar estimates the P1 to have manufacturing cost of approximately Rs. 680 and P2 to have a manufacturing cost of approximately Rs. 390. He calls a meeting of product designers and manufacturing personnel at the printer division. They all agree to have the Rs. 680 and Rs. 390 figures become target costs for designed version of P1 and P2 respectively. Product designers examine alternative ways of designing printer with comparable performance but lower costs. They come up with the following revised designs for P1 and P2 (termed P1 – REV and P2 – REV, respectively)

Particulars	P1 – REV	P2 – REV
Direct materials cost	Rs. 381.20	Rs. 263.10
Number of parts	71	39
Hours of assembly time	2.1	1.6
Number of machine – inserted parts	59	29
Number of manually – inserted parts	12	10

Hours of quality testing time 1.2 0.9

Required:

- Compute the present costs of products P1 and P2 using ABC system.
 - Compute the manufacturing costs of P1 – REV and P2 – REV. How do they compare with the Rs. 680 and Rs. 390 target costs?
17. (a) What is meant by Learning Curve effect? Mention some important applications of this phenomenon in cost and management accounting.

Learning Curve Theory

- (b) A company developed and manufactured a new machine. The manufacture of the first machine took 800 direct labour hours. The direct wages rate is Rs.20 per hour. The company experienced a learning curve effect of 80% (index is – 0.3219). The first piece was used as a demonstration piece and was not intended for sale. On the basis of the demonstration, the company obtained an order for the manufacture of 20 machines. The direct material cost is Rs.16,000 per machine. The variable overhead rate is Rs.25 per direct labour hour. The fixed overheads on absorption costing amounted to Rs.40 per direct labour hour. The selling price is to include a profit margin of 20% on selling price. Subsequently, after the delivery of the 20 machines, the company received a repeat order for supply of 30 machines.

Required:

- (i) Calculate the selling price per machine of the first lot of 20 machines.
- (ii) What reduction in selling price can the company allow in respect of the repeat order?

Simulation

- (c) A company manufactures 80 units of a product per day. The sales of the product follow a pattern of demand, which has the following distribution.

Sales in units	Probability
74	0.10
76	0.15
78	0.22
80	0.30
82	0.18
84	0.05

The selling price is Rs. 75 per unit. The variable cost is Rs. 45 and the total cost is Rs. 55 per unit. Any unsold product can be disposed of as scrap at Rs. 30 per unit. If the demand is not met, a penalty of Rs.5 per unit is payable by the company. In view of the loss arising from the unsold units, the company is contemplating to restrict its daily production to 76 units. Using the following random numbers,

simulate the sales for 10 days and determine the average profit per day if the company produces (i) 80 units per day and (ii) 76 units per day.

Random numbers are 41, 65, 14, 35, 81, 20, 79, 93, 71 and 14.

Linear Programming

18. Let us assume that you have inherited Rs. 100,000 from your father-in-law that can be invested in a combination of only two stock portfolios, with the maximum investment allowed in either portfolio set at Rs. 75,000. The first portfolio has an average return of 10%, whereas the second has 20%. In terms of risk factor's associated with these portfolios, the first has a risk rating of 4 (on a scale from 0 to 10), and the second has 9. Since you want to maximize your return, you will not accept an average rate of return below 12% or a risk factor above 6. Hence, you then face the important question. How much should you invest in each portfolio? Formulate this as a linear programming problem and solve it by graphic method.

The Assignment Problem

19. A company has 5 jobs to be done. The following matrix shows the written in Rs. of assigning of i^{th} machine ($i = 1, 2, 3, 4, 5$) to the j^{th} job ($j = 1, 2, 3, 4, 5$) assign the 5 jobs to the 5 machines. So as to maximize the total expected profit.

		Job				
		1	2	3	4	5
Machine	A	5	11	10	12	4
	B	2	4	6	3	5
	C	3	1	5	14	6
	D	6	14	4	11	7
	E	7	9	8	12	5

Transportation Problem

20. A company has three warehouses W_1 , W_2 and W_3 . It is required to deliver a product from these warehouses to three customers A, B and C. The warehouses have the following units in stock.

Warehouse:	W_1	W_2	W_3
No. of Units :	65	42	43
and Customer requirements are :			
Customer :	A	B	C
No. of Units :	70	30	50

The table below shows the cost of transporting one unit from warehouse to the customer:

		Warehouse		
		W_1	W_2	W_3
Customer	A	5	7	8
	B	4	4	6
	C	6	7	7

Find the optimal transportation route.

Critical Path Analysis and PERT

21. (a) Distinguish between PERT and CPM

(b) A project has the following time schedule:

Activity	1-2	1-3	1-4	2-5	3-6	3-7	4-6	5-8	6-9	7-8	8-9
Duration	2	2	1	4	8	5	3	1	5	4	3

(In months)

Construct PERT network and compute.

(a) Total float, free float and independent float for each activity.

(b) Critical path and its duration.

(c) Find the minimum number of cranes the project must have for its activities 2-5, 3-7 and 8-9 without delaying the project. Then, is there any change required in PERT network? If so, indicate the same.

Critical Path Analysis and PERT

22. A small project consisting of eight activities has the following characteristics.

Time-estimates (in weeks)

Activity	Preceding activity	Most optimistic (a)	Most likely (m)	Most pessimistic (b)
A	None	2	4	12
B	None	10	12	26
C	A	8	9	10
D	A	10	15	20
E	A	7	7.5	11
F	B, C	9	9	9
G	D	3	3.5	7
H	E, F, G	5	5	5

- (i) Draw the PERT network for the project.
- (ii) Determine the critical path.
- (iii) Prepare the activity schedule for the project.
- (v) If a 30 weeks deadlines is imposed, what is the probability that the project will be finished within the time limit?
- (v) If the project manager wants to be 99% sure that the project is completed on the schedule date, how many weeks before that date should he start the project work?

Simulation

23. (a) ABC Ltd. trade in a perishable commodity. Each day ABC receive supplies of the goods from a wholesaler but the quantity supplied is a random variable, as is subsequent retail customer demand for the commodity. Both supply and demand are expressed in batches of 50 units and over the past working year (300 days). ABC have kept records of supplies and demands. The results are given in the following table:

Wholesaler supplies	No. of days occurring	Customers demand	No. of days occurring
50	60	50	60
100	90	100	60
150	90	150	150
200	60	200	30

ABC Ltd. buys the commodity at Rs. 6 per unit and sells at Rs. 10 a unit. At present unsold units at the end of the day are worthless and there are no storage facilities. ABC estimates that each unit of unsatisfied demand on any day costs than Rs. 2. Using the following random numbers.

8 4 8 0 3 3 4 7 9 6 1 5

- (i) Simulate six days trading and estimate annual profit.
 - (ii) Return the exercise to estimate the value of storage facilities.
- (b) Define a simulation model. What is Monte Carlo simulation?

SUGGESTED ANSWERS/HINTS

1. (a) Material Requirements Planning (MRP) is a software based production planning and inventory control system used to manage manufacturing processes. Although it is not common nowadays, it is possible to conduct MRP by hand as well.

MRP is designed to answer three questions: what is needed, how much is needed, and when is it needed. The primary inputs of MRP are a bill of materials, which tells

what goes into a finished product; a master schedule, which tells how much finished product is desired and when; and an inventory-records file, which tells how much inventory is on hand or on order. This information is processed, using various computer programs to determine the net requirements for each period of the planning horizon. Outputs from the process include planned-order schedules, order releases, changes, performance-control reports, planning reports, and exception reports.

An MRP system is intended to simultaneously meet the following 3 objectives:

1. Ensure materials and products are available for production and delivery to customers.
 2. Maintain the lowest possible level of inventory.
 3. Plan manufacturing activities, delivery schedules and purchasing activities.
- (b) In the case of firm dealing with multi products, it would not be possible for it to analyse price-volume relationship for all of them. Pareto Analysis is used for analysing the firm's estimated sales revenue from various products and it might indicate that approximately 80% of its total sales revenue is earned from about 20% of its products. Such analysis helps the top management to delegate the pricing decision for approximately 80% of its product to the lower level of management, thus freeing them to concentrate on the pricing decisions for products approximately 20% of which is essential for the company's survival. Thus, a firm can adopt more sophisticated pricing methods for small proportion of products that jointly account for 80% of total sales revenue. For the remaining 80% products, which account for 20% of the total sales value the firm may use cost, based pricing method.
- (c) Traditional accounting systems record the flow of inventory through elaborate accounting procedures. Such systems are required in those manufacturing environment where inventory/WIP values are large. However, since JIT systems operate in modern manufacturing environment characterized by low inventory and WIP values, usually also associated with low cost variances, the requirements of such elaborate accounting procedures does not exist.

Back flushing requires no data entry of any kind until a finished product is completed. At that time the total amount finished is entered into the computer system which is multiplied by all components as per the Bill of materials (BOM) for each item produced. This yields a lengthy list of components that should have been used in the production process and this is subtracted from the opening stock to arrive at the closing stock to arrive at the closing stock/inventory.

The problems with back flushing that must be corrected before it works properly are:

- (i) The total production quantity entered into the system must be absolutely correct, if not, then wrong components and quantities will be subtracted from the stock.

- (ii) All abnormal scrap must be diligently tracked and recorded. Otherwise materials will fall outside the back flushing system and will not be charged to inventory.
- (iii) Lot tracing is impossible under the back flushing system. This is required when a manufacturer needs to keep records of which production lots were used to create a product in case all the items in a lot need be recalled.
- (iv) The inventory balance may be too high at all times because the back flushing transactions that relieves inventory usually does so only once a day, during which time other inventory is sent to the production process. This makes it difficult to maintain an accurate set of inventory records in the warehouse.

2. (a)

Rest house

Statement Showing Costs and Income

¹ No. of Guests	Income per annum	² Variable Costs Rs.	Contribution Rs.	Fixed cost (Note ³ and ⁴)	Surplus / (Deficit) Rs.
6	18,000	7,740	10,260	³ 16,000	(5,740)
7	21,000	9,030	11,970	16,000	(4,030)
8	24,000	10,320	13,680	16,000	(2,320)
9	27,000	11,610	15,390	16,000	(610)
10	30,000	12,900	17,100	16,000	1,100
11	33,000	14,190	18,810	⁴ 22,000	(3,190)
12	36,000	15,480	20,520	22,000	(1,480)
13	39,000	16,770	22,230	22,000	230
14	42,000	18,060	23,940	22,000	1,940
15	45,000	19,350	25,650	22,000	3,650

Working Notes

¹ 6 persons x Rs. 100 x 30 weeks = Rs. 18,000 and so on

² No of persons x Rs. 43 x 30 weeks = 7.740 and so on

³ Rs. 11,000 + Rs. 4,000 + Rs. 1,000 = Rs. 16,000

⁴ When guests are more than 10, Fixed Cost Rs. 16,000 (as above) + Rs. 200 x 30 = Rs. 22,000

(b) (i)	Company 1	Company 2	Total (merged plant)
1. Capacity utilization	100%	100%	100%
2. Sales	600	500	1,100
3. Variable costs	440	375	815
4. Contribution	160	125	285
5. Fixed Cost	80	50	130
6. Profit	80	75	155
7. P/V Ratio (Merged Plant)	$(285 \div 1100) \times 100 = 25.91\%$		
8. BEP of the Merged plant	$130 \div .2591 = \text{Rs. } 501,74$		
9. Capacity utilization at BEP	$501,74 \div 1,100 = 45.61\%$		

(ii) Profitability of the merged plant of 80% capacity

	Rs. in lakhs
Sales (1,100 x 80%)	880
Variable cost	652
Contribution	228
Fixed Cost	130
Profit	98
Profit as a % Sales	11.14%

(iii) Sales required for earning a profit of Rs. 75 lakhs

Contribution request = Fixed cost + Desired profit = 130 lakhs + 75 lakhs
= Rs. 205 lakhs

P/V Ratio = 25.91%

Desired sales Level = Desired contribution $\div$ P/V Ratio

Desired sales Level = Rs. 205 lakhs $\div$ 25.91% = Rs. 791.20 lakh

(iv) Percentage increase in Selling Price to sustain 5% increase in F.O. (with Rs. 75 lakhs profit)

Fixed overhead = Rs. 130 lakhs

5 % increase = Rs. 6.5 lakhs (Rs 130 lakhs x 0.05)

Sales = Rs. 791.20 lakhs (Given)

Hence % increase in S.P. = $(6.5 \div 791.20) \times 100 = 0.8215\%$

3. (a) Investment = Rs. 20 Crores

Rs.

Selling price/units 400

Variable cost/unit 240

Contribution/unit 160

Fixed cost = 23 lakhs; Life – 6 years; Rate of return = 12%

BEP = $\{(20 \text{ cr.} \div 4.111) + 23 \text{ lakhs}\} \div 160 = 3,18,437 \text{ units}$

- (b) All cash flows occur at the end of the year (assumption of DCF technique)

$\therefore$ Interest at $y_0 = 20 \text{ Cr.} + 12 \text{ Cr.} \times 12\%$

= Rs. 21.44 Cr.

$\therefore$ BEP = $\{(21.44 \text{ cr.} \div 4.111) + 23 \text{ lakhs}\} \div 160$

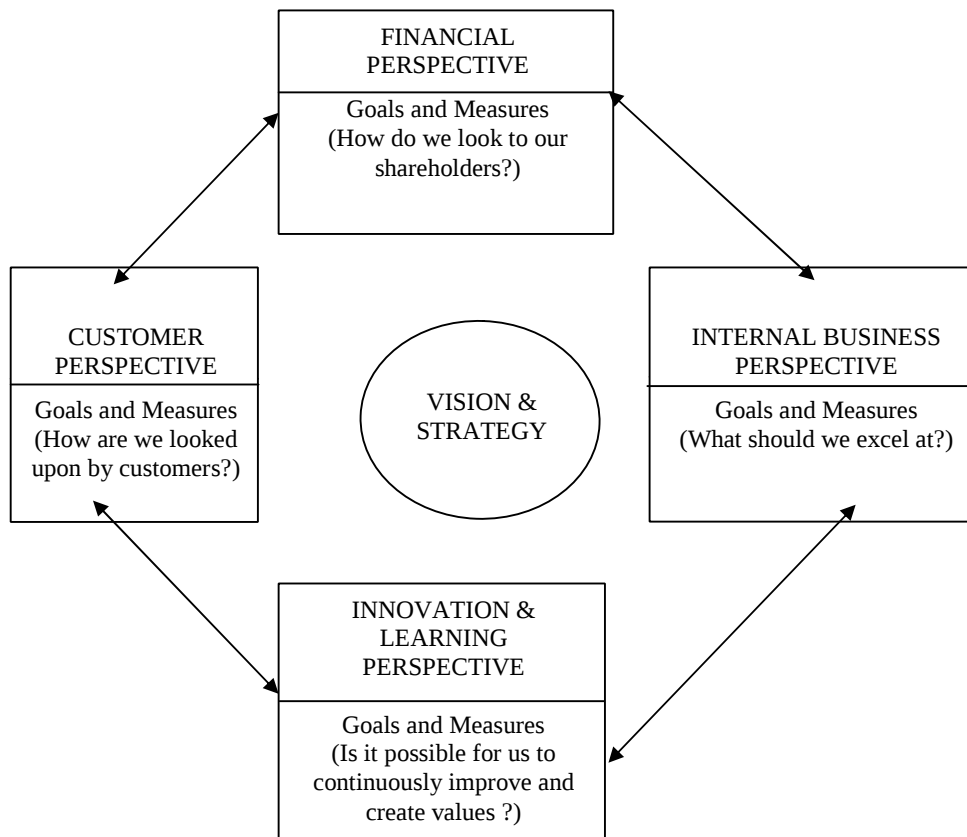
= 3,40,330 units

4. The Balanced Scorecard can be defined as 'an approach to the provision of information to management to assist strategic policy formulation and achievement. It emphasises the need to provide the user with a set of information, which addresses all relevant areas of performance in an objective and unbiased fashion. The information provided may include both financial and non financial elements, and cover areas such as profitability, customer satisfaction, internal efficiency and innovation'.

It is clear from the above definition that the central idea of the Balanced Scorecard is that managers should develop the measures on which they manage the business from four different perspectives:

1. customer satisfaction.
2. internal business process e.g., operating cycle time.
3. kaizen approach (can we continue to improve and create value).
4. financial e.g., operating income by segments.

The following figure summarises the ideas of a Balanced Scorecard:



According to Kaplan and Norton, the ultimate result of using the Balanced Scorecard approach should be an improved long-term financial performance. Since the scorecard gives equal importance to the relevant non – financial measures, it should discourage the short termism that leads to cuts in spending on new product development, human resource development etc which are ultimately detrimental for the future prospects of the company.

The responsibility to devise and implement a Balanced Scorecard should be that of the managers working with the business. Since every company is different, it shall need to work out for itself the various financial and non – financial measures, which need to be focussed upon for its own development. Since the Balanced Scorecard is recommended as a management tool used both for internal and external reporting purposes, it is again the manager's responsibility to decide as to what information needs to be disclosed and how any problems of confidentiality can best be overcome.

The following are some reasons why Balanced Scorecards sometimes fail to provide for the desired results:

- The use of non financial measures leads managers to think that they have a Balanced Scorecard already working for strategic purposes.
- Senior executives misguidedly delegate the responsibility of the Scorecard implementation to middle level managers.
- Company's try to copy measures and strategies used by the best companies rather than developing their own measures suited for the environment under which they function.
- There are times when Balanced Scorecards are thought to be meant for reporting purposes only. This notion does not allow a Business to use the Scorecard to manage Business in a new and more effective way.

It may be noted that the above-mentioned difficulties refer to the internal use of the Scorecard. It remains a matter of debate whether a Balanced Scorecard is applicable to external reporting. Critics argue that if the Scorecard is indeed a relevant driver of long term performance, shouldn't the information generated be of interest to the investment community? However, it has been noticed that the Scorecard does not translate easily to the investment community for the simple reason that it makes sense for individual business units and different individual projects rather than the company as a whole. Most companies have different divisions with their own mission and strategy and hence these individual scorecards cannot be aggregated into an overall corporate scorecard. However, in case the company somehow manages to overcome such a problem and indeed use its Scorecard for external reporting, it may end up passing sensitive information to its competitors which may end up being detrimental to the company in the long run. However, with changes in the thinking process of the investment community, such strategic reporting could well be accepted in the near future.

For a further understanding of the concept, please refer to chapter 14 of the Institute's Cost Management book.

5. 1. Direct Materials Cost Variance

Quantity Variance:

Actual quantity 1,600 kgs

Standard quantity 1500 kgs

Variance – unfavourable 100 kgs × Standard price, Rs 35 =(Rs. 3,500)

Price Variance:

Actual price Rs. 32.00 per kg

Standard price Rs 35

Variance – favourable Rs 3 per kg × Actual Qty, 1600 = 4,800

Total direct materials cost variance – favourable = Rs. 1,300

2. Direct Labour Cost Variance

Time Variance:

Actual time	4,500 hours	
Standard time	4,800 hours	
Variance – favourable	300 hours × Standard rate, Rs 11	Rs. 3,300

Rate Variance:

Actual rate	Rs. 11.80	
Standard rate	11.00	
Variance – unfavourable	Rs 0.80 per hr × Actual time, 4500 hours	<u>(3,600)</u>

Total direct labour cost variance - unfavourable (Rs 300)

3. Factory Overhead Cost Variance

Variable factory overhead – controllable variance:

Actual variable factory overhead cost incurred	Rs. 12,300	
Budgeted variable factory overhead for 4,800 hours	<u>11,520*</u>	
Variance – unfavourable		(Rs. 780)

Fixed factory overhead – volume variance:

Budgeted hours at 100% of normal capacity	5,500 hours	
Standard hours for actual production	<u>4,800</u>	
Productive capacity not used	700 hours	
Standard fixed factory overhead cost rate	<u>× Rs. 3.50</u>	
	hours	
Variance – unfavourable		<u>(2,450)</u>

Total factory overhead cost variance – unfavourable Rs. 3,230

*4,800 hours × Rs. 2.40 = Rs. 11,520

6. As the name suggests, cost volume profit (CVP) analysis is the analysis of three variables cost, volume and profit. Such an analysis explores the relationship between costs, revenue, activity levels and the resulting profit. It aims at measuring variations in cost and volume.

CVP analysis is based on the following assumptions:

1. Changes in the levels of revenues and costs arise only because of changes in the number of product (or service) units produced and sold – for example, the number of television sets produced and sold by Sony Corporation or the number of packages delivered by Overnight Express. The number of output units is the only revenue driver and the only cost driver. Just as a cost driver is any factor that affects costs, a revenue driver is a variable, such as volume, that causally affects revenues.
2. Total costs can be separated into two components; a fixed component that does not vary with output level and a variable component that changes with respect to output level. Furthermore, variable costs include both direct variable costs and indirect variable costs of a product. Similarly, fixed costs include both direct fixed costs and indirect fixed costs of a product
3. When represented graphically, the behaviours of total revenues and total costs are linear (meaning they can be represented as a straight line) in relation to output level within a relevant range (and time period).
4. Selling price, variable cost per unit, and total fixed costs (within a relevant range and time period) are known and constant.
5. The analysis either covers a single product or assumes that the proportion of different products when multiple products are sold will remain constant as the level of total units sold changes
6. All revenues and costs can be added, subtracted, and compared without taking into account the time value of money.
7. (a) (i) Statement showing total units before inspection, before and after introduction of TQM

It is to be worked back as follows:

Particulars	Existing	After TQM programme
Total sales requirement	5000 units	5000 units
Specification failures 5%, 2.5%	250	125
	5250	5125
Down grading at inspection $(12.5/87.5) \times 5250$ $(7.5/92.5) \times 5250$	750	
Total units before inspection	6000	5541
(ii) Purchase of material A (sq. mtr.)		
Material required to meet pre-inspection Production requirement	Sq. Mtr.	Sq. Mtr.
6000 units x 8 sq. mtr. ; 5541 x 8 Sq. mtr.	48,000	44,328

Processing loss (after input to machine)		
(4/96) x 48000: (2.5/97.5) x 44328	<u>2,000</u>	<u>1,137</u>
	50,000	45,465
Scrapped material due to poor quality		
(5/95) x 50000: (3/97) x 45465	<u>2,632</u>	<u>1,406</u>
Total purchases	<u>52,632</u>	<u>46,871</u>
(iii) Gross Machine Hours		
	Existing	After TQM programme
Initial requirements:		
6000 units x 0.6 hrs: 5541 units x 0.5 hrs.	3,600	2,771
Idle time		
(20/80) x 3600: (12.5/87.5)x2771	<u>900</u>	<u>396</u>
	<u>4,500</u>	<u>3,167</u>

(b) Profit and Loss Account (before and after the implementation of TQM)

Particulars	Before TQM programme	After TQM programme
Sales revenue	Rs.	Rs.
5000 units x Rs. 1000	50,00,000	50,00,000
Sales down graded		
750 x Rs. 1000 x 0.70*; 416 x Rs. 1000 x 0.70*	5,25,000	2,91,200
Total sales revenue	<u>55,25,000</u>	<u>52,91,200</u>
Less: costs		
Materials 52632 x Rs. 40; 46871 x Rs. 40	21,05,280	18,74,840
Inspection 52632 x Rs. 1; 46871 x Rs. 1	52,632	46,871
Machine costs		
4500 hrs x Rs. 400; 3167 hrs x 400	18,00,000	12,66,800
Inspection and other cost		
Fixed Rs. 250000 (given)	2,50,000	
60% of Rs. 250000		1,50,000
Product liability and other claims		

Rs. 5000000 x 3; Rs. 5000000 x 1%	1,50,000	50,000
Adm. Selling and Distribution		
Rs. 600000 (given); Rs. 600000 x 0.90	6,00,000	5,40,000
Preventive Programme		
Rs. 200000 (given); Rs. 600000 (given)	2,00,000	6,00,000
Total cost	<u>51,57,912</u>	<u>45,28,511</u>
Profit	36,70,88	7,62,689

* discount is 30%

Note: Readers should concentrate on output and loss relationship to find out the required figures in this question.

8. Computation of Target Cost

	Per tonne (in Rs)
ABC Ltd selling price to the merchant	1,466
Less freight paid by ABC Ltd	(30)
Less normal sales returns and allowances	(60)
XYZ Ltds Capital charge	(120)
Target cost for XYZ Ltd	1,256
Ship to Distribution Centre	(11)
Distribution Centre operating cost	(25)
Subtotal	1,220
Distribution centre capital charge	(58)
Mill target manufacturing cost	1,162

9. (1) The book value of the equipment is a sunk cost, irrelevant to the decision. The relevant cost of the equipment is Rs. 700, determined as follows:

	Rs.
Sales value of equipment now	1,500
Sales value after producing special order	<u>800</u>
Differential cost	<u>700</u>

- (2) The Rs. 12,000 portion of building depreciation allocated to the storage space to be used for the special order is irrelevant. First, it is a sunk cost. Second, any costs relating to the company's factory building will continue whether the special order is accepted or not. The relevant cost is the Rs. 18,000 rent that will be incurred only if the special order is accepted.

- (3) Noida Camera should make the subassembly. The subassembly's relevant cost is Rs. 22.00 per unit.

Relevant Cost of Making Subassembly (per unit)		Relevant Cost of Purchasing Subassembly (per unit)	
	Rs.		Rs.
Direct material	10.00	Purchase price	<u>24.00</u>
Direct labour	6.00		
Variable overhead	<u>6.00</u>		
Total	<u>22.00</u>		

The unitized fixed overhead, Rs. 8.00, is not a relevant cost of the subassembly. Noida Camera Company's total fixed cost will not change, whether the special order is accepted or not.

10. (a) The methods of pricing usually employed in industry when goods or services are transferred from one unit to the other can be broadly classified under the following three categories:

- (i) Pricing at cost or variants of cost e.g. manufacturing cost; standard cost; full cost and full cost plus mark up.
- (ii) Pricing at market price.
- (iii) Pricing at bargained or negotiated price.

- (b) Transfer price = Outlay cost + Opportunity cost
 = Rs. 10,000 + (Rs. 13,500 – 10,000)
 = Rs. 13,500

The Rs. 3,500 opportunity cost of a transfer is the contribution margin that will be forgone if a computer module is transferred instead of sold in the external market.

11. (i) Cost Sheets for Machine Shop, Fabrication and Assembly treating them as Cost Centres

	Machine Shop		Fabrication		Assembly	
	Budget	Actual	Budget	Actual	Budget	Actual
Raw Material and components	900	920	460	470	760	800
Wages	800	790	600	620	720	730
Utilities	320	330	560	530	470	410
Prime Cost	<u>2,020</u>	<u>2,040</u>	<u>1,620</u>	<u>1,620</u>	<u>1,950</u>	<u>1,940</u>
Shop Supdt's Office	400	392	300	294	400	392
Salaries and Expenses (Ratio 4:3:4)						

*Other factory overheads	<u>3,200</u>	<u>3,160</u>	<u>2,400</u>	<u>2,480</u>	<u>2,880</u>	<u>2,920</u>
Factory cost	5,620	5,592	4,320	4,394	5,230	5,252
@ Adm. Selling & Distribution Overheads (one-third each)	<u>5,390</u>	<u>5,443</u>	<u>5,390</u>	<u>5,443</u>	<u>5,390</u>	<u>5,444</u>
Total cost	<u>11,010</u>	<u>11,035</u>	<u>9,710</u>	<u>9,837</u>	<u>10,620</u>	<u>10,696</u>

*Factory overheads

	Budget	Actual
Utilities		
Maintenance	Rs. 400	Rs. 420
Stores	210	170
Planning	180	200
Depreciation	3880	3920
Works manager's office expense	<u>3810</u>	<u>3850</u>
Total factory overheads	<u>8480</u>	<u>8560</u>
Direct Wages (Rs. 800 + 600 + 720)	<u>2120</u>	<u>2140</u>
Factory overhead as a % of direct wages	<u>400%</u>	<u>400%</u>

@ Administration, Selling and Distribution Overheads

	Budget	Actual
Sales commission	Rs. 800	Rs. 850
Publicity expenses	1,100	1,200
Printing and Stationery	3,200	3,000
Travelling Expenses	4,000	4,200
General office salaries administartion	4,270	4,300
M. D. salary and administration	<u>2,800</u>	<u>2,780</u>
Total	<u>16,170</u>	<u>16,330</u>

These overheads are to be divided equally among the production departments.

- (b) (ii) Responsibility Accounting Report for the Shop Superintendent treating the Machine Shop, fabrication and Assembly as responsibility centres.

S. No.		Budget	Actual	Variance
1.	Machine Shop			
	Material	900	920	20 (A)
	Labour	800	790	10 (F)

	Utilities	<u>320</u>	<u>330</u>	<u>10 (A)</u>
		<u>2,020</u>	<u>2,040</u>	<u>20 (A)</u>
2.	Fabrication			
	Material	460	470	10 (A)
	Labour	600	620	20 (A)
	Utilities	<u>560</u>	<u>530</u>	<u>30 (F)</u>
		<u>1,620</u>	<u>1,620</u>	<u>—</u>
3.	Assembly			
	Material	760	800	40 (A)
	Labour	720	730	10 (A)
	Utilities	<u>470</u>	<u>410</u>	<u>60 (F)</u>
		<u>1,950</u>	<u>1,940</u>	<u>10 (F)</u>
	Total (1 + 2 + 3)	<u>5,590</u>	<u>5,600</u>	<u>10 (A)</u>

Note: Since Shop Superintendent's office salaries and expenses include his salary also, it has been assumed that these are not controlled by him and hence not included.

12. (a) The possible disadvantages of treating divisions as profit centres are as follows:
1. Divisions may compete with each other and may take decisions to increase profits at the expense of other divisions thereby overemphasizing short-term results.
 2. It may adversely affect co-operation between the divisions and lead to lack of harmony in achieving. Organisational goals of the company. Thus it is hard to achieve the objective of goal congruence.
 3. It may lead to reduction in the company's overall total profits.
 4. The cost of activities which are common to all divisions may be greater for decentralised structure than for centralised structure. It may thus result in duplication of staff activities.
 5. Top management delegates decision making to divisional managers. There are risks of mistakes committed by the divisional managers which the top management, may avoid.
 6. Series of control reports prepared for several departments may not be effective from the point of view of top management.
 7. It may under utilise corporate competence.
 8. It leads to complications associated with transfer pricing problems.
 9. It becomes difficult to identify and define precisely suitable profit centres.

10. It confuses division's results with manager's performance.

- (b) Bench marking is a technique which is being adopted as a mechanism for achieving continuous improvement. It is a continuous process of measuring a company's products, services or activities against the other best performing organizations either internal or external to the company. The objective is to ascertain how the processes and activities can be improved. The latest developments, best practices and model examples can be incorporated within various operations of the business of the company. It represents an ideal way of achieving high competitive standards.

13. (a) **Standard Cost Sheet**

Description	Cost per unit of Finished Good
Standard Raw Material Cost	Rs. 5,600
Variable Overheads	Rs. 1,400
Standard Fixed Overheads	Rs. 10,000
Standard Cost per Unit of Finished Good	Rs. 17,000

- (b) Production Volume Variance

Unutilised capacity × Standard Fixed Cost per Finished Good

100 × Rs 10,000 = Rs 10,00,000 Adverse

- (c) Usage and Material Price Variance (Actual Production : 100 Units)

Raw Material	Std Qty/FG	Std Qty on actual prod	Actual Qty on actual prod	Act Price per Ut of RM(Rs)	Std Price per Ut of RM(Rs)	Usage Variance (Rs)	Price Variance (Rs)
A	1	100	102	700	600	(1,200)	(10,200)
B	2	200	201	600	500	(500)	(20,100)
C	3	300	310	500	400	(4,000)	(31,000)
D	4	400	415	400	300	(4,500)	(41,500)
E	5	500	540	300	200	(8,000)	(54,000)
F	6	600	610	200	100	(1,000)	(61,000)
						(19,200)	(2,17,800)

- (d) Standard Profit (Rs 13,000 × 100)

Rs 13,00,000

Usage Variance	(19,200)
Price Variance	(2,17,800)
Production Volume Variance	(10,00,000)
Actual Profit	63,000

14. 1. Prevention costs: Quality training
 Appraisal costs: Product inspection and materials inspection
 Internal failure costs: Scrap and rework
 External failure costs: Warranty
2. Preceding year – Total quality costs: Rs. 20,00,000; percentage of sales: 20 per cent (Rs. 20,00,000/Rs. 10,00,000). Current year – Total quality costs: Rs. 15,45,000; percentage of sales: 15.45 per cent (Rs. 15,45,000/Rs. 10,00,000). Profit has increased by Rs. 4,55,000. If quality costs drop to 2.5 per cent of sales, another Rs. 12,95,000 of profit improvement is possible (Rs. 15,45,000 – Rs. 2,50,000).
15. The given information can be tabulated in following transportation problem

Profit Matrix

Factory	Sales Agency				Monthly Capacity (units)
	1	2	3	4	
A	3	7	9	4	10
B	2	2	6	1	15
C	0	0	5	-3	20
D	-3	0	4	-2	15
Monthly Requirements	8	12	18	22	

Where entries in the cells of the above table indicate profit per unit received by selling one unit of item from factory i ($i=A, B, C, D$) to j^{th} sales agency ($j=1,2,3,4$). The profit per unit is calculated using the following formula:

$$\text{Profit} = \text{Sales Price} - (\text{Cost of Production} + \text{Shipping Cost})$$

The objective of the company is to maximise the profit. For achieving this objective, let us convert this maximisation problem into minimisation problem by subtracting all the elements of the above pay off matrix from the highest payoff i.e. Rs. 9.

Loss Matrix

Factory	Sales Agency				Monthly Capacity (units)
	1	2	3	4	
A	6	2	0	5	10
B	7	7	3	8	15
C	9	9	4	12	20
D	12	9	5	11	15
Monthly Requirements	8	12	18	22	

Now, let us apply Vogel's Approximation Method to the above matrix for finding the initial feasible solution.

Factory	Sales Agency				Monthly Capacity	Difference
	1	2	3	4		
A		10			10/0	2 3 --
	6	2	0	5		
B				15	15/0	4 0 0 --
	7	7	3	8		
C	2		18		20/2/0	5 0 0 0
	9	9	4	12		
D	6	2		7	15/13/6/0	4 2 2 2
	12	9	5	11		
Monthly Requirement	8/6/0	12/2/0	18/0	22/7		
Difference	1 1 2 3	5 5 2 0	3 -- --	3 3 3 1		

The initial solution is as given below which is tested for optimality. There are $m+n-1=7$ independent allocations.

Let us introduce $u_i, v_j, i = (1,2,3,4); j = (1,2,3,4)$ such that $\Delta_{ij} = c_{ij} - (u_i + v_j)$ for allocated cells. We assume $u_4=0$ and remaining u_i 's, v_j 's and Δ_{ij} 's are calculated as below:

Factory	Sales Agency				u _i 's		
	1	2	3	4			
A	1	10	0	1	-7		
	6	2	0	5			
B	-2	1	-1	15	-3		
	7	7	3	8			
C	2	+0	3	18	-0	4	-3
	9	9	4	12			
D	6	-0	2	-2	+0	7	0
	12	9	5	11			
	12	9	7	11			

Since some of the Δ_{ij} 's are negative, therefore, the above solution is not optimal. Introduce in the cell (D, 3) with the most negative Δ_{ij} , an assignment θ . The value of θ and the reallocated solution as obtained from above is given below. The values of u_i 's, v_j 's are also calculated. The solution satisfies the conditions of optimality. The condition $\Delta_{ij} = c_{ij} - (u_i + v_j) \geq 0$ for non allocated cells is also satisfied.

Factory	Sales Agency				u_i 's
	1	2	3	4	
A	3	10	2	1	-7
	6	2	0	5	
B	0	1	1	15	-3
	7	7	3	8	
C	8	1	12	2	-1
	9	9	4	12	
D	2	2	6	7	0
	12	9	5	11	
v_j 's	10	9	5	11	

Since all Δ_{ij} 's for non basic cells are positive, therefore the solution obtained above is an optimal one. The allocation of factories to sales agencies and their profit amount is given below:

Factory	Sales Agency	Profit	
A	2	$10 \times \text{Rs } 7$	= Rs. 70
B	4	$15 \times \text{Rs } 1$	= Rs. 15
C	1	$8 \times \text{Rs } 0$	= Rs. 0
C	3	$12 \times \text{Rs } 5$	= Rs. 60
D	2	$2 \times \text{Rs } 0$	= Rs. 0
D	3	$6 \times \text{Rs } 4$	= Rs. 24
D	4	$7 \times \text{Rs}(-2)$	= -Rs. 14
			= Rs. 155

Since one of the Δ_{ij} 's is zero, the optimal solution obtained above is not unique. Alternate solution also exists.

16.	P1	P2
	Rs/unit	Rs./unit
Material	407.5	292.1
Overhead-Material handling	$85 \times 1.2 = 102$	$46 \times 1.2 = 55.2$
Assembly Management	$40 \times 3.2 = 128$	$40 \times 1.9 = 76$
Machine insertion	$48 \times 0.7 = 33.6$	$31 \times 0.7 = 21.7$
Manual insertion	$36 \times 2.1 = 75.6$	$1.5 \times 2.10 = 31.5$
Quality testing	$1.4 \times 25 = 35$	$1.1 \times 25 = 27.5$
Present cost	781.70	504.00
Target cost	680.00	390.00

	Revised P1	Revised P2
	Rs./unit	Rs./unit
Direct material	381.20	263.10
Overhead - Material handling	$(71 \times 1.2) = 85.2$	$(39 \times 1.2) = 46.8$
Assembly hour	$(2.1 \times 40) = 84.0$	$(1.6 \times 40) = 64.0$
Machine insertion	$(59 \times 0.7) = 41.3$	$(29 \times 0.7) = 20.30$
Manual insertion	$(12 \times 2.10) = 25.2$	$(10 \times 2.10) = 21.00$
Quality testing	$(1.2 \times 25) = \underline{30.00}$	$(0.9 \times 25) = \underline{22.50}$
Estimated cost	646.90	437.70
Target cost	680.00	390.00

	Achieved	Not achieved
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17. (a) Learning is the process during which a person acquires the skill to do a job. When a job is taken up for the first time, the worker is new to the job and he takes considerable time to complete it because his performance is not at its best. But, when the same job is repeated he is able to improve his performance because of the skill he has acquired by doing a similar job earlier. This phenomenon is known as learning effect. It applies only to labour oriented operations. The "learning curve theory" is expressed by the equation: $y = ax^b$

where, y = Cumulative average time when x units of products are made

a = Time taken for the first unit

b = The learning index represented by

$[\log \text{ learning effect}] / \log 2$

Some applications of learning curve in Cost and management Accounting are :

- (i) Setting labour standard times.
- (ii) Helps in budgeting and profit planning
- (iii) Helps in pricing successive batches / contract
- (iv) Helps in negotiations and bargaining because of declining unit time and cost.
- (v) Forecasting and preparing cost estimates, etc.

(b) First machine – Labour hours = 800

Order for 20 machines

Total machines 21

Labour hours= $800 (21)^{-0.3219}$

= $\log 800 - 0.3219 (\log 21)$

= 2.4775

Antilog of 0.4775= 3002

Average hours = 300.2 per machine

Repeat order 30 machines

Total machines 51

Labour hours= $800 (51)^{-0.3219}$

= $\log 800 - 0.3219 (\log 51)$

= 225.6 hours per machine

Net machines	1	21	51
Hours per unit	800	300.2	225.6
Total hours	800	<u>6,304.2</u>	<u>11,505.6</u>
Incremental hours		5,504.2	5,201.4
Costs machines		20	30
Direct materials $16,000 \times 20$		3,20,000	4,80,000
$16,000 \times 30$			
Direct labour 5504.2×20		1,10,084	1,04,028
$5,206.5 \times 20$			
Variable overheads @ 25/- per hr		1,37,605	1,30,035
Fixed Overheads @ 40/- per hour		<u>2,20,168</u>	<u>2,08,056</u>
Total		<u>7,87,857</u>	<u>9,22,119</u>

Cost per unit	39,392.85	30,737.3
Selling price (20% profit on S.P.)	49,241	38,421.63

Reduction in price for repeat order = Rs.10,819.37

(c) Random number allocation

Sales in units	Probability	Cumulative Probability	Random Nos. allocated
74	0.10	0.10	00-09
76	0.15	0.25	10-24
78	0.22	0.47	25-46
80	0.30	0.77	47-76
82	0.18	0.95	77-94
84	0.05	1.00	95-99

Simulation:

Contribution (75-45)= Rs.30

Scrap sales loss per unit (S.P. – V.C) = (Rs.30 – Rs.45) = (Rs.15)

Fixed costs per day = 80 units × Rs.10 = Rs.800

(i) 80 units per day

R.No.	Sales units	Contribution@ Rs.30	Scrap loss @ Rs.15/- p.u.	Penalty at Rs.5/-	Net Contribution (Rs.)
41	78	2,340	30		2,310
65	80	2,400	-		2,400
14	76	2,280	60		2,220
35	78	2,340	30		2,310
81	82	2,400	-	10	2,390
20	76	2,280	60		2,220
79	82	2,400	-	10	2,390
93	82	2,400	-	10	2,390
71	80	2,400	-		2,400

14	76	2,280	60	<u>2,220</u>
				<u>23,250</u>
			Average cost per	<u>2,325</u>
			per day	
			Less: Fixed costs per day	<u>800</u>
			Profit	<u>1,525</u>

Daily production 76 units

R. No.	Sales units	Contribution @ Rs. 30 p.u.	Scrap loss @ Rs.15 p.u.	Penalty @ Rs.5	Net contribution Rs.
41	78	2,280		10	2,270
65	80	2,280	Average/day	20	2,260
14	76	2,280	Fixed	10	2,280
35	78	2,280	costs/day	30	2,270
81	82	2,280	Net Profit/day	30	2,250
20	76	2,280		30	2,280
79	82	2,280		20	2,250
93	82	2,280			2,250
71	80	2,280			2,260
14	76	2,280			<u>2,280</u>
					<u>22,650</u>
					2,265
					<u>800</u>
					<u>1,465</u>

Note: Wherever sales are greater than the production of 76 units, sales and consequently the contribution are restricted to production units of 76.

18. Let x_1 : Investment in Portfolio 1

x_2 : Investment in Portfolio 2

The LPP may be expressed as under

Maximise $Z = 0.10x_1 + 0.20x_2$ Total Return

Subject to $x_1 + x_2 \leq 100,000$ Total Investment

$x_1 \leq 75,000$

$$\begin{array}{ll}
 x_2 \leq 75,000 & \text{Investment ceiling.} \\
 -2x_1 + 3x_2 \leq 0 & \text{Risk Requirement} \\
 -2x_1 + 8x_2 \geq 0 & \text{Return Requirement} \\
 x_1, x_2 \geq 0 & \text{Non-negativity}
 \end{array}$$

Note:

- (1) The Average risk is not to be exceeding 6. Thus we have,

$$\frac{4x_1 + 9x_2}{x_1 + x_2} \leq 6$$

$$\text{or } 4x_1 + 9x_2 \leq 6x_1 + 6x_2$$

$$\Rightarrow -2x_1 + 3x_2 \leq 0$$

- (2) It is desired to have an average return of at least 12 percent. Thus,

$$0.10x_1 + 0.20x_2 \geq 0.12(x_1 + x_2)$$

$$\Rightarrow -2x_1 + 8x_2 \geq 0$$

The given constraints are plotted in the following figure.

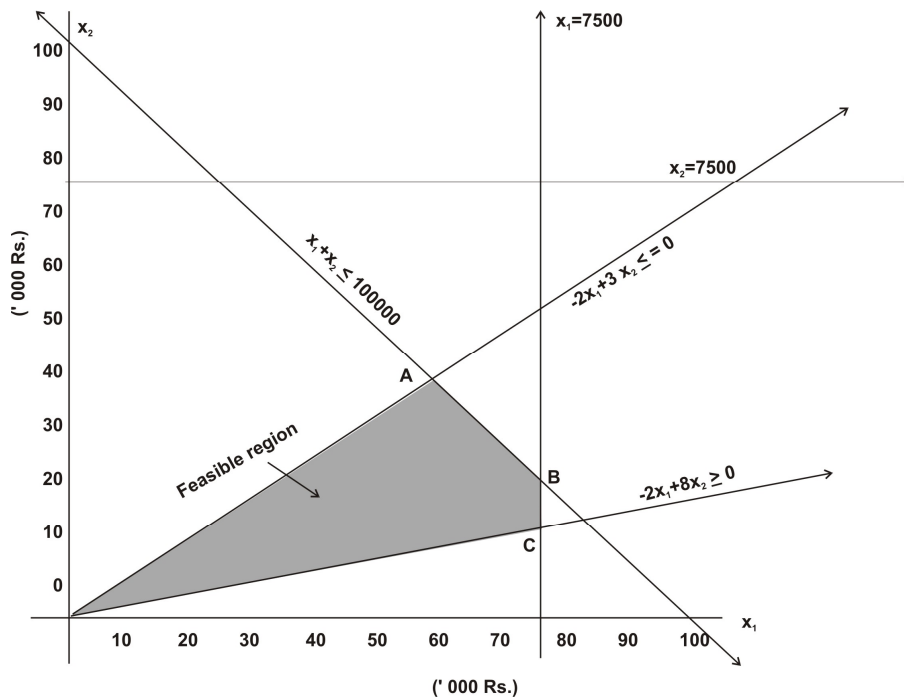


Fig: Graphic solution to Investment Problem

The feasible region is given by the shaded region with vertices O, A, B and C. These points are evaluated below:

Point	x_1	x_2	Z
O	0	0	0
A	60,000	40,000	14,000
B	75,000	25,000	12,500
C	75,000	18,750	11,250

Evidently, Rs. 60,000 should be invested in Portfolio 1 and Rs. 40,000 in Portfolio 2. It would yield a maximum return of Rs. 14,000, while meeting all the given requirements.

19. We shall consider the maximum assignment problem.

Table 1

	1	2	3	4	5
A	7	1	2	0	8
B	4	2	0	3	1
C	11	13	9	0	8
D	8	0	10	3	7
E	5	3	4	0	7

Table 2

	1	2	3	4	5
A	3	1	2	0	7
B	0	2	0	3	0
C	7	13	9	0	7
D	4	0	10	3	6
E	1	3	4	0	6

in table 2, the minimum no. of lines $M = 3$

the order of matrix $n = 5$

i.e. $M < n$

Table 3 :

	1	2	3	4	5
A	2	1	1	0	6
B	0	3	0	4	0
C	6	13	8	0	6
D	3	0	9	3	5
E	0	3	3	0	5

Here $M < n$

Table 4

	1	2	3	4	5
A	1	1	0	0	5
B	0	4	0	5	0
C	5	13	7	0	5
D	2	0	8	3	4
E	0	4	3	1	5

$M = n$

Table 5: The Maximum Assignment Table

	1	2	3	4	5
A			0	×	
B	×		×		0
C				0	
D		0			
E	0				

The Maximum Assignment Schedule

(A) $\rightarrow$ 3

(B) $\rightarrow$ 5

(C) $\rightarrow$ 4

(D) $\rightarrow$ 2

(E) $\rightarrow$ 1

$\therefore$ The Maximum profit = $10 + 5 + 14 + 14 + 7 = 50$

20. Let us formulate the given problem into a transportation problem as given below:

		W ₁	W ₂	W ₃	customer requirements
Customer	A	5	7	8	70
	B	4	4	6	30
	C	6	7	7	50
Stock		65	42	43	

Since stock = Customer requirements (=150 units), we note that the above transportation problem is a balanced one and it is a minimization problem. We shall now apply vogel's approximation method to find an initial solution.

		Ware House							
		W ₁	W ₂	W ₃	Requirements	Diff			
Customer	A	65	5		70/5/0	2	2	1	7
		5	7	8					
	B		30						
		4	4	6	30/0	0	-	-	-
C			7	43	50/7/0	1	1	0	0
		6	7	7					
Stock		65/0	42/12/7/0	43/0					
Diff		1	3	1					
		1	0	1					
		-	0	1					
		-	0	-					

The initial solution obtained by VAM is given below.

		Ware House			
		W1	W2	W3	
Customer	A	65	5		70
		5	7	8	
	B		30		
		4	4	6	30
C			7	43	50
		6	7	7	
Stock		65	42	43	

The total number of allocations is 5 which is equal to the revised $m+n - 1 = 5$ allocations. Let us now test the optimality of the initial solution obtained above. Introduce u_i, v_j ; (1, 2, 3) and $j = (1, 2, 3)$ such that $u_{ij} = C_{ij} (u_i + v_j)$ for allocated cells. We assume that $u_1 = 0$ and remaining u_i 's and u_{ij} 's are calculated below:

The initial solution obtained by VAM is given below.

		Ware House			
		W1	W2	W3	
Customer	A	65 5	5 7	8 0	0
	B	2 4	30 4	2 6	-3
	C	1 6	7 7	43 7	0
Vj's		5	7	7	

Since all U_{ij} 's for non basic cells are positive, therefore the solution obtained above is an optimal one. The allocation of units from warehouses to customers and their cost are given below:

Warehouses	Customer	Unit	Cost per unit	Total Cost
W ₁	A	65	Rs. 5	Rs. 325
W ₂	A	5	Rs. 7	Rs. 35
W ₂	B	30	Rs. 4	Rs. 120
W ₂	C	7	Rs. 7	Rs. 49
W ₃	C	43	Rs. 7	Rs. 301
Total				Rs. 830

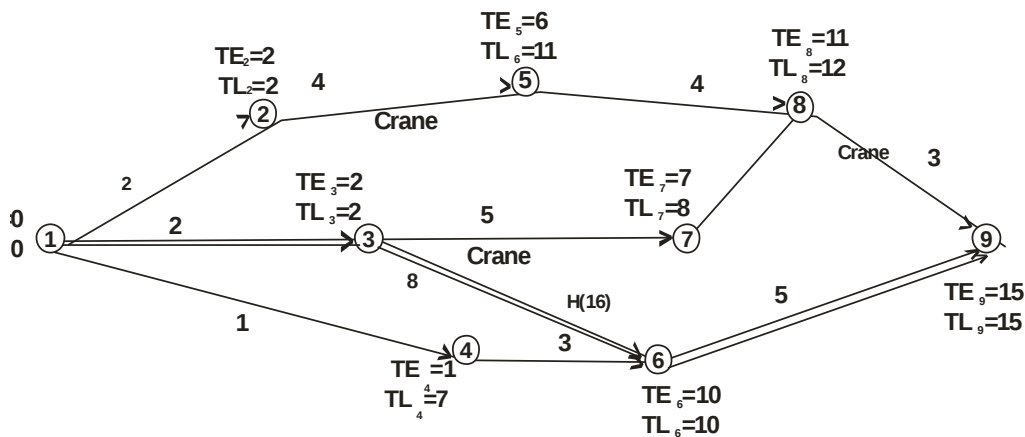
21. (a). PERT

1. Since PERT was developed in connection with an R&D work, therefore, it had to cope with the uncertainties which are associated with such activities. In PERT, the total project is regarded as a random variable, and therefore, associated probabilities are calculated so as to characterise it.
2. It is an event-oriented network because in the analysis of network, emphasis is given to important stages of completion of task rather than to the activities required to be performed to reach a particular event or task.
3. PERT is normally used for projects involving activities of non-respective nature in which time estimates are uncertain.

- It helps in pinpointing critical areas in a project so that necessary adjustment can be made to meet the scheduled completion date of the project.

CPM

- Since CPM was developed in connection with a construction project which consisted of routine tasks whose resource requirements and duration were known with certainty, it is basically deterministic.
 - CPM is suitable for establishing a trade-off for optimum balancing between schedule time and cost of the projects.
 - CPM is used for projects involving activities of a repetitive nature.
- (b) The network is given in the following figure.



The TE_i and TL_i are calculated using forward pass computations and backward pass computations, respectively. The various floats are calculated in the following table.

Activity (i-j)	Duration (in months)	Earliest		Latest		Total float	Free float	Independent float
		Start	Finish	Start	Finish			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1-2	2	0	2	4	6	4	4	4
1-3	2	0	2	0	2	0	0	0
1-4	1	0	1	6	7	6	0	0
2-5	4	2	6	7	11	5	0	0
3-6	8	2	10	2	10	0	0	0
3-7	5	2	7	3	8	1	0	0
4-6	3	11	4	7	10	6	6	0
5-8	1	6	7	11	12	5	4	3
6-9	5	10	15	10	15	0	0	0

7-8	4	7	11	8	12	1	0	0
8-9	3	11	14	12	15	1	1	0

(b) Critical path is 1 – 3 – 6 – 9 with duration 15 months.

(c) Minimum number of cranes.

Finish 3-7 at 7 with one crane.

Finish 2-5 at 7+4 = 11 with the same crane

Finish 5-8 at 11+1 = 12 without the crane.

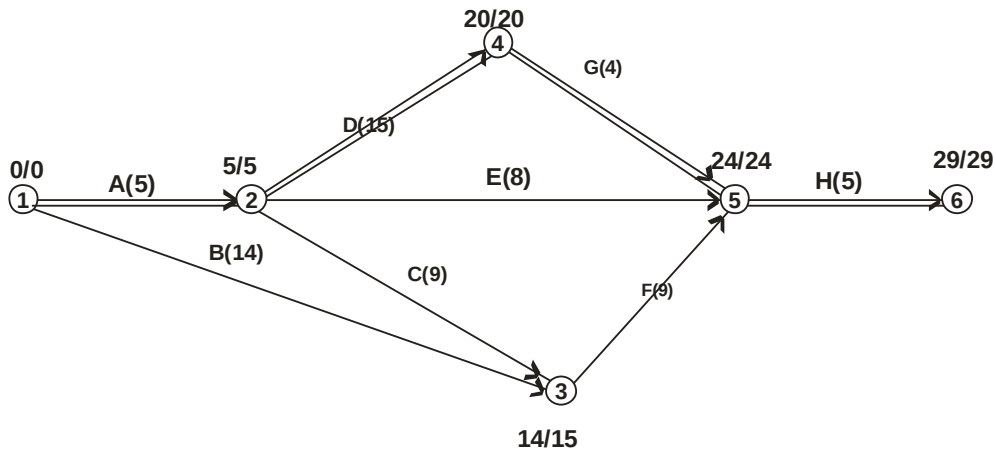
Finish 8-9 at 12+3 = 15 with the same crane.

Therefore, one crane will be sufficient, 2-5, 5-8 and start at 7, 11, and 12 respectively.

22. The expected time and variance of each activity is computed by using the formula.

$$\text{Mean time } t_{ei} = \frac{a + 4m + b}{6} \text{ and variance, } \sigma_i^2 = \left(\frac{b - a}{6} \right)^2$$

By using the expected activity duration, the required PERT network is



Calculation for Activity Duration Times and Scheduling Times

Activity	Time Estimates				σ_i^2	Earliest		Latest	
	a	m	b	t_e		start	finish	start	finish
A	2	4	12	5	25/9	0	5	0	5
B	10	12	25	14	64/9	0	14	1	15
C	8	9	10	9	1/9	5	14	6	15
D	10	15	20	15	25/9	5	20	5	20
E	7	7.5	11	8	4/9	5	13	16	24
F	9	9	9	9	0	14	23	15	24
G	3	3.5	7	4	4/9	20	24	20	24
H	5	5	5	5	0	24	29	24	29

The critical path of the project is 1–2–4–5–6, the critical activities being A, D, G and H.

Expected time for completion of the project = 5+15+4+5 = 29 week.

Project variance is obtained by summing variances of critical activities = $25/9 + 25/9 + 4/9 + 0 = 6$.

- (d) The required probability can be determined by finding the area under the normal curve to the left of $x = 30$. Now, the probability of completing the project within the 30 week deadline is

$$\begin{aligned} P(x \leq 30) &= 0.5 + p_{\mu < x < 30} \\ &= 0.5 + P(0 \leq Z \leq 0.41), \text{ where } Z = \frac{30 - 29}{\sqrt{6}} = 0.41 \\ &= 0.5 + 0.1591 = 0.6591 \end{aligned}$$

- (e) If the project start X weeks before the due date, the X will represent the ordinate under normal curve to the left of which 99% of area lies.

The area between 0 and x being 99–50 or 49%. and Z – value corresponding to this is 2.33 (from tables).

$$\therefore 2.33 = \frac{x - 29}{\sqrt{6}} \text{ or } X = 29 + 2.33\sqrt{6} = 34.7 \text{ weeks.}$$

23. (a) (i) The given supply and demand distributions are converted to probability distributions and random numbers allotted for each level of supply and demand in accordance with the relevant relative probabilities.

Supply

Number supplied	Number of days	Probability	Numbers allocated
50	60	0.2	0–1
100	90	0.3	2–4
150	90	0.3	5–7
200	60	0.2	8–9

Demand

Number supplied	Number of days	Probability	Number allocated
50	60	0.2	0–1
100	60	0.2	2–3
150	150	0.5	4–8
200	30	0.1	9

(Note: It is possible to use single – digit numbers here since random number to be used in the question are of single digit).

The figures for six days trading are given in the following table:

Day	Random number	Random Supply	Random number	Random Demand	Sales in Units	Costs	Revenue	Loss through shortage (Rs)	Profit (Loss) (Rs.)
1	8	200	4	150	150	1200	1500	–	300
2	8	200	0	50	50	1200	500	–	(700)
3	3	100	3	100	100	600	1000	–	400
4	4	100	7	150	100	600	1000	100	300
5	9	200	6	150	150	1200	1500	–	300
6	1	50	5	150	50	300	500	200	0
									600

The estimated daily profit is Rs. 100

∴ Annual profit is Rs. 100 x 300 = Rs. 30,000

(ii) The exercise has to be return to estimate the value of storage facilities.

Day	Random number	Supply	Random Number	Demand	Sales in units	Cost	Revenue	shortage loss	Store (Units)	Profit (Loss)
1	8	200	4	150	150	1200	1500	–	50	300
2	8	200	0	50	50	1200	500	–	200	700
3	3	100	3	100	100	600	1000	–	200	400
4	4	100	7	150	150	600	1500	–	150	900
5	9	200	6	150	150	1200	1500	–	200	300
6	1	50	5	150	150	300	1500	–	100	1200
										2400

The provision of a storage facility increased the 6 day profit by Rs. 1800. (This is Rs. 90,000 in a year).

- (b) A simulation is the imitation of the operation of a real-world process or system over time. The behaviour of a system as it evolves over time is studied by developing a simulation model. This model usually takes the form of a set of assumptions concerning the operation of the system. These assumptions are expressed in mathematical, logical, and symbolic relationships between the entities, or objects of interest, of the system.

Simulation modeling can be used both as an analysis tool for predicting the effect of changes to existing systems, and as a design tool to predict the performance of new systems under varying sets of circumstances.

The Monte Carlo method in the earliest method of simulations; the method employs random numbers and is used to solve problems that depend upon probability, where physical experimentation is impracticable and the creation of a mathematical formula impossible. It is method of simulation by the sampling technique. That is, first of all, the probability distribution of the variable under consideration is determined; then a set of random numbers is used to generate a set of values that have the same distributional characteristics as the actual experience it is devised to simulate.