

PAPER – 5 : ADVANCED MANAGEMENT ACCOUNTING
QUESTIONS

Decision Making: Application of Differential Cost Techniques in Managerial Decision

1. AB Ltd produces two products A and B, some details of which are given below :

	A	B
Budgeted Selling Price	₹ 3600	₹ 4300
Variable Production & selling cost	₹ 2700	₹ 3700

Total Fixed Cost is ₹ 18 lakhs

For effective selling, Marketing team has given two options for combined sale of products.

Option 1 : A & B in the proportion of 2: 3

Option 2: A & B in the proportion of 3: 4

Suggest the best option.

2. Your Company received an export offer from an potential foreign company for 20,000 units of a special product P @ ₹ 1800 per unit.. Cost and other information for the production of the same is given below :

- (i) Material Required per unit : 3 kg of X and 2 litres of Y

Cost of Material per unit :	X	Y
Book value (₹)	80	300
Replacement (₹)	100	320
Net Realizable	90	250

Material X is regularly used in the production process whereas 10,000 kg stock of Material Y is lying in stock which is to be disposed, if not used in the current year.

- (ii) Labour : Skilled 2 hours @ ₹ 150 and unskilled 4 hours @ ₹ 100

Skilled work-force is permanent in nature and underutilized.

Unskilled workers are to be hired on per hour basis.

- (iii) If the order is accepted, the production of one existing product R is to be curtailed by 5000 units. Information on price and cost of per unit of R is as follows :

Sales Price	: ₹ 1000
Material	: ₹ 200

Unskilled Labour of 4 hours

There will be saving on fixed overhead on the basis of labour hours.

- (iv) Variable Overhead is charged @ ₹ 30 per hour
- (v) Fixed Overhead for the whole year is estimated to ₹ 60 lakhs and the productive labour hour for the year is estimated to be 3 lakhs.
- (vi) Additional Fixed Overhead of ₹ 20.00 lakhs will be incurred for special order.

Required to calculate the profitability of the special order based on i) historical costing system and ii) Relevant costing system

Marginal Costing – Optimum Product Mix

3. (a) A Company Produces three products, details of costs & sales Value per unit is given below

	Products (₹ / Unit)		
	A	B	C
Sales Value	2000	3000	2500
Direct Material	500	1000	800
Direct Wages ₹ 100 per hour	500	700	400
Variable Overheads	300	600	700

- (i) 80% of Direct Material is imported @ ₹ 500 per kg. Import is restricted to 5,000 kg.
- (ii) Capacity available for production of A and C is restricted to 6250 and 6000 hrs respectively.
- (iii) Fixed Cost is ₹ 20 lakhs.
- (a) Workout most profitable product mix and profit.
- (iv) Company identifies a source of alternative material as replacement of imported material. Availability of material will not be restricted but carrying cost will be @ ₹ 2.75 per kg.

The company plans to modify its process to suit the new material and enhance its capacity for all products by 20% above the present one with an investment of ₹ 25 lakhs at an interest of cost of 15%. Company expects 30% rise in its profit.

- (b) Find out the price the company can pay to alternative source.

Decision making – Make or Buy

4. A pump manufacturing company needs four components W, X, Y and Z. The manufacturing Components may be procured from outside. The cost, purchase price for the components and other information are given below:
- (i) There are constraints in machine time in manufacturing all components. Total machine hours available is only 12,000.

- (ii) Other alternative is to use machine time in a second shift which will attract 20% extra wages and other fixed overheads @ ₹ 3,000 for 1000 hours or part thereof.

Give your suggestion about the course of action for maximization of profit.

	W	X	Y	Z
	(₹)	(₹)	(₹)	(₹.)
Direct Material	60	70	75	60
Direct wages	30	40	60	40
Direct Expenses @ ₹ . 20 per machine hour	40	30	40	40
Fixed Cost	20	20	15	25
Total Cost	150	160	190	165
Purchase price from market	150	160	200	135
Units required for the year	3,000	3,500	2,000	3,000

Shut Down of Operation or Continue

5. A Company manufactures has normal capacity of production of 20,000 units of Product P . Due to Trade depression, it is expected that only 2,000 units can be produced and sold in the next quarter of the year @ ₹ 1,000 per unit. Variable cost per unit is ₹ 900 and fixed cost for the year is ₹ 14 lakhs. The Company plans to shut down the plant and it is estimated that fixed cost for the quarter could be brought down to 1.00 lakhs. Additional cost of shut down is estimated to be ₹ 40,000.
- Decide whether the plant is to be shut down or not.
 - Calculate the shutdown point
 - What are other factors to be considered in the decision of shut down

Profit Optimization - Decision Making

6. ABC Ltd is producing following four products, sales and costs for last year is given below:

₹ Lakhs

Products ----- à	A	B	C	D
Sales	500	600	240	200
Direct Material	160	180	68	110
Direct Wages	100	120	64	56
Factory Overheads	80	70	54	30
Selling & Dist Overheads	40	50	20	35
Total cost	380	420	206	231
Profit	120	180	34	-31

Total Profit is ₹ 303 lakhs.

- (i) Present production is much below the capacity. There is market demand of Products A and B and the management likes to enhance production of both A & B by 30%.
- (ii) Management proposes to discontinue product D as it is loss making. However, sale of product C is in conjunction with D and D's discontinuance will affect sale of C by 25%.
- (iii) 50% of Factory Overheads is variable and variable Selling & Dist. Overheads is 5% of sales. In case of Increase of Production of A & B as above in (i), Fixed Factory Overheads apportioned to A and B will rise by 25% and 20% respectively. On discontinuance of D, Fixed Factory Overhead for product D can be eliminated by 70% and its portion of Selling & Dist Overhead can be avoided totally.
 - (a) Suggest whether Product D is to be discontinued.
 - (b) What will be profitability after enhancement of production of A & B ?

Product Pricing

7. AB Company has two departments producing several small electronic components. It has acquired a new technology to produce a electronic product X. Cost and other information for manufacturing X are given below :

Item	Department A	Department B
Direct Material	₹ 240	₹ 200
Direct Labour	2 hours @ ₹ 120	3 hours @ ₹ 100
Variable Overhead per hour	₹ 50	₹ 30
Fixed Overheads per hour (based on 100% capacity)	₹ 60	₹ 40
Value of Machinery on revaluation	₹ 40 lakhs	₹ 28 lakhs

- (i) Technology cost ₹ 25 lakhs and working capital requirement ₹ 7 lakhs
- (ii) Target Volume of production in the first year is 2000 units at 25% capacity
- (iii) Variable Selling & Distribution is ₹ 3 lakhs
- (iv) Expected net return on investment is 24%

Suggest on pricing product as (a) new one (b) established one - production at 80% capacity.

Costing of Service Sector

8. Hotel Galaxy analysed previous 5 years data for preparation of budget for current year. Average occupancy during off-season i.e Nov to April remains below 60%.

Contribution of Three Profit Centres: Accommodation: 50%, Restaurant: 30%, Bar 20%

The three Profit Centres had the following pattern of contribution %:

	Accommodation	Restaurant	Bar
Revenue	100	100	100
Wages	25	20	15
Direct Cost	15	50	45
Contribution	60	30	40

Estimated Revenue for the current year: ₹ 60 lakhs, and Fixed cost ₹ 10.00 lakhs.

To improve Return on Capital Employed of 110 lakhs, two suggestions have been made:

Option A. An offer of two-nights reduced price @ ₹ 1600 during off-season (Nov–April).

It is expected that occupants under this offer will spend 30% of accommodation charge in restaurant and 15% in the bar.

Option B. To increase restaurant & bar prices by 15% and also increase room rent (assuming that there will be no change in occupancy).

You are required to calculate the following (before tax):

- Expected Return on Capital Employed under the budget
- How many two-night offers to be sold as in proposal A to increase ROCE by 5%.
- What increase in room rent to be under proposal B to get same ROCE as in (ii).

Transfer Price

9. Division A produces three products X, Y and Z, cost per unit and other details are given below :

	X	Y	Z
Market Price (₹)	500	450	400
Max Demand (units)	800	500	300
Variable Cost (₹)	440	350	310
Labour hours required/ Unit	3	4	3

Division B requires 300 units of Y. Similar product is procured by it @ ₹ 430.

Division A operates as a profit centre. Work out a transfer price not affecting Division A, if labour hours available to division A are (i) 4400 hours (ii) 5900 hours

Activity Based Costing

10. ABC Ltd is manufacturing 4 similar products W, X, Y, Z with the following details :

Products -- à	W	X	Y	Z
Units	3,000	500	300	1000
Material Cost Per Unit (₹)	50	70	160	180
Labour Costs (₹)	50	60	100	75
Machine Time per unit (.hour)	0.5	0.5	2	4
No of Sets up	10	1	2	10
No of Purchase Order	6	1	1	5
No of Material handling	12	1	2	15

Set up cost is ₹ 9000, Purchase Ordering Cost ₹ 10,400, Handling Cost ₹ 6000 and other factory overheads is ₹ 1,27,000

In present system, total overheads are charged to production on machine hour basis.

Apply Activity based costing on the basis of relevant cost drivers and indicate the difference in cost of products under the two methods.

Target Costing

11. A company has sales of 1.00 units at a price of ₹ 200.00 per unit and profit of ₹ 40.00 lakhs in the current year. Due to stiff competition, the company has to reduce its price of product next year 5% to achieve same volume target of sales. The cost structure and profit for the current year is given as below :

	₹ lakhs
Direct Material	60.00
Direct wages	45.00
Variable Factory Overheads	20.00
Fixed Overheads including sales & admin exp	<u>35.00</u>
Total Cost	<u>160.00</u>

To achieve the target cost to maintain the same profit, the company is evaluating the proposal to reduce labour cost and fixed factory overheads. A vendor supplying machine for suitable for the company's operation has offered an advanced technology semi-auto machine of ₹ 20 lakhs as replacement of old machine of worth 5.0 lakhs. The vendor is agreeable to take back the old machine at ₹ 2.70 lakhs only. Company's policy is to charge depreciation @ 10% on WDV. The maintenance charge of the existing machine is ₹ 1.20 lakhs per annum whereas there will be warranty of services free of cost for the

new machine first two years. There are ten (10) supervisors whose salary is ₹ 1.50 lakhs per annum.

The new machine having conveyor belt is expected to help in cost cutting measures in the following ways :

- (i) improving productivity of workers by 20%
- (ii) cut down material wastage by 1.0 %
- (iii) Elimination of services of supervisors because of auto facilities of the machine
- (iv) Saving in packaging cost by ₹ 1.5 lakhs.

Assuming cost of capital to be 15%, calculate how many supervisors are to be removed from the production activities to achieve the target cost.

Budgeting

12. ABC Ltd has, over the past few years, has sales of ₹ 400 lakhs with 30% contribution.

Last year's fixed cost was ₹ 45 lakhs. Company plans to venture into new contract service business and also in the process of introduction of a new product.

- (i) Proposal A : Value of ₹ 30 lakhs with variable cost 60%, fixed cost of ₹ 4 lakhs
Proposal B : Value of ₹ 20 lakhs with variable cost 50%, fixed cost ₹ 3 lakhs
- (ii) New product : Expected Sales per month 6 lakh with 50% variable cost and fixed cost of ₹ 1.0 lakhs per month.
- (iii) Optimistic assumption : Offer for both Contract A & B will mature and be executed next year and new product will be launched from 2nd quarter of next year.
- (iv) Pessimistic assumption : Only Contract A will mature and be executed next year and new product will be launched from 4th quarters of next year and there will be rise in both variable and fixed cost by 10% without scope for rise in sales value.

Prepare two budgets based on optimistic and pessimistic assumptions.

Profit Planning

13. A Company is manufacturing car components to be supplied to a car Manufacturer. For the current year, material cost per unit is ₹ 100, Direct Wages ₹ 40 and direct expenses ₹ 10. The other information is as follows :

Semi-variable cost (₹ lakhs) at different levels of production :

Units	16,000	20,000	24,000
Indirect Material	2.00	2.60	3.20
Indirect Wages	1.02	1.50	1.98

Indirect Expenses	0.46	0.50	0.54
Selling Expenses	3.00	4.00	5.00

Fixed Expenses (Depreciation, Maintenance etc) = ₹ 5.50 lakhs per year.

The company is , at present, supplying 20,000 at a price of ₹ 200 expecting order of higher size at the same price. The plant has maximum capacity of producing 30,000 units. It has come to an understanding with the supplier that 1% discount in price (on present price) will be there for increase in size by each 5% from the present order. Direct Wages will increase by 5% next year. Moreover, the fixed overheads may increase by 5% for each increase in volume of production by 10% or part thereof. The marketing department assessed the probabilities of different order size :

Order Size	Probability
20,000	0.35
25,000	0.50
30,000	0.15

Prepare a budgeted profit for the next year on sale based on assessed probability with a comparison with the current year's expected profit .

Variance Analysis

14. EXEL Company is following JIT system for inventory management and it is expected that there will be no opening and closing balance for January 2012. Budgeted production of its product X during the month is 600 kg with the following standard cost per unit :

	₹
Direct Material 4 kg @ ₹ 40 per kg	160.00
Direct Wages 1.0 hours @ ₹ 100 per hour	100.00
Variable overheads 1 hour @ 30	30.00
Fixed Overheads 1 hour @ 50	50.00
Standard Cost	340.00
Standard Profit	60.00
Standard Selling Price	400.00

Actual Expenses :

- (i) Material 2380 kg at a total cost of ₹ 99,960
- (ii) Labour 580 hours at a cost of ₹ 56840
- (iii) Actual Operating Hours is 550.
- (iv) Variable Overheads of ₹ 19,200

- (v) Fixed Overheads of ₹ 31,500
- (vi) Selling and Administrative Expenses ₹ 5,400
- (vii) Output of 585 kg was sold for ₹ 2,28,150.
- (a) Calculate all variances and (b) Draw an operating statement for Jan 2012.

Decision Making on Acceptance of an Order

15. A Company had the following budget of operation & profit for the current year :

	₹ Lakhs
Sales	50.00
Direct Material	20.00
Direct Labour	10.00
Factory Overheads – variable	2.00
Factory Overheads – Fixed	2.00
Administrative expenses	3.00
Sales commission	1.00
Fixed Sales Expenses	2.00
Total Costs	40.00
Profit	10.00

For fixing prices, the company charges overheads as 100% of Direct wages. It is reviewed at the fourth quarter that the company would achieve the target of normal sales and profit. However, a special order has been received from a prospective customer valued ₹ 2.00 lakhs which involves no sales commission. However, it is estimated that material requirement will be of ₹ 1,00,000 and wages will be ₹ 60,000.

As total cost of the order taking overheads @ 100% wages is more than ₹ 2.00 lakhs, the company is hesitant to accept the order. As an accountant, give your suggestion.

Learning Curve Theory

16. In your company, production manager has observed that learning curve theory is very much applicable in the newly procured machine @ 90%. A batch of production is of 100 units. The average labour cost for the first batch is ₹ 200. Material Cost and Overheads are ₹ 150 and 50 per unit respectively. If profit margin is 25% on cost, estimate the price per unit if the order size is for (a) 800 units and (b) 1600 units (c) 2000 units

Theory of Constraints

17. What is theory of constraints? What are key measures suggested by it ?

Value Chain Analysis

18. What is value Chain Analysis ? How Value Chain Approach helps in assessing competitive advantage ?

Total Quality Management & Value Chain Analysis

19. (a) Define Total Quality Management (TQM). Explain in brief six Cs of T.Q.M. for its successful implementation.

Linear Programming

20. A Company produces three product P, Q, R with raw material M_1 & M_2 . Requirement and availability raw material and labour units are given in the following table. Contribution per unit of the products are given:

Products	Requirement of per unit			Availability per day
	P	Q	R	
Material M_1 (kg)	1	2	2	8 kg
Material M_2 (kg)	3	2	6	12 kg
Labour unit	2	3	4	12 unit
Contribution per unit	₹ .3	₹ .2	₹ .5	

Formulate this as a Linear Programming problem and solve it to determine optimum product mix.

Programme Evaluation and Review Technique

21. ABC Construction Company has the following 6 activities relating to a project:

Activity	Time estimate			Normal Cost (₹)	Crash Cost (₹)	Immediate Predecessor
	t_0	t_m	t_p			
A	2	3	4	6,000	8,000	-
B	4	5	6	12,000	13,500	A
C	3	5	7	16,000	22,000	A
D	2	4	6	8,000	10,000	A
E	1	2	3	6,000	7,500	C D
F	1	3	5	14,000	20,000	B E

Penalty for delay in completion of project beyond ten weeks is ₹ .2,500.

- Construct the PERT Network and determine critical path.
- Crash the activity in order to achieve the optimum cost for completion of the project.

Transportation Problem

22. A Fertilize Company has the following production in its four plants with following production capacity :

Plant	A	B	C	D
Demand (Tons)	10,000	18,000	22,000	24,000

The company has three Distribution centres located at places P, Q and R. The capacity of warehouses at these places and the and the cost of transportation from different plants to these warehouses are indicated given below:

Ports	Demand (Tons)	A	B	C	D
P	20,000	50	60	100	50
Q	38,000	80	40	70	50
R	16,000	90	70	30	50

Devise distribution plan to optimize transportation cost.

Assignment Problem

23. Output of 5 operators when they worked with different 4 machines are given in the table below:

	Machine			
Operator	M1	M2	M3	M4
A	10	5	7	8
B	11	4	9	10
C	8	4	9	7
D	7	5	6	4
E	8	9	7	5

Use assignment technique to solve it.

Simulation

24. Occurrence of rain in a city on a day is dependent up whether if rained on the previous day.

If rained previous day		If not rained previous day	
Event	Probability	Event	Probability
No rain	0.50	No rain	0.75
1 cm rain	0.25	1 cm rain	0.15

2 cm rain	0.15	2 cm rain	0.06
3 cm rain	0.05	3 cm rain	0.04
4 cm rain	0.03		
5 cm rain	0.02		

Simulate the city's weather for 10 days and determine the rain fall during the period. Use the following random numbers: 67, 63, 39, 55, 29, 78, 70, 06, 78, and 76.

SUGGESTED ANSWERS/HINTS

1.

	A	B	Total
Sales Value (₹)	3600	4300	
Contribution per unit (₹)	900	600	
Option 1			
Contribution per set (₹)	1800	1800	3600
Break Even Point (set)	000 units	1500 units	18,00,000/3600= 500 sets
Sales Value (₹ lakhs)	36	64.5	100.50
Option 2			
Contribution per set (₹)	2700	2400	5100
Break Even Point	1059	1412	18,00,000/5100 =353
Sales Value (₹ lakhs)	28.593	33.888	62.481

As BEP in Option 2 is at lower sales, it is preferable.

2. Revised Fixed Overhead rate :

Fixed Overheads = ₹ (60,00,000 – 4,00,00 + 20,00,000) = ₹ 76,00,000

Total Hours (3,00,000 – 20,000 + 120,000) 4,00,000

Fixed Overhead rate per hour ₹ 19.00

(i) Statement of Profit based on historical cost (for 20,000 units of P)

Item	Unit	Rate (₹)	₹ Lakhs
Material X	60,000 kg	80	48.00
Material Y	40,000 ltrs	300	120.00
Skilled Labour	40,000 hrs	150	60.00
Unskilled Labour	80,000 hrs	100	80.00

Variable Cost	120,000 hrs	30	36.00
Fixed Overhead	120,000 hrs	19	<u>22.80</u>
Total Cost			<u>366.80</u>
Sales value of product P	20,000	1800	360.00
Loss			6.80

(ii) Statement of Profitability based on Relevance Cost

Loss of profit from Sale of 5000 units of Product R :

		₹ lakhs
Sales Value @ ₹ 1000		50.00
Material Cost		10.00
Wages of 20000 hours unskilled workers @ ₹ 100		20.00
Variable Overhead of 20000 hours @ ₹ 30		6.00
Fixed Overheads of 20000 hours @ ₹ 20		4.00
Total Cost		40.00
Profit		10.00

Item	Remarks	Unit	Rate (₹)	₹ Lakhs
Material X	Replacement cost	60,000 kg	100	60.00
Material Y	Resale value	40,000 ltrs	250	100.00
Skilled Labour	Sunk cost			
Unskilled Labour		80,000 hrs	100	80.00
Variable Cost		120,000 hrs	30	36.00
Fixed Overhead	Identified portion – other not relevant			20.00
Loss of Profit from sale of R	Opportunity Cost			10.00
Total Cost				306.00
Sales value of product P		20,000	1800	360.00
Profit				54.00

3. (a)

	A	B	C	Total
Sales price (₹)	2000	3000	2500	
Imported Material (₹)	400	800	640	
Domestic Material (₹)	100	200	160	
Direct Wages (₹)	500	700	400	
Variable Overheads (₹)	300	600	700	
Total Variable Cost (₹)	1300	2300	1900	
Contribution per unit (₹)	700	700	600	
Imported Material in Kg	0.8	1.6	1.28	
Contribution per kg of imported mat (₹)	875	437.5	468.75	
Ranking based on contribution per kg imported material	1	3	2	
Labour Hours required	5	7	4	
Contribution per labour hours (₹)	140	100	150	
Ranking based on contribution per labour hour	2	3	1	
Units to be produced on basis Labour Hours available	1250		1500	
Imported Material required/ available in Kg	1000	2080	1920	
Optimum Product Mix	1250	1300	1500	
Contribution (₹)	875000	910000	900000	
Total Contribution				2685000
Fixed Cost				2000000
Profit				685000

(b) Profitability to be maintained after process modification & capacity enhancement

	A	B	C	Total
Units to be produced	1500	1560	1800	
Sales Value	3000000	4680000	4500000	12180000
Substitute Material required (kg)	1200	2496	2304	6000
Total Variable cost per unit	900	1500	1260	

(excluding import material)				
Total Variable cost (excluding cost of subs material)	1350000	2340000	2268000	5958000
Contribution required + Sub Material Cost				6222000
Profit required at enhanced rate				890500
Fixed Cost (including interest on invest.)				2375000
Contribution Required				3265500
Substitute Material Cost of 6000 kg				2956500
Cost Per kg of Substitute Material				492.75
Transport Cost per kg				2.75
Price may be offered per kg for substitute material				490

4.

	W	X	Y	Z
	(₹)	(₹)	(₹)	(₹.)
Marginal Cost	130	140	175	140
Purchase Price	150	160	200	135
Contribution per unit	20	20	25	- 5
Machine Hrs required per unit	2.0	1.5	2.0	-
Contribution per machine hr	10.00	13.33	12.5	
Rank	3	1	2	-

As the price of Z is less than the marginal cost , it may be procured from outside market.

The plan for manufacturing other components considering the limiting factor is as follows:

X: 3500 units	5250 hrs
Y: 2000 units	4000 hrs
W: 1375 units	2750 hrs
Total	12.000 hrs

Let us calculate cost of manufacturing of balance quantity of W in 2nd shift.

Balance 1625 units of W requires m/c hrs 3250 hrs

Cost of manufacturing of W per unit

Material cost	₹ . 60
Wage Cost (rs 30 x 1.2)	₹ . 36
Direct Expenses	<u>₹ . 40</u>
Total Variable cost	<u>₹ .136</u>

Fixed cost is excluded in calculation because fixed cost is already allocated to product W and for the purpose of decision making here it is a sunk cost.

Variable Cost of production of 1625 units in 2 nd shift @ ₹ 136	₹ 2,21,000
Extra fixed cost for 3250 hrs (₹ 3000 x 4)	₹ 12,000
Total cost of manufacturing 1625 units in 2 nd shift	₹ 2,33,000
Purchase price for 1625 unit @ ₹ 150/- =	₹ 2,43,750

Hence, balance quantity of W should be manufactured in the second shift.

5. (a) If Plant is in Operation

Contribution per unit = ₹ 100

Total Contribution from 2000 units = ₹ 2.00 lakhs.

Fixed Cost for the Quarter (14 x 0.25) = ₹ 3.50 lakhs

Expected Loss in operation = ₹ 1.50 lakhs

If Plant is Shut Down

Unavoidable fixed cost for the period = ₹ 1.00 lakhs

Shutdown cost = ₹ 0.40 lakhs

Total Loss on Shut Down = ₹ 1.40

Hence, plant may be shut down.

(b) Shut Down point = (Fixed Cost – Shutdown cost) / Contribution per unit

$$= (3,50,000 - 1,40,000) / 100 = 2,100 \text{ units}$$

(c) Other non-cost factors to be considered for shut-down :

- (i) Difficulty in getting the skilled workers at the time of re-opening, because worker might switch over to other jobs.
- (ii) Re-opening cost of plants
- (iii) Effect on long shutdown on the machinery
- (iv) Loss of loyalty to customers etc

6. (a) On Discontinuance of D, sale of C will be 75% and hence profitability of C will be affected as follows :

For Product C	₹ Lakhs
Sale	180.0
Direct Material	51.0
Direct Wages	48.0
V Factory Overheads	20.3
Fixed Factory Overheads	27.0
V Selling & Dist Overheads	9.0
Fixed Selling & Dist Overheads	8.0
Total Cost	163.3
Profit for C	16.7
Less Fixed Fac Overheads for D	7.5
Profit on discontinuance of D	9.2

Earlier profitability of products of both C and D was ₹ 3 lakhs only which has been increased to ₹ 9.20 lakhs. Hence, D may be discontinued.

Profitability of A and B on enhancement of its production by 30% (₹ lakhs)

	A	B	Total
Sales	650	780	1430
Direct Material	208	234	
Direct Wages	130	156	
V Factory Overheads	52	45.5	
Fixed Overheads	50	42	
V. Selling & dist. Overheads	32.5	39	
Fixed Selling & Dist Overheads	15	20	
Total cost	477.5	536.5	1014
Profit			326

Total Profit including that of C = ₹ 335.2 lakhs i.e increase by ₹ 32.2 lakhs.

7. Variable Cost per unit of X

Item	Dept A (₹)	Dept B (₹)	Total (₹)
Direct Material	240	200	440
Direct Labour	240	300	540
Variable Overhead	100	90	190

Variable S/D Overheads			150
Total Variable Cost			1320

Fixed Cost = ₹ 8000 (60 x 2 + 40 x 3) = ₹ 19.20 lakhs

Fixed Capital Employed = ₹ (40+28+25+7) lakhs = 100 lakhs

Return Expected @ 24 % on capital = 24 lakhs

(a) For New Product, minimum price may be at variable cost i.e ₹ 1320.

(b) When the product will be established one, unit sold will be 6400 units.

Return on Capital per unit = ₹ (24 + 19.2) lakhs / 6400 = ₹ 675.

It is assumed that S/D cost will be at the same rate.

Price to be charged = ₹ (1320 + 675) = ₹ 1995.

8. (i) Analysis of Revenue and Contribution

Profit Centre	Estimated Revenue		Contribution	
	%	Amount (₹ lakhs)	%	Amount (₹ lakhs)
Accommodation	50	30.00	60	18.00
Restaurant	30	18.00	30	5.40
Bar	20	12.00	40	4.80
Total	100	60.00		28.20
			Fixed Cost	10.00
			Gross profit	18.20

ROCE (before Tax) under the budget = 18.2/110 = 16.55 %

(ii) Extra Revenue to be earned from per occupancy of two-night offer :

	Amount (₹)	%	Amount (₹)
Accommodation	1600	60	960
Restaurant	480	30	144
Bar	240	40	96
Total	2320		1200

Required ROCE (before tax) = (16.55 +5) % = 21.55 %

Gross Profit required = ₹ 110 x 0.2155 lakhs = ₹ 23.70 lakhs

Additional contribution required = ₹ (23.70 – 18.20) = ₹ 5.50 lakhs

No of two-nights offer at reduced price to be sold = 5.50 lakhs / 1200 = 458

- (iii) We assume that contribution % of revenue will remain same after increase in price.

Increase in revenue from restaurant & bar by 15% increase in price will be

₹ 2.70 lakhs and ₹ 1.80 lakhs respectively.

Increase in Contribution from restaurant and bar = $2.7 \times 0.30 + 1.8 \times 0.40 = ₹ 1.53$ lakhs

Additional contribution required from accommodation $(5.50 - 1.53) = ₹ 3.97$ lakhs

Required increase in revenue = ₹ lakhs $(3.97 / 0.60) = ₹ 6.60$ lakhs approx

Required percentage increase in rent = $6.60 / 30 = 22\%$

9.

	X	Y	Z
Contribution Per Unit (₹)	60	100	90
Labour Hours per unit (units)	3	4	3
Contribution per L. hour (₹)	20	25	30
Ranking on Contribution	3	2	1

- (i) If only 4400 hours available, production of Division A will be :

	When sold in outside market			Transfer to Div B		
Product	Units	Labour Hours	Contribution (₹)	Units	Labour Hours	Contribution (₹)
Z	300	900	27000	300	900	27000
Y	500	2000	50000	800	3200	74000
X	500	1500	30000	100	300	6000
Total		4400	107000		4400	107000

On 300 units transfer of Y, loss on production of X by 400 units will cause loss of contribution of ₹ 24,000. Thus, 300 units transfer should make up loss @ ₹ 80 per unit. Thus, transfer price of ₹ 430 satisfies the same.

- (ii) If only 5900 hours available, production of Division A will be :

	When sold in outside market			Transfer to Div B		
Product	Units	Labour Hours	Contribution (₹)	Units	Labour Hours	Contribution required (₹)
Z	300	900	27000	300	900	27000

Y	500	2000	50000	800	3200	62000
X	800	2400	48000	600	1800	36000
Total		5300	125000		5900	125000

In this case, on 300 units transfer of Y, loss on production of X by 200 units will cause loss of contribution of ₹ 12,000. Thus, 300 units transfer should make up loss @ ₹ 40 per unit.

In this case, transfer price may be fixed at ₹ 390.

Division A will earn higher contribution of ₹ 18,000 for its extra effort.

And a transfer price of ₹ 430 will give Division A ₹ 30,000 higher contribution.

10. Total Machine hour = $1500+250+600+4000 = 6350$ hrs

Overheads rate per machine hr = ₹ $(1,27,000 + 9000 + 10400 + 6000) / 6350 = ₹ 24$

No of Set up = 18, Cost per set up = ₹ $9000 / 18 = ₹ 500$

No of Purchase Orders = 13, Cost per Purchase Order = ₹ $10,400 / 13 = ₹ 800$

No Of Material Handling = 30, Cost per material handling = ₹ $6000 / 30 = 200$

Other Factory Overheads rate on basis of Machine hr = ₹ $1,27,000 / 6350 = ₹ 20$

Cost of Products in present system per unit in Rupees

Products --- à	W	X	Y	Z
Material Cost (₹)	50	70	160	180
Labour Cost (₹)	50	60	100	75
Overheads at M/C hr rate	12	12	48	96
Total Cost	112	142	308	351

Cost of Products on the basis of Activity Based Costing per unit in rupees :

Products --- à	W	X	Y	Z
Material Cost	50.00	70.00	160.00	180.00
Labour Cost	50.00	60.00	100.00	75.00
Set Up Cost	$5000/3000=1.67$	$500/500=1$	$500/600=0.83$	$5000/1000=5.00$
Ordering Cost	$4800/3000=1.60$	$800/500=1.60$	$800/600=1.33$	$4000/1000=4.00$
Material Handling	$2400/3000=0.80$	$200/500=0.40$	$200/600=0.33$	$3000/1000=3.00$
Other Factory OH	10.00	10.00	40.00	80.00
Total Cost	114.07	133.00	302.49	347.00

11. Due to cut in price of product, sales value will decrease by ₹ 10.00 lakhs.

For maintaining same profit margins i.e ₹ 40 lakhs, cost has to be down by ₹ 10.00 lakhs. With improvement of labour productivity, wages will be $(45/1.20) = ₹ 37.50$

₹ lakhs

Reduction in wages	7.50.
Elimination of wastage of materials	0.60
Saving in Packaging Cost	1.50
Saving in Maintenance cost	1.20
Loss in disposal of selling of old machine	- 2.30
Difference in Depreciation	- 1.50
Cost of capital investment	<u>- 3.00</u>
Effective cost reduction	4.00
Additional reduction required for target cost	6.00

Hence, number of supervisors to be eliminated = 4

12. Budget for the next year based on optimistic assumptions (Figures in ₹ Lakhs)

Activities	Revenue	Variable Cost	Fixed Cost	Profit
Normal Activity	400	280	45	75
Contract service	50	28	7	15
New Product	54	27	9	18
Total	504	335	61	108

Budget based on pessimistic assumptions (Figures in ₹ Lakhs)

Activities	Revenue	Variable Cost	Fixed Cost	Profit
Normal Activity	400	280	45	75
Contract service	30	19.8	4.4	5.8
New Product	18	9.9	3.3	4.8
Total	448	309.7	52.7	85.6

13. Next year Order Size = $20,000 \times 0.35 + 25,000 \times 0.50 + 30,000 \times 0.15 = 25,000$

Increase in volume by 25%

Metal price will increase by 5% and fixed expenses by 15%

20,000 units

25,000 units

	Cost Per Unit (₹)	
Direct material	100.00	95.00
Direct Wages	40.00	42.00
Direct Expenses	10.00	10.00
Variable cost per unit	150.00	147.00
Total Variable Cost (₹ Lakhs)	30.00	36.75
Overheads	₹ Lakhs	₹ Lakhs
Indirect Material	2.60	3.35
Indirect Wages	1.50	2.10
Indirect Expenses	0.50	0.55
Selling Expenses	4.00	5.25
Fixed Overheads	5.50	6.235
Total Overheads	13.50	17.485
Total Cost (₹ lakhs)	43.50	53.485
Sales Value	50.00	62.50
Profit	6.50	8.015

Increase in profit will by 1.515 i.e 23.3 % approx.

14. (a) Material Price Variance = $AQ \times (SR - AR) = 2520 (40 - 42) = ₹ 5040 (A)$
 Material Usage Variance = $SR \times (SQ - AQ) = 160 (2400 - 2380) = 3200(F)$
 Labour Rate Variance = $AH (SR - AR) = 580 (100 - 98) = 1160 (F)$
 Labour Efficiency Variance = $SR \times (SH - AH) = 100 (600 - 580) = 2000 (F)$
 Labour Idle Time Variance = $SR \times \text{Idle Time} = 100 (580 - 550) = 3000 (A)$
 Variable Overhead Exp Var = $(BVOH - AVOH) = 550 \times 30 - 19,200 = ₹ 2,700 (A)$
 Variable Overhead Efficiency Var = $SR (SH - AH) = 30 (585 - 590) = 150 (A)$
 Fixed Overhead Expenditure Var = $(BFOH - AFOH) = 600 \times 50 - 31,500 = ₹ 1,500(A)$
 Fixed Overhead Volume Var = $BFOH \text{ per unit} (BV - AV) = 50 (600 - 585) = 750 (A)$
 Fixed Overhead Efficiency Var = $BFOH \text{ per hr} (SH - AH) = 50 (585 - 550) = ₹ 1750(F)$
 Fixed Overhead Capacity Var = $BFOH \text{ per hour} (\text{Bugt Capacity} - \text{Actual capacity})$
 $= 50 (600 - 550) = 2500 (A)$
 Sales Price Variance = $AQ (SP - AP) = 585 (400 - 390) = ₹ 5850 (A)$
 Sales Volume Variance = $\text{Std Profit per unit} (\text{Budgeted sales unit} - \text{Actual Sales Unit})$
 $= 60 (600 - 585) = 900 (A)$

(b) Operating Statement for the month of January, 2012

Budgeted Profit (before Selling & Administrative Exp) (600 x 6)		₹ 36,000
Selling & Administrative Expenses		<u>5,400</u>
Profit		₹ 30,600
Sales Variances :		
Price	5850 (A)	
Volume	<u>900 (A)</u>	<u>6,750(A)</u>
Actual Sales minus Standard Cost of Sales		23,850
Cost Variances :	F	A
Material Price Variance		5040
Material Usage Variance	3200	
Labour Rate Variance	1160	
Labour Efficiency Variance	2000	
Labour Idle Time Variance		3000
Variable Overhead Expenditure Var		2700
Variable Overhead Efficiency Var		150
Fixed Overhead Expenditure Var		1,500
Fixed Overhead Volume Var		750
Fixed Overhead Efficiency Var	1750	
Fixed Overhead Capacity Var	<u> </u>	<u>2500</u>
	8110	15640
Actual Profit for the month		<u>7, 530(A)</u> 16, 320

15. It is assumed that Fixed Overheads have been assessed at normal production. Moreover, the sales commission is not involved in the case of special order.

Taking Variable Factory Overheads @ 20% of wages,

Total cost of the special order will be ₹ (1.00 + 0.60 + 0.12) laks i.e ₹ 1.72 lakhs

Thus, the special order, if executed will give profit of ₹ 28,000.

Hence, the order should be accepted.

16. Average cost for first 200 units = $0.90 \times 200 = ₹ 180$
 Average cost for first 400 units = $0.90 \times 180 = ₹ 162$
 Average cost for first 800 units = $0.90 \times 162 = ₹ 145.80$
 Average cost for first 1600 units = $0.90 \times 145.80 = ₹ 131.22$

We know that learning curve equation :

$$Y = ax^b$$

Where y = average time for producing x units

a = time spent on first unit / batch

b = co-efficient of learning curve

$$b = -\log(1 - \% \text{ decrease}) / \log 2 = \log(1 - 0.10) / \log 2 = -0.0458 / 0.3010 = -0.15206$$

Thus, for 2000 units, batch = 2000 / 100 = 20

$$Y = 200 \times 20^{-0.15206}$$

$$\log y = \log(200) - 0.15206(\log 20) = 2.3010 - 0.15206 \times 1.3010 = 2.103172$$

$$\text{Thus } y = \text{antilog}(2.103172) = 126.81$$

Thus, average labour cost for 2000 units = ₹ 126.81

Thus, price to be quoted for different units are :

	First 800 units (₹)	First 1600 units (₹)	First 2000 units (₹)
Material @ ₹ 150	120000	240000	300000
Labour Cost	116640	209952	253620
Overheads	40000	80000	100000
Total Cost	276640	529952	653620
Profit	69160	132488	163405
Price to be quoted	345800	662440	817025

17. (a) The theory of constraints focuses its attention on constraints and bottlenecks within organisation which hinder speedy production. The main concept is to maximize the rate of manufacturing output is the throughput of the organisation. This requires to examine the bottlenecks and constraints. A bottleneck is an activity within the organization where the demand for that resource is more than its capacity to supply.

A constraint is a situational factor which makes the achievement of objectives / throughput more difficult than it would otherwise, for example of constraint may be lack of skilled labour, lack of customer orders, or the need to achieve high quality in product output.

For example let meeting the customers' delivery schedule be a major constraint in an organisation. The bottleneck may be a certain machine in the factory. Thus bottlenecks and constraints are closely examined to increase throughput.

Key measures of theory of constraints:

- (i) **Throughput contribution:** It is the rate at which the system generates profits through sales. It is defined as, sales less completely variable cost, sales – direct are excluded. Labour costs tend to be partially fixed and conferred are excluded normally.
 - (ii) **Investments:** This is the sum of material costs of direct materials, inventory, WIP, finished goods inventory, R & D costs and costs of equipment and buildings.
 - (iii) **Other operating costs:** This equals all operating costs (other than direct materials) incurred to earn throughput contribution. Other operating costs include salaries and wages, rent, utilities and depreciation.
18. (a) Value chain may be defined as a series of internal processes or activities a company performs, “ to design, produce, market, deliver and support its product.” “ A firms value chain and the way it performs individual activities are a reflection of its history, its strategy, its approach of implementing strategy , and the underlying economics of the activities themselves.” For further details refer to Chapter 13 of Cost Management Book of the Institute.
- (b) In order to gain a competitive advantage over its competitors , a company needs to profitably satisfy or even exceed the needs and expectations of its various customers. This can be done by the use of Value Chain Analysis . This analysis can be used to better understand which segments, distribution channels, price points, product differentiation, selling propositions and value chain configurations will yield the firm its greatest competitive advantage. The use of VCA to assess competitive advantage involves the following analysis:
- (i) **Internal Cost Analysis :** Organisations use the value chain approach to identify sources of profitability and to understand the cost of their internal processes or activities. The principal steps of internal cost analysis are :
 1. Identify the firm’s value-creating processes.
 2. Determine the portion of the total cost of the product or services attributable to each value-creating process.
 3. Identify the cost drivers for each process.
 4. Identify the links between processes.
 5. Evaluate the opportunities for achieving relative cost advantage.
 - (ii) **Internal Differentiation Analysis :** The value chain approach is also used by organisations to identify opportunities for creating and sustaining superior differentiation. In this situation, the primary focus is on the customer's perceived value of the products and services.

As with internal cost analysis, internal differentiation analysis requires firms to first identify their value-creating processes and primary cost drivers. They are then ready to perform a differentiation analysis using the following guidelines :

1. Identify the customers' value-creating processes;
2. Evaluate differentiation strategies for enhancing customer value; and
3. Determine the best sustainable differentiation strategies.

(iii) **Vertical Linkage Analysis** : Linkages among value-creating processes do not end with the activities within a firm. The greatest competitive advantage may come out of linkages between a firm's value-creating activities and those of its suppliers, channels or users.

Vertical linkage analysis is a much broader application of internal cost and differentiation analysis that includes all upstream and downstream value-creating processes throughout the industry. Vertical linkage analysis considers all links from the source of raw materials to the disposal and/or recycling of the product.

- 19. Total Quality Management:** The total quality management is a set of concepts and tools for getting all employees focused on continuous improvement in the eyes of the customer. Quality is an important aspect of world-class manufacturing. The success of Japanese companies is grass rooted in their long-term commitment to improvement of quality. A world class manufacturing approach demands that the quality must be designed into product and the production process, rather than an attempt to remove poor quality by inspection. The objectives of quality assurance in a world- class-manufacturing environment, is not just reject defective product, but to systematically investigate the cause of defects so that they can be gradually eliminated. Though the goal is zero defect, the methodology is one of continuous improvement.

Six Cs of TQM

- (i) **Commitment** - If a TQM culture is to be developed, so that quality improvement becomes normal part of everyone's job, a clear commitment, from the top must be provided. Without this all else fails.
- (ii) **Culture** - Training lies at the centre of effecting a change -in culture and attitudes. Negative perceptions must be changed to encourage individual contributions.
- (iii) **Continuous improvement** - TQM is a process, not a program, necessitating that we are committed in the long term to the never ending search for ways to do the job better.
- (iv) **Co-operation**: The on-the-job experience of all employees must be fully utilized and their involvement and co-operation sought in the development of improvement strategies and associated performance measures.
- (v) **Customer focus**: Perfect service with zero defects in all that is acceptable at either internal or external levels.

(vi) Control: Documentation, procedures and awareness of current best practice are essential if TQM implementations are to function appropriately. The need for control mechanisms is frequently overlooked, in practice.

20. Let x_1 , x_2 , x_3 are number of units of products P, Q, R respectively. Mathematical formulation for the problem with three stock variables s_1 , s_2 and s_3 :

$$\text{Maximize } Z = 3x_1 + 2x_2 + 5x_3 + 0s_1 + 0s_2 + 0s_3$$

Subject to constraints:

$$x_1 + 2x_2 + 2x_3 + s_1 = 8$$

$$3x_1 + 2x_2 + 6x_3 + s_2 = 12$$

$$2x_1 + 3x_2 + 4x_3 + s_3 = 12$$

$$x_1, x_2, x_3, s_1, s_2, s_3 \geq 0$$

We shall now solve the problem with simplex algorithm. An initial Basic feasible solution is:

$$x_1 = 0, x_2 = 0, x_3 = 0, s_1 = 8, s_2 = 12, s_3 = 12.$$

SIMPLEX TABLEAU 1, II, & III

$C_j \rightarrow$ $CB \downarrow$	Basic variables	Solution values	3 x_1	2 x_2	5 x_3	0 s_1	0 s_2	0 s_3	Ratio
0	s_1	8	1	2	2	1	0	0	4
0	s_2	12	3	2	6*	0	1	0	$\leftarrow 2$
0	s_3	12	2	3	4	0	0	1	3
x_3 enters	Z_j	0	0	0	0	0	0	0	
s_2 leaves	$C_j - Z_j$		3	2	5 $\uparrow$	0	0	0	
0	s_1	4	0	4/3	0	1	-1/3	0	-
5	x_3	2	1/2	1/3	1	0	1/6	0	$\leftarrow 4$
0	s_3	4	0	5/3	0	0	-2/3	1	-
x_1 enters	Z_j	10	5/2	5/3	5	0	5/6	0	
x_3 leaves	$C_j - Z_j$		1/2	1/3	0	0	-5/6	0	
0	s_1	4	0	4/3	0	1	-1/3	0	3
3	x_1	4	1	2/3	2	0	1/3	0	6
0	s_3	4	0	5/3	0	0	-2/3	1	12/5
	Z_j	12	3	2	6	0	1	0	
	$C_j - Z_j$		0	0	-1	0	-1	0	

Since all the entries in $C_J - Z_J$ row are either negative or zero, an optimum solution has been obtained and the maximum value of Z is 12 which occurs when $x_1 = 4$, $x_2 = 0$ and $x_3 = 0$.

Since x_2 is a non-basic variable and the corresponding $C_J - Z_J$ entry in the final simplex tableau is 0, the optimum solution obtained is not unique. To obtain an alternate optimum solution, we perform one more iteration. Taking x_2 as an entering variable, we obtain the following tableau:

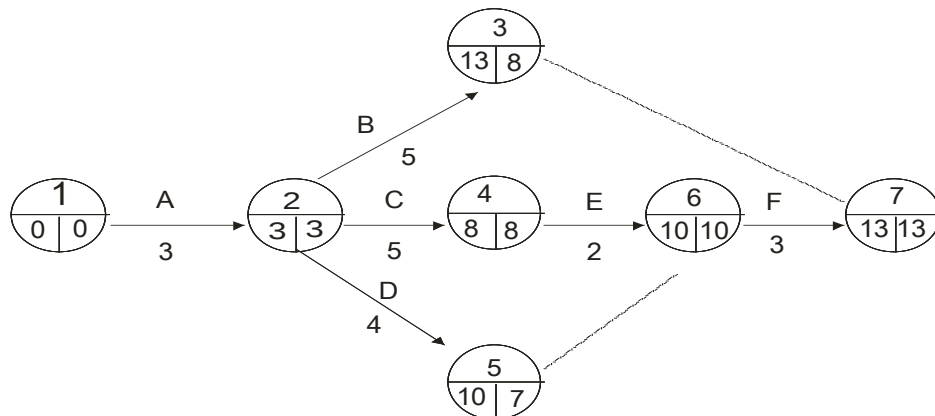
$C_J \rightarrow$ $CB \downarrow$	Basic variables	Solution values	3 x_1	2 x_2	5 x_3	0 s_1	0 s_2	0 s_3
0	s_1	4/5	0	0	0	1	1/5	-4/5
3	x_1	12/5	1	0	2	0	3/5	-2/5
2	x_2	12/5	0	1	0	0	-2/5	3/5
	Z_J	12	3	2	6	0	1	0
	$C_J - Z_J$		0	0	-1	0	-1	0

The optimum solution is : $x_1 = \frac{12}{5}$, $x_2 = \frac{12}{5}$ and $x_3 = 0$ and the maximum value of Z is 12,

as before. It may be noted that the entries under the columns s_1, s_2, s_3 in the $C_J - Z_J$ row of the final tableau are 0, -1, 0. Their absolute values, viz., 0, 1, 0 are known as the shadow prices of the resources. Hence the shadow prices of the resources are 0, 1 and 0 respectively.

21.

Activities	A	B	C	D	E	F
Expected duration = $\frac{1}{6}(t_0 + 4t_m + t_p)$	2	5	5	4	2	3



Critical path 1 – 2 – 4 – 6 – 7 i.e. A – C – E – F

Project cost = Normal cost + Penalty Cost

$$= ₹ .62,000 + (13 - 10) \times 2,500 = ₹ .69,500$$

Activity	A	B	C	D	E	F
Expected duration	3	5	5	4	2	3
Crash time	2	4	3	2	1	1
Normal Cost	6,000	12,000	16,000	8,000	6,000	14,000
Crash Cost	8,000	13,500	22,000	10,000	7,500	20,000
Cost shape	2,000	1,500	3,000	1,000	1,500	3,000

Crash the critical activities where cost shape is less than 2,500/-.

Activities	No. of days crashed	Cost shape	Crash cost (₹ .)
A	1	2,000	2,000
E	1	1,500	1,500
Total Crash Cost (₹ .)			3,500

Project duration = 11 weeks

Total Project cost

= Normal Cost + Crash Cost + Penalty Cost

$$= ₹ .(62,000 + 3,500 + 2,500) = ₹ .68,000$$

22. Following Vogel's Approximation Method (VAM), an initial feasible solution is:

From	A		B		C		D		Demand	v_i
P	10000	50		60		100		50	20000	$u_1 = 0$
Q		80		40		70		50	38000	$u_2 = 0$
R		90		70		30		50	16000	$u_3 = -40$
Supply	10000		18000		22000		24000		74000	
v_j	$v_1 = 50$		$v_2 = 40$		$v_3 = 70$		$v_4 = 50$			

Since, there are 6 allocation i.e. (4 + 3 – 1) and all the opportunity cost are negative, the optimum solution has been reached.

Transportation Cost

$$= ₹ (10,000 \times 50 + 18,000 \times 40 + 6,000 \times 70 + 14,000 \times 50 + 16,000 \times 30) = ₹ 3,32,000$$

23. **Step 1:** The problem is a maximization one. Convert it to minimization one as the assignment algorithm is for minimization. All elements are subtracted from the largest element 11.

As there are 5 operators and only 4 machines, one dummy machine with no output is introduced.

	Machine				
Operator	M1	M2	M3	M4	Dummy
A	1	6	4	3	0
B	0	7	2	1	0
C	3	7	2	3	0
D	4	6	5	7	0
E	3	2	4	6	0

Step 2: Subtract minimum elements of a column from other elements of the respective column.

	Machine				
Operator	M1	M2	M3	M4	Dummy
A	1	4	2	2	0
B	0	5	0	0	0
C	3	5	0	3	0
D	4	4	3	6	0
E	2	0	2	5	0

Cut all zero with minimum number of straight lines. No of Lines = 4 < No of machines

Step 4: Add minimum element not crossed i.e. 1 to the doubly crossed element and subtract all other elements by 1. Cut all Zeros by drawing lines.

	Machine				
Operator	M1	M2	M3	M4	Dummy
A	0	3	2	1	0
B	0	5	1	0	0
C	2	4	0	2	0
D	3	3	3	5	0
E	2	0	2	5	0

Step 5: Now, Number of lines drawn to cut zero = 5 = No of machines

Hence the solution is an optimum one.

Now, Assignment. Is as follows :

Operator	Machine	Output
A	M1	10
B	M4	10
C	M3	9
D	Dummy	0
E	M2	<u>9</u>
Total Output		<u>38 units.</u>

24. Assume that one the 1st day of simulation, there was no rain on the previous day.

Table 1 Rain on previous day.

Event	Probability	Cum Prob.	Range for random no.
No rain	0.50	0.50	00 – 49
1 cm rain	0.25	0.75	50 – 74
2 cm rain	0.15	0.90	75 – 89
3 cm rain	0.05	0.95	90 – 94
4 cm rain	0.03	0.98	95 – 97
5 cm rain	0.02	1.00	98 – 99

Table 2: No rain previous day

Event	Probability	Cum Prob.	Range for random no.
No rain	0.75	0.75	00 – 74
1 cm rain	0.15	0.90	75 – 89
2 cm rain	0.06	0.96	90 – 95
3 cm rain	0.04	1.00	96 – 99

Table 3: Simulation Sheet

Day	Random No.	Event	From Table	Cum Rain
1	67	No rain	2	
2	63	No rain	2	
3	39	No rain	2	
4	55	No rain	2	
5	29	No rain	2	
6	78	1 cm rain	1	1 cm
7	70	1 cm rain	1	2 cm
8	06	No rain	1	3 cm
9	78	1 cm rain	2	4 cm
10	76	2 cm rain	1	5 cm