

PAPER – 5 : ADVANCED MANAGEMENT ACCOUNTING

QUESTIONS

Developments in the Business Environment: Total Quality Management & Value Chain Analysis

1. (a) Define Total Quality Management (TQM). Explain in brief six C_s of T.Q.M. for its successful implementation.
- (b) How can Value Chain Analysis be used to assess competitive advantage. Give a diagram for value chain activities within the firm with suitable classifications under primary and support activities and also the industry value chain indicating what the end use consumer pays for.

Developments in the Business Environment: Target Costing & Life Cycle Costing

2. (a) What is Target Costing and what are the stages to the methodology ?
- (b) What is total-life-cycle costing approach? Why is it important?

Developments in the Business Environment: Just in Time (JIT) & Concept of Back Flushing in JIT

3. (a) 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.
- (b) Littlefield Company uses a backflush costing system with three trigger points:
 - Purchase of direct materials
 - Completion of good finished units of product
 - Sale of finished goods

There are no beginning inventories. Information for March, 2008 is:

	Rs.		Rs.
Direct materials purchased	4,40,000	Conversion costs allocated	2,00,000
Direct materials used	4,25,000	Cost transferred to finished goods	6,25,000
Conversion costs incurred	2,11,000	Cost of goods sold	5,95,000

Required:

1. Prepare journal entries for April (without disposing of underallocated or overallocated conversion costs). Assume there are no direct materials variances.
2. Under an ideal JIT production system, how would the amounts in your journal entries differ from the journal entries in requirement 1?

Cost Concept in Decision Making: Opportunity Cost and Differential Cost

4. (a) What is Opportunity Cost? Explain with suitable examples.
- (b) What are the areas in which differential cost technique is used in managerial decision.
- (c) Salabhi Arora, Sales Manager for Green Industries, has been asked by a potential foreign customer to sell 10,000 units of a certain gear for Rs. 100 per unit. Green normally sells this item for Rs. 150 per unit, but they have had some excess manufacturing capacity in recent months. It is anticipated that this would be a one-time order from this customer. The product unit cost report for this type gear is as follows:

	Rs.
Direct materials	30
Direct labour	25
Variable manufacturing overhead	12.50
Fixed manufacturing overhead	25
Variable selling and administrative expense	17.50
Fixed selling and administrative expense	<u>22.50</u>
Total per unit cost	<u>132.50</u>

After looking at the product cost report, Salabhi advises the customer as follows:

"I may not be an accountant, but I am smart enough to know that I will lose Rs. 32.50 per unit if I make this sale. Therefore, I must refuse your offer."

Required:

- (i) From the list of costs in the product cost report, which costs would be relevant to the decision to sell at the special price ?
- (ii) What will be the amount of the total relevant cost per unit in regard to this order ?
- (iii) What would be the differential income (loss) to Green Industries if this order were accepted ?
- (iv) Are there any non-financial factors that you would consider in making this decision ?

Cost Concept in Decision Making: Break-even Point, Absorption and Variable costing

5. Amazing Products Company has a maximum productive capacity of 1,00,000 units per year. Normal capacity is 90,000 units per year. Standard variable manufacturing costs

are Rs. 20 per unit. Fixed factory overhead is Rs. 4,50,000 per year. Variable selling expense is Rs. 10 per unit and fixed selling expense is Rs. 3,00,000 per year. The unit sales price is Rs. 50.

The operating results for the year are as follows:

Sales, 80,000 units;

Production 85,000 units and beginning inventory 5,000 units.

All variances are written off as additions to (for deductions from) the standard cost of sales.

Required:

- (i) What is the break-even point expressed in rupees sales?
- (ii) How many units must be sold to earn a net income of Rs. 50,000 per year?
- (iii) Prepare a formal income statement for the year ended December 31, 2008, under the following:
 - (a) Absorption costing.
 - (b) Variable costing.

Decision Making and Process Costing

6. A company is organised into two processes. Raw material is introduced into Process A and its output becomes the raw material for Process B. The finished goods of Process B is sold in the market. Process A has a capacity to process an input of 200,000 kg. of raw material per annum. The normal scrap is 10% and 5% of input in Process A and Process B respectively. The realizable value of scrap is Re.1 and Rs.2 per kg. respectively for Processes A and B. The operating data for a year are as under:

	Process A	Process B
Direct Wages	Rs.22,00,000	21,00,000
Overheads	Rs. 9,56,000	13,45,800

There are three suppliers of raw material whose price quotations and terms are as under:

Supplier	Price Rs./Kg.	Terms
P	10.00	Maximum quantity offered is Rs.1,20,000 kg.
Q	11.20	Maximum quantity offered is 1,60,000 kg.
R	11.00	If the entire quantity of 2,00,000 kg. is ordered. Otherwise, for any quantity less than 2,00,000 kg. the price charged is Rs.11.60 per kg.

In each case, the raw material is to be collected from the supplier's factory. The variable transport cost for bringing the raw materials is as under:

Supplier	P	Q	R
Variable transport cost per Kg.	Rs.1.20	1.00	1.00

The fixed transport cost will be Rs.2,00,000 per annum irrespective of the supplier from whom the raw material is purchased.

The output of the company emerging from Process B can be sold to three customers at the prices and terms given below:

Customer	Price Rs. /Kg.	Discount	Condition
K	65.00	2%	Maximum quantity acceptable to K is 80,000 Kg.
L	64.00	2%	Maximum quantity acceptable to L is 1,60,000 Kg.
M	61.80	—	Provided the entire production of the company is sold to M

In the case of customers K and L, fixed delivery costs of Rs.5,000 in total per month will be incurred. The variable delivery costs in respect of customers K and L respectively are Rs.2.60 and Rs.1.44 per Kg. Customer M will collect the output from the company's factory at his own cost.

- You are required to indicate with supporting calculations the choice of (a) suppliers and (b) customers.
- Based on your recommendation in (i) above, prepare a statement showing the process wise costs and profit of the company for the year.

CVP Analysis & Decision Making: Product Mix Decisions

- A market gardener is planning his production for next season, and he has asked you as a cost accountant, to recommend the optimal mix of vegetable production for the coming year. He has given you the following data relating to the current year.

	Potatoes	Turnips	Parsnips	Carrots
Area occupied (acres)	25	20	30	25
Yield per acre (tonnes)	10	8	9	12
Selling price per tonne (Rs.)	100	125	150	135
Variable cost per acre (Rs.)				
Fertilizers	30	25	45	40
Seeds	15	20	30	25

Pesticides	25	15	20	25
Direct wages	400	450	500	570

Fixed overhead per annum Rs. 54000

The land that is being used for the production of carrots and parsnips can be used for either crop, but not for potatoes or turnips. The land being used for potatoes and turnips can be used for either crop, but not for carrots or parsnips. In order to provide an adequate market service, the gardener must produce each year at least 40 tonnes each of potatoes and turnips and 36 tonnes each of parsnips and carrots.

- (a) You are required to present a statement to show:
 - (i) the profit for the current year;
 - (ii) the profit for the production mix that you would recommend.
- (b) Assuming that the land could be cultivated in such a way that any of the above crops could be produced and there was no market commitment, you are required to:
 - (i) advise the market gardener on which crop he should concentrate his production;
 - (ii) calculate the profit if he were to do so;
 - (iii) calculate in rupees the break-even point of sales.

CVP Analysis & Decision Making: Accepting & Rejecting of an Order

8. A company has been making a machine to order for a customer, but the customer has since gone into liquidation, and there is no prospect that any money will be obtained from the winding up of the company.

Costs incurred to date in manufacturing the machine are Rs. 50,000 and progress payments of Rs. 15,000 had been received from the customer prior to the liquidation.

The sale department has found another company willing to buy the machine for Rs. 34,000 once it has been completed.

To complete the work, the following costs would be incurred.

- (a) Materials: these have been bought at a cost of Rs. 6,000. They have no other use, and if the machine is not finished, they would be sold for scrap for Rs. 2,000.
- (b) Further labour costs would be Rs. 8,000. Labour is in short supply, and if the machine is not finished, the work force would be switched to another job, which would earn Rs. 30,000 in revenue, and incur direct costs of Rs. 12,000 and absorbed (fixed) overhead of Rs. 8,000.

- (c) Consultancy fee Rs. 4,000. If the work is not completed, the consultants' contract would be cancelled at a cost of Rs. 1,500.
- (d) General overheads of Rs. 8,000 would be added to the cost of the additional work.
- Required: Assess whether the new customer order should be accepted.

CVP Analysis & Decision Making

9. Vikas Travel Agency (VTA) specializes in flights between Delhi to Bangalore. It books passengers on Dolphin Airlines at Rs. 9,000 per round-trip ticket. Until last month, Dolphin paid VTA a commission of 10% of the ticket price paid by each passenger. This commission was VTA's only source of revenues. VTA's fixed costs are Rs. 1,40,000 per month (for salaries, rent and so on) and its variable costs are Rs. 200 per ticket purchased for a passenger. This Rs. 200 includes Rs. 150 per ticket delivery fee paid to Senti Express. (Rs. 150 delivery fee applies to each ticket).

Dolphin Airlines has just announced a revised payment schedule for travel agents. It will now pay travel agents a 10% commission per ticket up to a maximum of Rs. 500. Any ticket costing more than Rs. 5,000 generates only a Rs. 500 commission, regardless of the ticket price.

Required:

- (i) Under the old 10% commission structure, how many round-trip tickets must VTA's sell each month (a) to break-even and (b) to earn an operating income of Rs. 70,000.
- (ii) How does Dolphin revised payment schedule affect your answers to (a) and (b) in requirement 1 ?

Pricing Decisions: Pricing of Finished Product

10. ABC Ltd recently began production of a new product, M, which required the investment of Rs. 16,00,000 in assets. The costs of producing and selling 80,000 units of Product M are estimated as follows:

	Rs.	
Variable costs:		
Direct materials	10.00	per unit
Direct labour	6.00	
Factory overhead	4.00	
Selling and administrative expenses	<u>5.00</u>	
Total	<u>25.00</u>	per unit

Fixed costs:

Factory overhead	8,00,000
Selling and administrative expenses	4,00,000

ABC Ltd is currently considering establishing a selling price for Product M. The President of ABC Ltd has decided to use the cost-plus approach to product pricing and has indicated that Product M must earn a 10% rate of return on invested assets.

Instructions:

- (i) Determine the amount of desired profit from the production and sale of Product M.
- (ii) Assuming that the total cost concept is used, determine (a) the cost amount per unit, (b) the markup percentage, and (c) the selling price of Product M.
- (iii) Assuming that the product cost concept is used, determine (a) the cost amount per unit, (b) the mark up percentage, and (c) the selling price of Product M.
- (iv) Assuming that the variable cost concept is used, determine (a) the cost amount per unit, (b) the markup percentage, and (c) the selling price of Product M.
- (v) Assume that for the current year, the selling price of Product M was Rs. 42 per unit. To date, 60,000 units have been produced and sold, and analysis of the domestic market indicates that 15,000 additional units are expected to be sold during the remainder of the year. Recently, ABC Ltd received an offer from XYZ Ltd for 4,000 units of product M at Rs. 28 each. XYZ Ltd. will market the units in Korea under its own brand name, and no additional selling and administrative expenses associated with the sale will be incurred by ABC Ltd. The additional business is not expected to affect the domestic sales of Product M, and the additional units could be produced during the current year, using existing capacity. (a) Prepare a differential analysis report of the proposed sale to XYZ Ltd (b) Based upon the differential analysis report in (a), should the proposal be accepted?

Pricing Decisions: Computing Minimum Selling Price

11. The Directors of Domestic Ltd. are considering a new type of Kitchen Gadget which their Research Department has developed. The expenditure so far on research has been Rs. 40,000 and a Consultant's report has been prepared at a cost of Rs. 7,500. The report provides the following information:

A. Cost of Production per unit	Rs.
Materials	22.50
Labour	37.50
Fixed overheads (based on company's normal allocation rates)	<u>10.00</u>
	<u>70.00</u>

B. Anticipated additional fixed costs:

Rent for additional space Rs. 75,000 per annum.

Other additional Fixed costs Rs. 37,500 per annum.

A new machine will be built with the available facilities at a cost of Rs. 60,000 (Materials Rs. 50,000 and Labour Rs. 10,000). The materials are readily available in stores which are regularly used. However, these are to be immediately replenished. The price of these materials has since risen by 40%. Scrap value of the machine at the end of 10th year is 10,000. The product scraps generated can be disposed off at the end of year 10 for a price of Rs. 71,920.

The estimated demand for product is as follows:

Year 1-5		Year 6-10	
Demand (units)	Probability	Demand (units)	Probability
20,000	0.10	12,000	0.2
10,000	0.65	8,000	0.5
6,000	0.25	2,000	0.3

It is expected that the commercial life of the Gadget will be no longer than 10 years and the after tax cost of Capital is 10%. The full cost of the machine will be depreciated on straight line basis which is allowed for taxation also, over a period of 10 years. Tax rate is 40%. DCF Factors

1-5 Years (cumulative)	3.79
6-10 Years (cumulative)	2.355
10th Year	0.386

Compute Minimum Selling Price of the Gadget.

Pricing Decisions: Pareto Analysis

12. The following information of manufacture and sale is obtained from the records of Vee Aar Ltd. for the 12 months ending 31.12.2008:

Product	Contribution
	(Rs.)
A	500
B	200
C	1,500
D	75

E	100
F	<u>125</u>
Total	<u>2,500</u>

You are required to prepare a Pareto product contribution chart and comment on the results.

Budget & Budgetary Control: Flexible Budget

13. A single product company having a normal capacity of 8,00,000 units per annum has prepared the following cost sheet:

	Rs. per unit
Direct materials	5
Direct labour	2
Factory overheads (50% fixed)	4
Selling & Administrative overheads (1/3 variable)	3
Selling price	18

The Company achieved a sales volume of 6,00,000 units during the last year. During the current year, since the market is buoyant the company has launched an expansion programme. The proposed operational details for the current year are as under:

- The capacity will be increased to 12,00,000 units.
- The additional fixed overheads will amount to Rs.8 lacs upto 10,00,000 units and will increase by Rs.4 lacs more beyond 10 lac unit level.
- The expansion scheme involving a capital cost of Rs.20 lacs will be financed through borrowings at an interest rate of 15% per annum.
- Depreciation on new investment is 20% on straight line basis.

The company has two proposals for operating the expanded plant during current year as under:

- Sales can be increased to 10 lac units by spending Rs.2, 00,000 on special advertisement; or
- Sales can be increased to 12 lac units subject to the following:
 - by an overall price reduction of Rs.2/- per unit on all units sold.
 - by increasing the variable selling and administrative expenses by Rs.1,00,000.
 - by a reduction in direct material cost by 5% due to bulk buying discount.

Required:

- (i) Construct a flexible budget at 6 lacs, 10 lacs and 12 lacs units of production.
- (ii) Advise which level of output should be chosen by the company.

Budget & Budgetary Control: Functional Budget

14. RNRB Company's budgeted unit sales for the year 2008 were:

Bike tyres	60,000
Bus tyres	12,500

The budgeted selling price for Bus tyres was Rs. 15,000 per tyre and for Bike tyres was Rs. 4,500 per tyre. The beginning finished goods inventories were expected to be 2,500 Bus tyres and 6,000 Bike tyres, for a total cost of Rs. 2,00,25,500, with desired ending inventories at 2,000 and 5,000, respectively, with a total cost of Rs. 1,63,23,900. There was no anticipated beginning or ending work in process inventory for either type of tyre.

The standard materials quantities for each type of tyre were as follows:

	Bus	Bike
Rubber	35 lbs.	15 lbs.
Steel belts	4.5 lbs.	2.0 lbs.

The purchase prices of rubber and steel were Rs. 150 and Rs. 100 per pound, respectively. The desired ending inventories for rubber and steel were 60,000 and 6,000 pounds, respectively. The estimated beginning inventories for rubber and steel were 75,000 and 7,500 pounds, respectively.

The direct labour hours required for each type of tyre were as follows:

	Molding Department	Finishing Department
Bus tyre	0.20	0.10
Bike tyre	0.10	0.05

The direct labour rate for each department is as follows:

Molding Department	Rs. 650 per hour
Finishing Department	Rs. 750 per hour

Budgeted factory overhead costs for 2008 were as follows:

	Rs.
Indirect materials	85,28,000
Indirect labour	79,40,000
Depreciation of building and equipment	49,16,000
Power and light	<u>63,00,000</u>
Total	<u>2,76,84,000</u>

Required:

Prepare each of the following budgets for RNRB for the year ended 2008:

- (i) Sales budget
- (ii) Production budget
- (iii) Direct material budget
- (iv) Direct labour budget
- (v) Factory overhead budget
- (vi) Cost of goods sold budget.

Standard Costing: Variance Analysis

15. (i) Explain, with the aid of simple numeric examples, the logic, purpose and limitation, of each of the following variance analysis exercises:
 - (1) The separation of the fixed overhead volume variance into capacity utilisation and efficiency components.
 - (2) The separation of the materials usage variance into materials mixture and materials yield components.
 - (3) The separation of the labour rate variance into planning and operational components.
- (ii) Budgetary control and standard costing are used within an insurance company and a standard cost of Rs. 20 has been set for obtaining and issuing each new life policy.

Prior to the commencement of the annual financial period, the life business manager had forecast that 7,500 policies would be sold during the year and the Rs. 20 standard cost was based on the following budgeted costs for the department. Actual costs are also shown.

Code		Budget	Actual
		Rs.	Rs.
301	Sales' Salary	30,000	33,750
302	Staff Commission	30,000	28,500
303	Staff Expenses	15,000	13,000
431	Underwriting Staff	45,000	50,000
599	Other Admin. Cost	<u>30,000</u>	<u>33,000</u>
		<u>1,50,000</u>	<u>1,58,250</u>

At the end of the year, it was ascertained that

1. 6,750 new life policies had been issued.
2. the sales staff and underwriting staff received as salaries pay award of 12½% which had been back-dated to the beginning of the year and this had not been included in the budget.
3. expenses on codes 302, 303 and 431 are regarded as direct costs which vary with activity, and those on code 301 are treated as a direct fixed cost while those on code 599 are an indirect fixed cost.

You are required to

- (A) present a statement (or control report) for the life business manager showing the variances which have arisen,
- (B) comment on the likely cause or causes for each variance identifying, so far as you can from the information given, how much of each variance arises from price differences and how much can be related to efficiency or inefficiency.

Standard Costing: Variance Analysis

16. ABC Limited manufactures three types of products namely Product 1, Product 2 and Product 3. The production process requires a single input raw material, a single type of direct labour and a single energy input, electricity. Overheads are shared by all three products. Budgeted details of the three products are shown below;

	Product 1	Product 2	Product 3
Labour hours per unit	0.20	0.25	0.40
Material kg per unit	1.0	1.1	1.3
Kilowatt hours per unit(kwhr)	0.5	0.6	0.8
Budgeted sales in units	10,000	6,000	2,000
Forecasted price (Rs)	15	20	40

The committed fixed overheads are expected to cost Rs 80,000 per period and the unit costs for the input resources are as follows ;

Labour	Rs 20 per hour
Material	Rs 4 per unit
Energy	Rs 6 per kilowatt hour

The actual financial results for ABC Limited for the concerned budgeted period are shown below;

Sales		Rs 3,85,000
	Labour	Rs 1,09,452
	Material	96,448
	Energy	61,671
Variable costs		2,67,571
Committed overhead		84,000
Profits		Rs 33,429

Additional information regarding inputs and outputs during the concerned period are provided to you below;

Outputs			Inputs		
	Quantity	Price		Quantity	Price
Product 1	12,000	Rs 16	Labour	5,212 hours	Rs 21.00
Product 2	5,500	22	Materials	21,920 kg	4.40
Product 3	1,800	40	Energy	10,633 kwhr	5.80

With the help of the above information, you are required to calculate the standard margin (contribution) and subsequently compute the following variances in order to reconcile Budgeted Profits with the Actual Profits;

- Sales –Activity Variance
- Price – Recovery Variance
- Productivity Variance

Standard Costing: Variance Analysis

17. S.T. Company manufactures ceramic vases. It uses its standard costing system when developing its flexible-budget amounts. In April 2007, 4,000 finished units were produced. The following information is related to its two direct manufacturing cost categories: direct materials and direct manufacturing labour.

Direct materials used were 8,800 kilograms. The standard direct materials input allowed for one output unit is 2 kilograms at Rs. 15 per kilogram. S.T. purchased 10,000 kilograms of materials at Rs. 16.50 per kilogram, a total of Rs. 1,65,000.

Actual direct manufacturing labour-hours were 6,500 at a total cost of Rs. 1,32,600. Standard manufacturing labour time allowed is 1.5 hours per output unit, and the standard direct manufacturing labour cost is Rs. 20 per hour.

Required:

1. Calculate the direct materials price variance and efficiency variance, and the direct manufacturing labour price variance and efficiency variance. Base the direct materials price variance on a flexible budget for actual quantity purchased, but base the direct materials efficiency variance on a flexible budget for actual quantity used.
2. Prepare journal entries for a standard costing system that isolates variances at the earliest possible time.

Costing of Service Sector

18. An airline company operates a single aircraft from station A to Station B. It is licensed to operate 3 flights in a week each way thereby making a total of 312 flights in a year. While the seating capacity of the aircraft is 160 passengers, the average number of passengers actually caused per flight is 120 only. The fare charged per passenger for one way flight is Rs.8000. The cost data are as under:

- Variable fuel costs per flight Rs.1,60,000
- Food served on board the flight (not charged to passengers) Rs.200 per passenger
- Commission paid to travel agents (on an average 80% of the seats are booked through travel agents) 5% of fare
- Fixed annual lease costs allocated to each flight Rs.4,00,000 per flight
- Fixed ground and landing charges Rs.1,00,000 per flight
- Fixed salaries of flight crew allocated to each flight Rs.60,000 per flight

Required:

- (i) Compute the operating income on each one-way flight between stations A and B.
- (ii) The company has been advised that in case the fare is reduced to Rs.7500 per flight per passenger, the average number of passengers per flight will increase to 132. Should this proposal be implemented? Show your calculations.

Transfer Pricing

19. L Ltd. and M Ltd. are subsidiaries of the same group of companies. L Ltd. produces a branded product sold in drums at a price of Rs. 20 per drum.

Its direct product costs per drum are:

Raw material from M Ltd.: At a transfer price of Rs. 9 for 25 litres.

Other products and services from outside the group: At a cost of Rs. 3.

L Ltd.'s fixed costs are Rs. 40,000 per month. These costs include process labour whose costs will not alter until L Ltd.'s output reaches twice its present level.

A market research study has indicated that L Ltd.'s market could increase by 80% in volume if it were to reduce its price by 20%.

M Ltd. produces a fairly basic product, which can be converted into a wide range of end products. It sells one third of its output to L Ltd. and the remainder to customers outside the group.

M Ltd.'s production capacity is 10,00,000 kilolitres per month, but competition is keen and it budgets to sell no more than 7,50,000 kilolitres per month for the year ending 31 December.

Its variable costs are Rs. 0.20 per Kilolitre and its fixed costs are Rs. 60,000 per month.

The current policy of the group is to use market prices, where known, as the transfer price between its subsidiaries. This is the basis of the transfer prices between M Ltd. and L Ltd.

You are required to calculate

- (a) the monthly profit position for each of L Ltd. and M Ltd. if the sales of L Ltd. are
 - (i) at their present level, and
 - (ii) at the higher potential level indicated by the market research, subject to a cut in price of 20%.
- (b) (i) Explain why the use of a market price as the transfer price produces difficulties under the conditions outlined in (a) (ii) above;
- (ii) Explain briefly, as Chief Accountant of the group, what factors you would consider in arriving at a proposal to overcome these difficulties;

Uniform Costing : Inter-Firm Comparison

20. Describe the requisites to be considered while installing a system of inter-firm comparison by an industry.

Cost Sheet, Profitability Analysis & Reporting : The Balance Scorecard

21. (a) 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?
- (b) Kitchen King company makes a high-end kitchen range hood 'Maharaja'. The company presents the data for the year 2007 and 2008:

	2007	2008
1. Units or maharaja produced and sold	40,000	42,000
2. Selling Price per unit in Rs.	1,000	1,100
3. Total Direct Material (Square feet)	1,20,000	1,23,000
4. Direct material cost per square feet in Rs.	100	110
5. Manufacturing Capacity (in units)	50,000	50,000
6. Total Conversion cost in Rs.	1,00,00,000	1,10,00,000
7. Conversion cost per unit of capacity (6)/(5)	200	220
8. Selling and customer service capacity	300	290
	customer	customer
9. Total selling and customer service cost in Rs.	72,00,000	72,50,000
10. Cost per customer of selling and customer service capacity (9)/(8)	24,000	25,000

Kitchen King produces no defective units, but it reduces direct material used per unit in 2008. Conversion cost in each year depends on production capacity defined in terms of Maharaja units that can be produced. Selling and Customer service cost depends on the number of customers that the selling and service functions are designed to support. Kitchen King has 230 customers in 2007 and 250 customers in 2008.

You are required

1. Describe briefly key elements that would include in Kitchen King's Balance Score Card.
2. Calculate the Growth, Price-recovery and productivity component that explain the change in operating income from 2007 to 2008.

Cost Sheet, Profitability Analysis & Reporting : Product Cost Sheet & Profitability Analysis

22. EXE Wood Company is a metal and woodcutting manufacturer, selling products to the home construction market. Consider the following data for 2008:

	Rs.
Sandpaper	1,000
Materials-handling costs	35,000
Lubricants and coolants	2,500
Miscellaneous indirect manufacturing labour	20,000
Direct manufacturing labour	1,50,000
Direct materials inventory, Jan. 1, 2008	20,000
Direct materials inventory, Dec. 31, 2008	25,000
Finished goods inventory, Jan. 1, 2008	50,000
Finished goods inventory, Dec. 31, 2008	75,000
Work in process inventory, Jan. 1, 2008	5,000
Work in process inventory, Dec. 31, 2008	7,000
Plant-leasing costs	27,000
Depreciation – plant equipment	18,000
Property taxes on plant equipment	2,000
Fire insurance on plant equipment	1,500
Direct materials purchased	2,30,000
Revenues	6,80,000
Marketing promotions	30,000
Marketing salaries	50,000
Distribution costs	35,000
Customer-service costs	50,000

Required:

1. Prepare an income statement with a separate supporting schedule of cost of goods manufactured. For all manufacturing items, classify costs as direct costs or indirect costs and indicate by V or F whether each is basically a variable cost or a fixed cost (when the cost object is a product unit). If in doubt, decide on the basis of whether the total cost will change substantially over a wide range of units produced.
2. Suppose that both the direct material costs and the plant-leasing costs are for the production of 4,50,000 units. What is the direct material cost of each unit produced ? What is the plant-leasing cost per unit ? Assume the plant-leasing cost is a fixed cost.

3. Suppose EXE Wood Company manufactures 5,00,000 units next year. Repeat the computation in requirement 2 for direct materials and plant-leasing costs. Assume the implied cost-behaviour patterns persist.

Linear Programming

23. Using Simplex Method to solve the following L.P.P.

$$\text{Minimize } Z = 2x_1 + x_2$$

Subject to

$$3x_1 + x_2 = 3$$

$$4x_1 + 3x_2 \geq 6$$

$$x_1 + 2x_2 \leq 3$$

$$x_1, x_2 \geq 0.$$

Linear Programming

24. Solve graphically the following L.P.P.

$$\text{Maximize } Z = x_1 + x_2$$

$$\text{Subject to } -2x_1 + x_2 \leq 1$$

$$x_1 \leq 2$$

$$x_1 + x_2 \leq 3$$

$$x_1, x_2 \geq 0.$$

Transportation Problem

25. Find the optimum solution of the following transportations problem.

	A	B	C	D	
1	42	48	38	37	160
2	40	49	52	51	150
3	39	38	40	43	190
	80	90	110	160	

The Assignment Problem

26. Find the assignment of salesman to district that will result in maximum sales.

		A	B	C	D	E
Salesmen	1	32	38	40	28	40
	2	40	24	28	21	36
	3	41	27	33	30	37
	4	22	38	41	36	36
	5	29	33	40	35	39

Critical Path Analysis and PERT

27. A project schedule has the following characteristic

Activity	Time (weeks)	
1-2	4	
1-3	1	
2-4	1	
3-4	1	
3-5	6	
4-9	5	
5-6	4	
5-7	8	
6-8	1	
7-8	2	
8-10	5	
9-10	7	

- construct the network
- compute E and L per each event, and
- find critical path.

Critical Path Analysis and PERT

28. The following tables gives data on normal time and cost and crash time and cost for a project.

- Draw the network and identity the critical path.
- What is the normal project duration and associated cost ?
- Find out total float for each activity.
- Crash the relevant activities systematically and determine the optimum project time and cost.

Activity	Normal		Crash	
	Time (weeks)	Cast (Rs.)	Time (weeks)	Cast (Rs.)
1-2	3	300	2	400
2-3	3	30	3	30
2-4	7	420	5	580
2-5	9	720	7	810
3-5	5	250	4	300
4-5	0	0	0	0
5-6	6	320	4	410
6-7	4	400	3	470
6-8	13	780	10	900
7-8	10	1000	9	1200

4220

Indirect costs are Rs. 50 per week.

Simulation

29. A car manufacturing company manufactures 40 cars per day. The sale of cars depends upon demand which has the following distribution.

Sales of Cars	Probability
37	0.10
38	0.15
39	0.20
40	0.35
41	0.15
42	0.05

The production cost and sale price of each car are Rs. 4 lakhs and Rs. 5 lakhs respectively. Any unsold car is to be disposed off at a loss of Rs. 2 lakhs per car. There

is a penalty of Rs. 1 lakh per car, if the demand is not met. Using the following random numbers, estimates total profit/loss for the company for the next ten days.

9, 98, 64, 98, 94, 01, 78, 10, 15, 19

If the company decides to produce 39 cars per day, what will be its impact on profitability?

Time Series Analysis & Forecasting

30. Apply the method of link relatives to the following data and calculate seasonal indices.

Quarterly Figures					
Quarter	1995	1996	1997	1998	1999
I	6.0	5.4	6.8	7.2	6.6
II	6.5	7.9	6.5	5.8	7.3
III	7.8	8.4	9.3	7.5	8.0
IV	8.7	7.3	6.4	8.5	7.1

Time Series Analysis and Forecasting

31. The following table relates to the tourist arrivals during 1990 to 1996 in India:

Years	:	1990	1991	1992	1993	1994	1995	1996
Tourists arrivals	:	18	20	23	25	24	28	30

(in millions)

Fit a straight line trend by the method of least squares and estimates the number of tourists that would arrives in the year 2000.

Testing of hypothesis

32. A manufacturer claimed that at least 95% of the equipment which he supplied to a factory conformed to specifications. An examination of a sample of 200 pieces of equipment revealed that 18 were faulty. Test this claim at a significance level of (i) 0.05 (ii) 0.01.

Testing of Hypothesis (Analysis of variance – ANOVA)

33. For the following data representing the number of units of production per day turned out by five workers using from machines, set-up the ANOVA table (Assumed Origin at 20).

Workers	Machine Type			
	A	B	C	D
1.	4	-2	7	-4

2.	6	0	12	3
3.	-6	-4	4	-8
4.	3	-2	6	-7
5.	-2	2	9	-1

Testing of Hypothesis (Chi-Square Distribution)

34. Given below in the contingency table for production is three shifts and the number of defective good turn out- Find the value of C. It is possible that the number defective goods depends on the shifts then by them, No of Shifts:

Shift	I Week	II Week	III Week	Total
I	15	5	20	40
II	20	10	20	50
III	25	15	20	60
	60	30	60	150

SUGGESTED ANSWERS / HINTS

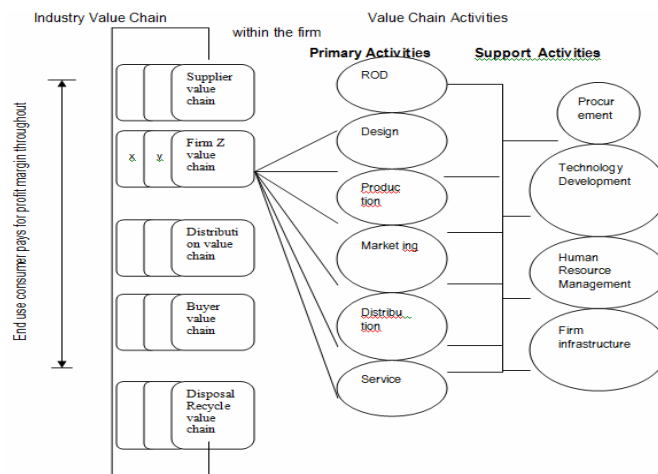
Developments in the Business Environment: Total Quality Management & Value Chain Analysis

1. (a) Total Quality Management: Traditional focus was primarily on the financial performance of an organisation. Now a days it is crucial for organisation to monitor performance in many non financial areas as well. For many companies, quality is at the forefront of the area in which non financial performance is critically important. Monitoring product quality coupled with measuring and reporting quality costs helps companies program of total quality management (TQM) . TQM refers to the broad set of management and control processes designed to focus the entire organisation and all of its employees on providing products or services that do the best possible job of satisfying the customers.

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.
- (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 analyses:
- Internal cost analysis
 - Internal differential analysis
 - Vertical linkage analysis



Developments in the Business Environment: Target Costing & Life Cycle Costing

2. (a) Target Costing: It is a management tool used for reducing a product cost over its entire life cycle. It is driven by external Market factors. Marketing management prior to designing and introducing a new product determines a target market price. This target price is set at a level that will permit the company to achieve a desired market share and sales volume. A desired profit margin is then deducted to determine the target maximum allowable product cost. Target costing also develops methods for achieving those targets and means to test the cost effectiveness of different cost-cutting scenarios.

Stages of Target Costing:

1. Conception (planning) Phase: Under this stage of life cycle, competitors products are to be analysed, with regard to price, quality, service and support, delivery and technology. The features which consumers would like to have like consumer value etc. established. After preliminary testing, the company may be asked to pinpoint a market niche, it believes, is under supplied and which might have some competitive advantage.
 2. Development phase: The design department should select the most competitive product in the market and study in detail the requirement of material, manufacturing process along with competitors cost structure. The firm should also develop estimates of internal cost structure based on internal cost of similar products being produced by the company. If possible the company should develop both the cost structures (competitors and own) in terms of cost drivers for better analysis and cost reduction.
 3. Production phase: This phase concentrates its search for better and less expensive products, cost benefit analysis in different features of a product priority wise, more towards less expensive means of production, as well as production techniques etc.
- (b) Total life cycle costing approach: Life cycle costing estimates, tracks and accumulates the costs over a product's entire life cycle from its inception to abandonment or from the initial R & D stage till the final customer servicing and support of the product. It aims at tracing of costs and revenues on product by product basis over several calendar periods throughout their life cycle. Costs are incurred along the product's life cycle starting from product's design, development, manufacture, marketing, servicing and final disposal. The objective is to accumulate all the costs over a product life cycle to determine whether the profits earned during the manufacturing phase will cover the costs incurred during the pre and post manufacturing stages of product life cycle.

Product life cycle costing is important for the following reasons:

- (i) When non-production costs like costs associated with R & D, design, marketing, distribution and customer service are significant, it is essential to

identify them for target pricing, value engineering and cost management. For example, a poorly designed software package may involve higher costs on marketing, distribution and after sales service.

- (ii) There may be instances where the pre-manufacturing costs like R & D and design are expected to constitute a sizeable portion of life cycle costs. When a high percentage of total life cycle costs are likely to be so incurred before the commencement of production, the firm needs an accurate prediction of costs and revenues during the manufacturing stage to decide whether the costly R & D and design activities should be undertaken.
- (iii) Many costs are locked in at R & D and design stages. Locked in or Committed costs are those costs that have not been incurred at the initial stages of R & D and design but that will be incurred in the future on the basis of the decisions that have already been taken. For example, the adoption of a certain design will determine the product's material and labour inputs to be incurred during the manufacturing stage. A complicated design may lead to greater expenditure on material and labour costs every time the product is produced. Life cycle budgeting highlights costs throughout the product life cycle and facilitates value engineering at the design stage before costs are locked in.

Total life-cycle costing approach accumulates product costs over the value chain. It is a process of managing all costs along the value chain starting from product's design, development, manufacturing, marketing, service and finally disposal.

Developments in the Business Environment: Just in Time (JIT) & Concept of Back Flushing in JIT

3. (a) 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.
- (b) 1. Journal entries for April are:

	Rs.	Rs.
Entry (a) Inventory: Materials and In-Process Control	4,40,000	
Accounts Payable Control		4,40,000
(direct materials purchased)		
Entry (b) Conversion Costs Control	2,11,000	
Various Accounts (such as Wages Payable Control)		2,11,000
(Conversion costs incurred)		
Entry (c) Finished Goods Control	6,25,000	
Inventory: Materials and In-Process Control		4,25,000
Conversion Costs Allocated		2,00,000
(Standard cost of finished goods completed)		
Entry (d) Cost of Goods Sold	5,95,000	
Finished Goods Control		5,95,000
(Standard costs of finished goods sold)		

2. Under an ideal JIT production system, if the manufacturing lead time per unit is very short, there could be zero inventories at the end of each day. Entry (c) would be Rs. 5,95,000 finished goods production [to match finished goods sold in entry (d)], not Rs. 6,25,000. If the marketing Department could only sell goods costing Rs. 5,95,000, the JIT production system would call for direct materials purchases and conversion costs of lower than Rs. 4,40,000 and Rs. 2,11,000, respectively, in entries (a) and (b).

Cost Concept in Decision Making: Opportunity Cost & Differential Cost

4. (a) Opportunity Cost : It is the cost of Opportunity lost by diversion of an input factor from one use to another. It is the measure of the benefit of Opportunity foregone.

The introduction of opportunity cost concept is helpful to the management in making profitability calculations when one or more of the inputs required by one or more of the alternative courses of action are already available. These inputs may nevertheless have a cost and this is measured by the sacrifice made by the alternative action chosen or the cost that is given up in order to make them available for the current proposal.

The examples of Opportunity cost are :-

- (i) The opportunity cost of using a machine to produce a particular product is the foregone earnings that would have been possible if the machine was used to produce other products.
 - (ii) The opportunity cost of funds invested in a business is the interest that could have been earned by investing the funds in alternative avenues say Bank deposit.
 - (iii) The opportunity cost of one's time is the salary which he would have earned by his profession.
- (b) The differential cost technique is used for making the following managerial decisions:
- (i) Whether to process a product further or not: Many companies manufacture certain products which can be sold as such or can be subjected to further processing. It is also possible that waste emanating from one operation can be sold after further processing. In such cases, the matter for consideration is whether the incremental revenues arising from further processing is sufficient to cover the incremental cost involved.
 - (ii) Dropping or adding a product line: Often a firm manufacturing a number of products may find that one or more of its products are not profitable. In such cases, the firm may have two alternatives as under :-
 - (iii) To drop the non-remunerative product and leave the capacity unutilized.
 - (iv) To drop the non-remunerative product and to utilize the capacity freed to manufacture of a more remunerative product.
- (c) (i) The relevant costs in this case are the ones that will change if the special order is accepted. These include the variable costs, which are:
- Direct materials
 - Direct labour
 - Variable manufacturing overhead
 - Variable selling and administrative expenses*
- *Some of the usual variable selling and administrative expenses may not be

incurred if the special order is accepted, because the customer came to Salabhi unsolicited. For the remainder of this solution, the assumption is that all of this expense is relevant.

- (ii) The additional costs that will be incurred per unit if the special order is accepted are as follows:

	Rs.
Direct materials	30
Direct labour	25
Variable manufacturing overhead	12.50
Variable selling and administrative expense	<u>17.50</u>
Total per unit relevant cost	<u>85.00</u>

- (iii) To determine the differential profit (loss) to the company if the order is accepted, the differential (additional) revenue from the order must be compared to the differential (additional) costs that will be incurred if the order is accepted. The differential revenue is computed as follows:

$$10,000 \text{ units} \times \text{Rs. } 100 / \text{unit} = \text{Rs. } 10,00,000$$

The differential costs consist of the Rs. 85 of variable costs per unit that will only be incurred if the order is accepted:

$$10,000 \text{ units} \times \text{Rs. } 85 / \text{unit} = \text{Rs. } 8,50,000$$

To compute the differential income (profit), the differential revenue must be compared to the differential costs:

	Rs.
Differential revenue	10,00,000
Differential costs	<u>8,50,000</u>
Differential income	<u>1,50,000</u>

- (iv) Various non-financial factors to be considered are:

- the excess capacity is sufficient to produce the 10,000 units without taking away from the manufacture of units that can be sold at full price;
- this selling price will become known to regular customers who then will demand a similar price;
- this will be a one-time order or if this customer will be a source of future business, thus demanding the same price breaks on follow-up orders.

Cost Concept in Decision Making: Break-even Point, Absorption and Variable costing

5. (i) To compute the break-even point in sales dollars, you must first identify the total fixed costs, the variable cost per unit, and the selling price per unit and then put them into the following formula:

$$\begin{aligned}
 \text{Break - even sales volume} &= \frac{\text{Fixed costs}}{1 - (\text{Variable costs} / \text{Sales})} \\
 &= \frac{\text{Rs. 4,50,000} + \text{Rs. 3,00,000}}{1 - [(\text{Rs. 20} + \text{Rs. 10}) / \text{Rs. 50}]} \\
 &= \frac{\text{Rs. 7,50,000}}{1 - 0.60} \\
 &= \frac{\text{Rs. 7,50,000}}{0.40} \\
 &= \text{Rs. 18,75,000}
 \end{aligned}$$

- (ii) To solve for the target volume in units, you must first identify the total fixed costs, the desired net income, the unit sales price, and the unit variable cost and then put them into the following formula:

$$\begin{aligned}
 \text{Target volume in units} &= \frac{\text{Fixed costs} + \text{Net income}}{\text{Units sales price} - \text{Unit variable cost}} \\
 &= \frac{\text{Rs. 7,50,000} + \text{Rs. 50,000}}{\text{Rs. 50} - \text{Rs. 30}} \\
 &= 40,000 \text{ units.}
 \end{aligned}$$

- (iii) Before preparing an income statement under absorption costing, you must:

- (a) Compute the standard production cost per unit:

Standard production cost per unit = Variable cost + Fixed cost

$$\begin{aligned}
 &= \text{Rs. 20} + \left(\frac{\text{Rs. 4,50,000}}{90,000 \text{ units} *} \right) = \text{Rs. 20} + \text{Rs. 5} \\
 &= \text{Rs. 25}
 \end{aligned}$$

*Note that the fixed overhead per unit is based on normal capacity.

(b) Compute the ending inventory:

Beginning inventory	5,000
Add: Production	<u>85,000</u>
Inventory available for sale	90,000
Less: Sales	<u>80,000</u>
Ending inventory	<u>10,000</u>

(c) Determine the unfavourable volume variance:

Normal capacity	90,000
Actual Production	<u>85,000</u>
Volume variance in units	5,000
Fixed overhead per unit	<u>Rs. 5</u>
Unfavourable volume variance	Rs. <u>25,000</u>

Amazing Products Company
Absorption Costing Income Statement
for the year ended December 31, 2008

	Rs.	Rs.
Sales (80,000 × Rs. 50)		40,00,000
Less: Difference		
Beginning inventory (5,000 × Rs. 25)	1,25,000	
Cost of goods manufactured (85,000 × Rs. 25)	<u>21,25,000</u>	
Goods available for sale	22,50,000	
Closing inventory (10,000 × Rs. 25)	<u>2,50,000</u>	
Cost of goods sold at standard cost	20,00,000	
Add: Unfavourable volume variance	<u>25,000</u>	
		<u>20,25,000</u>
Gross Margin (Sales – Cost of Goods sold)		19,75,000
Selling expenses:		
Variable (80,000 × Rs. 10)	8,00,000	
Fixed	<u>3,00,000</u>	<u>11,00,000</u>
Net income (Gross Margin – Selling Expenses)		<u>8,75,000</u>

Before preparing an income statement under variable, you must:

(a) Realise that the variable production cost per unit is only Rs. 20.

(b) Use the contribution margin format for your income statement, where

Sales – Variable cost of goods sold = Manufacturing margin

Manufacturing margin – Variable selling and administrative = contribution margin

Contribution margin – Fixed costs = Net income

Amazing Products Company
Variable Income Statement
for the year ended December 31, 2008

	Rs.	Rs.
Sales		40,00,000
Variable costs:		
Beginning inventory (5,000 × Rs. 20)	1,00,000	
Cost of goods manufactured (85,000 × Rs. 20)	<u>17,00,000</u>	
Goods available for sale	18,00,000	
Ending inventory (10,000 × Rs. 20)	<u>2,00,000</u>	
Variable cost of goods sold		<u>16,00,000</u>
The Manufacturing margin		24,00,000
Variable selling expenses (80,000 × Rs. 10)		<u>8,00,000</u>
Contribution margin		16,00,000
Fixed costs:		
Fixed factory overhead	4,50,000	
Fixed selling expense	<u>3,00,000</u>	<u>7,50,000</u>
Net income		<u>8,50,000</u>

Decision Making and Process Costing

6. (i) (a) Purchases:

	P	Q	R
	Upto	Upto	Any
	1,20,000 kg	1,60,000 kg	2,00,000 kg.
Price (Rs.)	10.00	11.20	11.60

Variable transport cost (Rs.)	<u>1.20</u>	<u>1.00</u>	<u>1.00</u>	<u>.00</u>
Total	<u>11.20</u>	<u>12.20</u>	<u>12.60</u>	<u>12.00</u>

Plan I	Quantity (kgs.)	1,20,000	80,000		
	Cost (Rs.)	13,44,000	9,76,000	Total	23,20,000
Plan II	Quantity (kgs.)				2,00,000
	Cost (Rs.)				24,00,000

Plan I being lesser in cost therefore it should be adopted, buy 1,20,000 kg from P and 80,000 kg from Q.

Fixed transport cost being constant is not relevant to the decision.

(b)			Kg.
Production:	Process A Input		2,00,000
	Loss 10%		<u>20,000</u>
	Output		1,80,000
	Process B Loss 5%		<u>9,000</u>
	Final output		<u>1,71,000</u>

Sales	K	L	M
	Upto	Upto	1,71,000 kg
	80,000 kg	1,60,000 kg	
Selling Price Rs.	65.00	64.00	61.80
Discount 2%	<u>1.30</u>	<u>1.28</u>	=
Net selling price	63.70	62.72	61.80
Transport (V)	<u>2.60</u>	<u>1.44</u>	=
Net realisation	<u>61.10</u>	<u>61.28</u>	<u>61.80</u>

Plan I sell quantity	1,71,000 kg to M	Sales Revenue (Rs.)	1,05,67,800
Plan II sell quantity	(kgs.)11,000 to K	1,60,000 to L	
	(Rs.) 6,72,100	98,04,800	1,04,76,900
Fixed delivery charges	Rs. 5,000 × 12		<u>60,000</u>
		Sales Revenue (Rs.)	<u>1,04,16,900</u>

Since sales realisation is greater on selling to M, entire quantity should be sold to M

(ii) Costs & profit statement		
	Kg.	Rs.
Process A		
Raw materials	2,00,000	23,20,000
Fixed transport		2,00,000
Wages		22,00,000
Overheads		<u>9,56,000</u>
Total		56,76,00
Sale of scrap	<u>20,000 @ 1/-</u>	<u>(20,000)</u>
Net cost	<u>1,80,000</u>	<u>56,56,000</u>
Process B		
Process A	1,80,000	56,56,000
Wages		21,00,000
Overheads		<u>13,45,800</u>
Total	1,80,000	91,01,800
Sale of scrap	<u>9,000 @ 2/-</u>	<u>(18,000)</u>
Net cost	1,71,000	90,83,800
Net sales		<u>1,05,67,800</u>
Profit (Rs.)		<u>14,84,000</u>

CVP Analysis & Decision Making: Product Mix Decisions

7. (a) Preliminary calculations

Variable costs are quoted per acre, but selling prices are quoted per tonne.

Therefore, it is necessary to calculate the planned sales revenue per acre. The calculation of the selling price and contribution per acre is as follows:

	Potatoes	Turnips	Parsnips	Carrots
(a) Yield per acre in tonnes	10	8	9	12
(b) Selling price per tonne	Rs. 100	Rs. 125	Rs. 150	Rs. 135
(c) Sales revenue per acre, (a)×(b)	Rs. 1,000	Rs. 1,000	Rs. 1,350	Rs. 1,620
(d) Variable cost per acre	Rs. 470	Rs. 510	Rs. 595	Rs. 660
(e) Contribution per acre (Sales – Variable cost)	Rs. 530	Rs. 490	Rs. 755	Rs. 960

(i) Profit statement for current year

	Potatoes	Turnips	Parsnips	Carrots	Total
(a) Acres	25	20	30	25	
(b) Contribution per acre	Rs. 530	Rs. 490	Rs. 755	Rs. 960	
(c) Total contribution (a × b)	Rs. 13,250	Rs. 9,800	Rs. 22,650	Rs. 24,000	Rs. 69,700
			Less: Fixed costs		<u>Rs. 54,000</u>
			Profit		<u>Rs. 15,700</u>

(ii) Profit statement for recommended mix

	Area A (45 acres)		Area B (55 acres)		Total
	Potatoes	Turnips	Parsnips	Carrots	
(a) Contribution per acre	Rs. 530	Rs. 490	Rs. 755	Rs. 960	
(b) Ranking	1	2	2	1	
(c) Minimum sales requirements in acres ¹		5	4		
(d) Acres allocated ²	40			51	
(e) Recommended mix (acres)	40	5	4	51	
(f) Total contribution, (a)×(e)	Rs. 21,200	Rs. 2,450	Rs. 3,020	Rs. 48,960	Rs. 75,630
			Less fixed costs		<u>Rs. 54,000</u>
			Profit		<u>Rs. 21,630</u>

- (b) (i) Production should be concentrated on carrots, which have the highest contribution per acre (Rs. 960).

	Rs.
(ii) Contribution from 100 acres of carrots (100×Rs. 960)	96000
Less : Fixed overhead	<u>54000</u>
Profit from carrots	<u>42000</u>

¹ The minimum sales requirement for turnips is 40 tonnes, and this will require the allocation of 5 acres (40 tonnes/8 tonnes yield per acre). The minimum sales requirement for parsnips is 36 tonnes, requiring the allocation of 4 acres (36 tonnes/9 tonnes yield per acre).

² Allocation of available acres to products on basis of a ranking that assumes that acres are the key factor.

$$(iii) \text{ Break-even point in acres for carrots} = \frac{\text{fixed costs (Rs. 54000)}}{\text{contribution per acre (Rs. 960)}} = 56.25 \text{ acres}$$

Contribution in sales value for carrots

= Rs. 91125 (56.25 acres at Rs. 1620 sales revenue per acre).

CVP Analysis & Decision Making: Accepting & Rejecting an Order

8. (a) Costs incurred in the past, or revenue received in the past are not relevant because they cannot affect a decision about what is best for the future. Costs incurred to date of Rs. 50,000 and revenue received of Rs. 15,000 are 'sunk' and should be ignored.
- (b) Similarly, the price paid in the past for the materials is irrelevant. The only relevant cost of materials affecting the decision is the opportunity cost of the revenue from scrap which would be forgone – Rs. 2,000.
- (c) Labour Costs

	Rs.
Labour costs required to complete work	8,000
Opportunity costs : contribution forgone by losing other work (30,000 – 12,000)	18,000
Relevant cost of labour	26,000

- (d) The incremental cost of consultancy from completing the work is Rs. 2,500

	Rs.
Cost of completing work	4,000
Cost of cancelling contract	1,500
Incremental cost of completing work	2,500

- (e) Absorbed overhead is a notional accounting cost and should be ignored. Actual overhead incurred is the only overhead cost to consider. General overhead costs (and the absorbed overhead of the alternative work for the labour force) should be ignored.

- (f) Relevant costs may be summarised as follows.

	Rs.	Rs.
Revenue from completing work		34,000
Less : Relevant costs		
Materials: Opportunity cost	2,000	

Labour: basic pay	8,000	
opportunity cost	18,000	
Incremental cost of consultant	<u>2,500</u>	
		<u>30,500</u>
Extra profit to be earned by accepting the order		<u>3,500</u>

CVP Analysis & Decision Making:

9. (i) VTA receives a 10% commission on each ticket: $10\% \times 9,000 = \text{Rs. } 900$, thus,

Selling price = Rs. 900 per ticket

Variable cost per unit = Rs. 200 per ticket

Contribution margin per unit = Rs. 900 – Rs. 200 per ticket

= Rs. 700 per ticket

Fixed costs

= Rs. 1,40,000 per ticket.

$$(a) \text{ Break - even number of tickets} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}} = \frac{\text{Rs. } 1,40,000}{\text{Rs. } 700 \text{ per ticket}} = 200 \text{ tickets}$$

- (b) When target operating income = Rs. 70,000 per month:

$$\text{Quantity of tickets required to be sold} = \frac{(\text{Fixed costs} + \text{Target operating income})}{\text{Contribution per unit}}$$

$$= \frac{\text{Rs. } 1,40,000 + \text{Rs. } 70,000}{\text{Rs. } 700 \text{ per ticket}}$$

$$= \frac{\text{Rs. } 2,10,000}{\text{Rs. } 700 \text{ per ticket}} = 300 \text{ tickets.}$$

- (ii) Under the new system, Wembley would receive only Rs. 500 on the Rs. 9,000 per ticket. Thus,

Selling price = Rs. 500 per ticket

Variable cost per unit = Rs. 200 per ticket

Contribution margin per unit = Rs. 500 – Rs. 200 = Rs. 300 per ticket

Fixed costs

= Rs. 1,40,000 per month

$$(a) \text{ Break - even number of tickets} = \frac{\text{Rs. } 1,40,000}{\text{Rs. } 300 \text{ per ticket}} = 467 \text{ tickets (rounded up)}$$

$$(b) \text{ Quantity of tickets required to be sold} = \frac{\text{Rs. 2,10,000}}{\text{Rs. 300 per ticket}} = 700 \text{ tickets}$$

The Rs. 500 cap on the commission paid per ticket causes the break-even point to more than double (from 200 to 467 tickets) and the tickets required to be sold to earn Rs. 70,000 per month to also more than double (from 300 to 700 tickets). As would be expected, travel agents reacted very negatively to the Dolphin Airlines decision to change commission payments.

Pricing Decisions: Pricing of Finished Product

10. (i) Desired profit from the production and sale of product M =
Rs. 1,60,000 (Rs. 16,00,000 × 10%)

- (ii) a. Total costs:

	Rs.
Variable (Rs. 25 × 80,000 units)	20,00,000
Fixed (Rs. 8,00,000 + Rs. 4,00,000)	<u>12,00,000</u>
Total	<u>32,00,000</u>

Cost per unit = Rs. 32,00,000 ÷ 80,000 units = Rs. 40.00

$$b. \text{ Markup percentage} = \frac{\text{Desired profit}}{\text{Total costs}} = \frac{\text{Rs. 1,60,000}}{\text{Rs. 32,00,000}} = 5\%$$

- c.

	Rs.
Cost amount per unit	40.00
Markup (Rs. 40 × 5%)	<u>2.00</u>
Selling price	<u>42.00</u>

- (iii) a. Total manufacturing costs:

	Rs.
Variable (Rs. 20 × 80,000 units)	16,00,000
Fixed factory overhead	<u>8,00,000</u>
Total	<u>24,00,000</u>

Cost amount per unit: Rs. 24,00,000 ÷ 80,000 units = Rs. 30.00

$$\begin{aligned}
 \text{b. Markup percentage} &= \frac{\text{Desired profit} + \text{Total selling and administrative expenses}}{\text{Total manufacturing costs}} \\
 &= \frac{\text{Rs. 1,60,000} + \text{Rs. 4,00,000} + (\text{Rs. 5} \times 80,000 \text{ units})}{\text{Rs. 24,00,000}} \\
 &= \frac{\text{Rs. 1,60,000} + \text{Rs. 4,00,000} + \text{Rs. 4,00,000}}{\text{Rs. 24,00,000}} \\
 &= \frac{\text{Rs. 9,60,000}}{\text{Rs. 24,00,000}} = 40\%
 \end{aligned}$$

c.	Rs.
Cost amount per unit	30.00
Markup (Rs. 30 × 40%)	<u>12.00</u>
Selling price	<u>42.00</u>

(iv) a. Variable cost amount per unit = Rs. 25

Total variable costs = Rs. 25 × 80,000 units = Rs. 20,00,000

$$\begin{aligned}
 \text{b. Markup percentage} &= \frac{\text{Desired profit} + \text{Total fixed costs}}{\text{Total variable costs}} \\
 &= \frac{\text{Rs. 1,60,000} + \text{Rs. 8,00,000} + \text{Rs. 4,00,000}}{\text{Rs. 20,00,000}} \\
 &= \frac{\text{Rs. 13,60,000}}{\text{Rs. 20,00,000}} = 68\%
 \end{aligned}$$

c.	Rs.
Cost amount per unit	25.00
Markup (Rs. 25 × 68%)	<u>17.00</u>
Selling price	<u>42.00</u>

(v) a. Proposal to Sell to XYZ Ltd.

	Rs.
Differential revenue from accepting offer:	
Revenue from sale of 4,000 additional units at Rs. 28	1,12,000
Differential cost from accepting offer:	
Variable production costs of 4,000 additional units at Rs. 20	<u>80,000</u>
Differential income from accepting offer	<u>32,000</u>

b. The proposal should be accepted.

Pricing Decisions: Computing Minimum Selling Price

11.

Particulars	Year 0	Year 1-5	Year 6-10	Year 10
Outflow (Rs.) (Refer to working note 1)	80,000			
Inflow				
Sales volume (units) (Refer to working note2)		10,000	7,000	
Selling price (Rs.)		X	X	
Total sales revenue : (Rs.) (A)		10,000X	7,000X	
Cost				
Materials and labour cost (Rs.)		6,00,000	4,20,000	
Incremental fixed overhead (Rs.)		1,12,500	1,12,500	
Depreciation of machine (Rs.)		<u>8,000</u>	<u>8,000</u>	
Total cost: (Rs.) (B)		<u>7,20,500</u>	<u>5,40,500</u>	
Profit before tax : (Rs.) (A) – (B)		(10,000X – 7,20,500)	(7,000X -5,40,500)	
Less : Tax @ 40%		(4000 X – 2,88,200)	(2800 X – 2,16,200)	
Profit after tax before depreciation(Rs.)		(6000 X –4,24,300)	(4200 X –3,16,300)	
Salvage / Scrap (Rs.)				6,000
Values net of tax				43,152
Net Flows : (C)	(80000)	(6000 X – 424300)	(4200 X – 316300)	(6,000 + 43,152)
DCF Factors: (D)		3.79	2.355	0.386
Discounted Value of Cash Inflows: (C) × (D)	(80,000)	(6,000 X –4,24,300) 3.79	(4,200 X – 3,16,300)2.355	(6,000 + 43,152) 0.386

Sum of the discounted inflows:

$$[22740 X + 9891 X] - [16,08,097 + 744887] + [2316 + 16657]$$

$$= [32631 X - 23,34,011]$$

Sum of the discounted cash outflows = Rs.80,000

Net cash inflows:

$$= \text{Rs.}32,631 X - \text{Rs.}23,34,011 - \text{Rs.}80,000$$

Minimum selling price: For determining minimum selling price the net cash inflows should be zero i.e.

$$32,631 X = \text{Rs. } 24,14,011$$

$$\text{or } X = \text{Rs. } 73.98 \text{ or (Rs.}74)$$

Notes:

1. (i) Expenditure on R & D and consulting reports are treated as sunk costs.
(ii) Relevant cost of the machine is based on replenished purchased materials
 $= \text{Rs. } 50,000 + 40\% \text{ of Rs.}50,000 \text{ (increase) + labour cost}$
 $= \text{Rs. } 70,000 + \text{Rs.}10,000 = \text{Rs. } 80,000$
2. Expected sales volume
1-5 yrs $= (20000 \times 0.1) + (10,000 \times 0.65) + (6000 \times 0.25) = 10,000 \text{ units}$
6-10 yrs $= (12000 \times 0.2) + (8000 \times 0.5) + (2000 \times 0.3) = 7000 \text{ units}$

Pricing Decisions: Pareto Analysis

12. Let us rearrange the products in descending order of contribution and find out the cumulative contribution percentage.

Product	Contribution	Cumulative contribution	Cumulative contribution
	(Rs.)	(Rs.)	(%)
C	1,500	1,500	60
A	500	2,000	80
B	200	2,200	88
F	125	2,325	93
E	100	2,425	97
D	<u>75</u>	2,500	100
	<u>2,500</u>		

On analysis it is found that 80% of the total contribution is earned by two products C and A. The position of these products needs protecting, perhaps through careful attention to branding and promotion. The other products should be investigated to see whether their contribution can be improved through increased prices, reduced costs, increased sales volume, etc.

Budget & Budgetary Control: Flexible Budget

13. (i) Flexible Budget:

	(Fig' lacs of Rs.)		
Units	6,00,000	10,00,000	12,00,000
	Rs.	Rs.	Rs.
Sales revenue: (A)	108	180	192
Direct materials	30	50	57
Direct wages	12	20	24
Variable factory overheads	12	20	24
Selling & Administration overheads	<u>6</u>	<u>10</u>	<u>13</u>
Total variable costs: (B)	<u>60</u>	<u>100</u>	<u>118</u>
Contribution : {(A) – (B)}	<u>48</u>	<u>80</u>	<u>74</u>
Less: Fixed factory overheads	16	16	16
Less: Fixed selling and administrative overheads	16	16	16
Less: Additional fixed overheads	—	8	12
Less: Interest cost	—	3	3
Less: Depreciation	—	4	4
Less: Special advertisement	<u>—</u>	<u>2</u>	<u>—</u>
Profit	<u>16</u>	<u>31</u>	<u>23</u>

- (ii) Advise: The company should choose 10 lacs level of output to arrive at optimum profit.

Budget & Budgetary Control: Functional Budget

14. (i) In preparing the sales budget, the forecasted unit sales must be multiplied by the budgeted selling price to obtain the sales volume in rupees.

RNRB Company			
Sales Budget			
For the year ended December 31, 2008			
Product	Unit Sales Volume	Unit Selling Price	Total Sales
		Rs.	Rs.
Bike	60,000	4,500	27,00,00,000
Bus	<u>12,500</u>	15,000	<u>18,75,00,000</u>
Total	<u>72,500</u>		<u>45,75,00,000</u>

- (ii) In preparing the production budget, the forecasted unit sales from the sales budget are added to the desired ending inventory to determine the total units needed, then the estimated beginning inventory is deducted from that total to determine the unit production needed.

RNRB Company
Production Budget
For the year ended December 31, 2008

	Units	
	Bike tyres	Bus tyres
Sales (from sales budget)	60,000	12,500
Plus desired ending inventory, Dec. 31	<u>5,000</u>	<u>2,000</u>
Total	65,000	14,500
Less estimated beginning inventory, Jan. 1	<u>6,000</u>	<u>2,500</u>
Total production	<u>59,000</u>	<u>12,000</u>

- (iii) In preparing the direct materials budget the quantities of materials needed for production must be added to the desired ending inventory of materials to determine the materials needed. Then, the estimated beginning inventory must be subtracted from this total to determine the quantity of materials to be purchased.

RNRB Tyre Company
Direct Materials Budget
For the year ended December 31, 2008

	Direct Materials		Total
	Rubber (lbs.)	Steel Belts (lbs.)	
Quantities required for production:			
Bike tyres:			
59,000 × 15 lbs.	8,85,000		
59,000 × 2.0 lbs.		1,18,500	
Bus tyres:			
12,000 × 35 lbs.	4,20,000		
12,000 × 4.5 lbs.		54,000	
Plus desired ending inventory, Dec. 31	<u>60,000</u>	<u>6,000</u>	
Total	13,65,000	1,78,000	

Less: Estimated beginning inventory, Jan. 1	<u>75,000</u>	<u>7,500</u>	
Total quantity to be purchased	12,90,000	1,70,500	
Unit price	<u>Rs. 150</u>	<u>Rs. 100</u>	
Total direct materials purchases	<u>Rs. 19,35,00,000</u>	<u>Rs. 1,70,50,000</u>	<u>Rs. 21,05,50,000</u>

- (iv) In preparing the direct labour budget the total direct labour hours that should be worked on all products must be determined for each department, and then multiplied by the wage rate for that department.

RNRB Tyre Company
Direct Labour Budget
for the year ended December 31, 2008

	Department		Total
	Molding	Finishing	
Hours required for production:			
Bike tyres:			
59,000 × .10	5,900		
59,000 × .05		2,950	
Bus tyres:			
12,000 × .20	<u>2,400</u>		
12,000 × .10		<u>1,200</u>	
Total	8,300	4,150	
Hourly rate	<u>Rs. 650</u>	<u>Rs. 750</u>	
Total direct labour cost	<u>Rs. 53,95,000</u>	<u>Rs. 31,12,500</u>	<u>Rs. 85,07,500</u>

- (v) In this problem, the budgeted costs for each factory overhead item are given. In practice, the challenge is to determine the variable and fixed components of semi-variable factory overhead costs.

RNRB Company
Factory Overhead Budget
for the year ended December 31, 2008

	Rs.
Indirect materials	85,28,000
Indirect labour	79,40,000
Depreciation of building and equipment	49,16,000
Power and light	<u>63,00,000</u>
Total factory overhead cost	<u>2,76,84,000</u>

- (vi) The information from the direct materials, direct labour and factory overhead budgets, in addition to data on desired beginning and ending inventories, is used to prepare the cost of goods sold budget.

RNRB Company
Cost of Goods Sold Budget
for the year ended December 31, 2008

	Rs.	Rs.
Finished goods inventory, Jan. 1		200,25,500
Direct materials inventory Jan. 1 ¹	1,20,00,000	
Direct materials purchases	<u>21,05,50,000</u>	
Total direct materials available	22,25,50,000	
Less: Direct materials inventory, Dec. 31 ²	<u>96,00,000</u>	
Cost of direct materials used	21,29,50,000	
Direct labour	85,07,500	
Factory overhead	<u>2,76,84,000</u>	
Cost of goods manufactured		<u>24,91,41,500</u>
Cost of goods available for sale	26,91,67,000	
Less: Finished goods inventory, Dec. 31	<u>1,63,23,900</u>	
Cost of goods sold	<u>25,28,43,100</u>	
1. Rubber 75,000 lbs. × 150	Rs. 1,12,50,000	
Steel belts 7,500 lbs. × 100	<u>7,50,000</u>	
	Rs. <u>1,20,00,000</u>	
2. Rubber 60,000 lbs. × 150	Rs. 90,00,000	
Steel belts 6,000 lbs. × 100	<u>6,00,000</u>	
	Rs. <u>96,00,000</u>	

Standard Costing: Variance Analysis

15. (i) (1) The fixed overhead volume variance shows the amount of over- or under absorption of fixed overheads based upon the actual level of output compared with the budgeted level of output. The capacity utilisation component arises because of the change in the level of output at a fixed (budgeted) overhead rate of absorption. The efficiency component occurs when the actual rate of overhead absorption is greater or less than that budgeted for a given level of output. This may be illustrated by the following example.

XYZ Ltd.	Budget	Actual
Fixed overheads	Rs. 1,00,000	Rs. 1,01,000
Level of output	500 units	520 units
Labour used	2,000 hours	2,020 hours

The fixed overhead volume variance is Rs. 4,000 favourable, i.e. 20 units $\times$ 4 hours per unit $\times$ Rs. 50 per hour.

The capacity component is Rs. 1,000 favourable, i.e. 20 hours $\times$ Rs. 50 per hour.

The efficiency component is Rs. 3,000 favourable, i.e. 60 hours $\times$ Rs. 50 per hour.

The purpose of this subdivision of the variance is to aid management's understanding of the causes of the variance to enable management by exception.

Investigation of the capacity variance would look at the level of customer orders and any capacity constraints within the organisation. The efficiency variance investigation would look at the control and utilisation of labour. The limitations of this subdivision are:

- it is only possible for an absorption costing system;
- it may be difficult to decide which costs are truly fixed in nature;
- the use of labour hours as a driver of fixed costs may not be meaningful in modern manufacturing environments.

- (2) The materials usage variance shows the standard cost of the variation in quantity of materials used from the standard for a given level of output. The mixture component arises from the standard for a given level of output. The mixture component arises from the standard for a given level of output. The mixture component arises from using different relative proportions of the constituent raw materials from the budget. The yield component reflects any difference between the actual output achieved and that expected based upon the standard operation. For example :

	Standard	Actual
Input for 100 kg of product XY	• 60 kg of X at Rs 100 per kg. • 40 kg of Y at Rs 130 per kg.	• 64 kg of X at Rs 100 per kg • 38 kg of Y at Rs 125 per kg.

The material usage variance is Rs 140 adverse, i.e. 2 kg Y $\times$ Rs 130 – 4 kg X $\times$ Rs 100.

The material mixture component is Rs 84 favourable , i.e. $2.8 \text{ kg X} \times \text{Rs } 130 - 2.8 \text{ kg X} \times \text{Rs } 100$.

The material yield component is Rs 224 adverse , i.e. $2 \text{ kg of XY at standard cost of } (0.6 \times 100 + 0.4 \times 130)$.

The purpose is the same for part (a). The limitation is that this model assumes that there is no change in the quality of the product XY produced from different proportions of X and Y . This is not likely to be true in actual practice where side chemical reactions may become more prevalent which may render the product unsuitable for its intended purpose. Investigation of the variances would consider:

- Mixture variance : ingredients used , material control and wastage;
- Yield variance : efficiency of equipment and the quality of materials used.

- (3) The labour rate variance is the difference between the actual cost incurred for the actual hours worked and the cost for working the actual amount of hours using the budgeted labour rate. The operational component arises from any changes in the rate of pay, which were a consequence of the way labour was operated, e.g. allowing a discretionary extra payment for poor working conditions. The planning component shows the change in labour rate due to inadequacies or inaccuracies in the preparation of the original budget. For example, the anticipated annual pay rise may have been different from that obtained from the workforce:

Actual hours worked	100
Actual wages paid	Rs. 500
Original standard wage rate	Rs. 4 per hour
Revised standard wage rate for the period	Rs. 5.20 per hour

The labour rate variance is Rs 100 adverse i.e. $(500 - (4 \times 100))$

The operational component is Rs 20 favourable, i.e. $(500 - (5.20 \times 100))$

The planning component is Rs 120 adverse, i.e. (100×1.20)

Again, the purpose is the same as for part (a). The limitation for this subdivision is that it is rare for there to be a controllable (operational) reason for the labour rate variance. In general labour rates are fixed by the market place, i.e., they are uncontrollable (planning) variances.

Thus, this subdivision is an unnecessary complication that will rarely provide an insight which is an improvement on that provided by the labour rate variance. However, any investigation would focus on the establishment of wage rates and

labour recruitment, whereas investigation of the operational variance would look at the actual payment of wages and control of payroll.

(ii) (A) Control Report

Code		Fixed budget 7,500 units	Flexible Budget 6,750 units	Actual 6750	Variances
301	Sales salaries	Rs. 30,000	Rs. 30,000	33,750	Rs. 3750 (A)
302	Staff Commission	30,000	27,000	28,500	1,500 (A)
303	Staff expenses	15,000	13,500	13,000	500 (F)
431	Underwriting Staff	45,000	40,500	50,000	9,500 (A)
599	Other Admin Costs	<u>30,000</u>	<u>30,000</u>	<u>33,000</u>	<u>3,000 (A)</u>
		<u>1,50,000</u>	<u>1,41,000</u>	<u>158,250</u>	<u>17,250 (A)</u>

(B) Sales Salaries – Rs. 3,750 (A) Rate Variance is due to unanticipated pay award.

Sales Commission – Rs. 3,000 (F) is due to drop in activity and Rs. 1,500 (A) may be due to increasing sales commission on selected policies or due to inefficiency.

Sales Expenses – Rs. 1,500 reduction due to drop in activity and Rs. 500 (F) for improved control.

Underwriting Salaries – Rs. 4,500 (F) due to drop in activity, Rs. 5062 (A) due to unbudgeted salaries increases and Rs. 4,438 (A) due to inefficiency.

Other Administration – Rs. 3,000 (A) seem to have been caused by changes due to high cost suppliers or hiring temporary office staff.

Standard Costing: Variance Analysis

16. Computation of Standard Margin

	Product 1	Product 2	Product 3
Selling Price	Rs 15.00	Rs 20.00	Rs 40.00
Labour	Rs 4.00	Rs 5.00	Rs 8.00
Material	4.00	4.40	5.20
Energy	3.00	3.60	4.80
Variable costs	Rs 11.00	Rs 13.00	Rs 18.00
Contribution margin	4.00	7.00	22.00

(a) Sales Activity Variance = (Actual output – Budgeted output) × Standard margin
= (12,000 – 10,000) × 4 + (5,500 – 6,000) × 7 +
(1,800 – 2,000) × 22
= Rs. 100 Favourable

(b) Price –Recovery Variance = Sales Price Variance – Input Cost Variance

Where,

Sales Price Variance = (Actual price – Budgeted price) × Actual sales volume

Input cost variance = (Actual unit cost of input – Standard unit cost of input) ×
Actual inputs consumed.

Sales Price Variance = [(16 – 15) × 12,000 + (22 – 20) × 5,500 + (40 – 40) ×
1,800]
= Rs. 23,000 Favourable

Input Cost Variance

	Actual unit costs	Budgeted unit costs	Difference	Actual Inputs	Input Cost Variances
Labour	21.00	20	1	5,212 hr.	Rs. 5,212
Materials	4.40	4	0.40	21,920 kg.	8,768
Energy (kw hr.)	5.80	6	– 0.20	10,633 kw hr	(2,127)

Committed overhead 84,000 80,000 4,000 4,000

Input cost variance Rs. 15,853

Hence Price Recovery Variance = Rs. 23,000 – Rs. 15,853

= Rs. 7,147 Favourable.

(c) Productivity Variance

Productivity Variance = (Std. Consumption @ actual output – Actual Consumption) × Std. Price

	Standard consumption @actual output			Total	Actual Consumption	Diff	Std Price	Usage Variance
	Product 1	Product 2	Product 3					
Labour	2,400	1,375	720	4,495	5,212	717	Rs. 20	Rs.14,340
Material	12,000	6,050	2,340	20,390	21,920	1,530	4	6,120
Energy	6,000	3,300	1,440	10,740	10,633	- 107	6	(642)
Productivity Variance								Rs.19,818

Standard Costing: Variance Analysis

17. (1) Material Variance:

$$\begin{aligned}
 \text{(i) Direct Material Price Variance} &= (\text{Actual Input Quantity} \times \text{Actual Price} - \text{Actual} \\
 &\quad \text{Input Quantity} \times \text{Budgeted Price}) \\
 &= (\text{Rs. } 16.50 - \text{Rs. } 15) 10,000 \text{ kg.} \\
 &= \text{Rs. } 15,000 \text{ (A)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) Direct Material Efficiency Variance} \\
 &[\text{Actual Input Quantity} \times \text{Budgeted Price} - \text{Budgeted Input Quantity Allowed for} \\
 &\quad \text{Actual Output} \times \text{Budgeted Price}] \\
 &= (8,800 \text{ kg.} \times \text{Rs. } 15 - 4,000 \text{ units} \times 2 \text{ kg. / unit} \times \text{Rs. } 15) \\
 &= \text{Rs. } 12,000 \text{ (A)}
 \end{aligned}$$

Labour Variance:

$$\begin{aligned}
 \text{(i) Direct Manufacturing Labour Price Variance} \\
 &(\text{Actual Hours} \times \text{Actual Rate} - \text{Actual Hours} \times \text{Standard Rate}) \\
 &= (6,500 \text{ hours} \times \text{Rs. } 20.40 - 6,500 \text{ hours} \times \text{Rs. } 20) \\
 &= \text{Rs. } 2,600 \text{ (A)} \\
 \text{(ii) Direct Manufacturing Labour Efficiency Variance} \\
 &(\text{Actual Hours} \times \text{Standard Rate} - \text{Budgeted Hours allowed for Actual Output} \times \\
 &\quad \text{Standard Rate}) \\
 &= (6,500 \text{ hours} \times \text{Rs. } 20 - 4,000 \text{ units} \times 1.50 \text{ hours / unit} \times \text{Rs. } 20) \\
 &= \text{Rs. } 10,000 \text{ (A)}
 \end{aligned}$$

(2) Journal Entries

	Rs.	Rs.
Material Control	1,50,000	
Direct Material Price Variance	15,000	
Accounts Payable Control		1,65,000
Work in Process Control	1,20,000	
Direct Materials Efficiency Variance	12,000	
Materials Control		1,32,000

Work in Process Control	1,20,000	
Direct Manufacturing Labour Price Variance	2,600	
Direct Manufacturing Labour Efficiency Variance	10,000	
Wages Payable Control		1,32,600

Costing of Service Sector

18.

(i) Per flight basis:

		Rs.
Fare collection		9,60,000
120 × Rs. 8000		
Commission (5% of 80% of 9,60,000)		<u>38,400</u>
Net fare		<u>9,21,600</u>
Expenses:		
Fuel		1,60,000
Food (120 × Rs. 200)		<u>24,000</u>
Total variable cost		<u>1,84,000</u>
Contribution		7,37,600
Less : Fixed costs:		
Annual lease apportioned	4,00,000	
Ground handling charges	1,00,000	
Crew salaries	<u>60,000</u>	5,60,000
Operating income		1,77,600

(ii) Calculation of profit as per given proposal:

Fare collections (132 × Rs.7,500)	9,90,000
Commission (5% of 80% of 9,90,000)	<u>39,600</u>
Net fare	<u>9,50,400</u>
Expenses:	
Fuel	1,60,000
Food (132 × Rs.200)	<u>26,400</u>
Total variable cost	<u>1,86,400</u>

Contribution	7,64,000
Fixed costs	<u>5,60,000</u>
Profit	<u>2,04,000</u>

Excess of income is 2,04,000 – 1,77,600 = Rs.26,400

Hence reduction in fare is recommended.

Transfer Pricing

19. (a) (i) Monthly profits at present level of L & M Ltd.

	(Rs.' 000)
L Ltd.: Sales (10,000 drums* @ Rs.20 per drum)	200
Less : Costs: Raw materials @ Rs. 9 per drum	90
Other costs @ Rs.3 per drum	<u>30</u>
Contribution	80
Less : Fixed costs	<u>40</u>
Profit	<u>40</u>
M Ltd.: Sales (7,50,000 kilolitres at Rs. 9 per 25 litres)	270
Less: Costs: Variable (@Rs. 0.20 per Kilolitre)	<u>150</u>
Contribution	120
Less : Fixed costs	<u>60</u>
Profit	<u>60</u>

Note:

* Sales of L Ltd. = (2,50,000 kilolitres internal transfers / 25 litres per drum.)
= 10,000 drums

(ii) Monthly profits at higher sales level

	(Rs.' 000)
L Ltd.: Sales (18,000 drums* at Rs.16 per drum)	288
Less: Costs: Raw materials (Rs. 9 per drum)	162
Other expenses (Rs.3 per drum)	<u>54</u>
Contribution	72
Less: Fixed costs	<u>40</u>
Profit	<u>32</u>

M Ltd. Sales (9,50,000 kilolitres* at Rs. 9 per 25 litres)	342
Costs: Variable (@ Rs.0.20 per kilolitre)	<u>190</u>
Contribution	152
Less : Fixed costs	60
Profit	<u>92</u>

Note:

* Internal transfers (18,000 drums of 25 litres per drum) plus 5,00,000 kilolitres external sales.

- (b) (i) The use of a market price as the transfer price produces difficulties because L Ltd. is not motivated to reduce the selling price, in order to increase volume, because its profit declines from Rs. 40,000 to Rs. 32,000. However, the profits of M Ltd. increase from Rs. 60,000 to Rs. 92,000. Thus, the profits for the company as a whole increase by Rs. 24,000. Hence the transfer price does not encourage goal congruence in this particular situation.
- (ii) In order to overcome the above difficulties, there is a need to offer some inducement to L Ltd. such that its profits will increase as a result of lowering the selling price in order to increase volume. Factors to consider are the following:
1. The significance of the loss in profits arising from the difference between profits at the optimum output level and profits based on the output using the current transfer pricing system.
 2. Savings in selling and distribution costs arising from internal transfers compared with external sales. The savings per unit should be deducted from the market price.

Uniform Costing & Inter-Firm Comparison

20. Requisites of inter-firm comparison system: The following requisites should be considered while installing a system of inter-firm comparison:–
1. Centre for Inter-Comparison — For collection and analysing data received from member units, for doing a comparative study and for dissemination of the results of study a Central body is necessary. The functions of such a body may be :–
 - (a) Collection of data and information from its members;
 - (b) Dissemination of results to its members;
 - (c) Undertaking research and development for common and individual benefit of its members;
 - (d) Organising training programmes and publishing magazines.

2. Membership — Another requirement for the success of inter-firm comparison is that the firms of different sizes should become members of the Centre entrusted with the task of carrying out inter-firm comparison.
3. Nature of information to be collected — Although there is no limit to information, yet the following information useful to the management is in general collected by the Centre for inter-firm comparison.
 - a. Information regarding costs and cost structures.
 - b. Raw material consumption.
 - c. Stock of raw material, wastage of materials, etc.
 - d. Labour efficiency and labour utilisation.
 - e. Machine utilisation and machine efficiency.
 - f. Capital employed and Return on capital.
 - g. Liquidity of the organisation.
 - h. Reserve and appropriation of profit.
 - i. Creditors and debtors.
 - j. Methods of production and technical aspects.
4. Method of Collection and presentation of information — The Centre collects information at fixed intervals in a prescribed form from its members. Sometimes a questionnaire is sent to each member; the replies of the questionnaire received by the Centre constitute the information/data. The information is generally collected at the end of the year as it is mostly related with final accounts and Balance Sheet. The information supplied by firms is generally in the form of ratios and not in absolute figures. The information collected as above is stored and presented to its members in the form of a report. Such reports are not made available to non-members.

Cost Sheet, Profitability analysis & Reporting: the Balance Scorecard

21. (a) 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.

(b) Kitchen King's Score card should describe its product differentiation strategy. The key points that should be included in its balance score card are

- ◆ Financial Perspective – Increase in operating income by charging higher margins on Maharaja.
- ◆ Customer Perspective – Market share in high-end kitchen range market and customer satisfaction.
- ◆ Internal business Perspectives: Manufacturing quality, order delivery time, on time delivery and new product feature added.
- ◆ Learning and Growth Perspective: Development time for designing new end product and improvement in manufacturing process.

Operative Income:

	(Amount in 000' Rs.)	
	2007	2008
Revenue (40,000 × 1,000: 42,000 × 1,100)	40,000	46,200
Direct Material	12,000	13,530
Conversion cost	10,000	11,000
Selling and Customer service	7,200	7,250
Total cost	29,200	31,780
Operative Income	10,800	14,420

Change in operating Income is Rs. 36,20,000 (F)

A. Growth Component

(a) Revenue effect = Output Price in 2007 {Actual units sold in 08 – Actual units sold in 07}

$$= \text{Rs. } 1,000 (42,000 \text{ units} - 40,000 \text{ units})$$

$$= \text{Rs. } 20,00,000 \text{ (F)}$$

(b) The cost effect = Input price in 2007 {Actual units of input to produce 2007 output less Actual units of input which would have been used to produce year 2008 output on the basis of 2007}

$$(i) \text{ Direct Material} = \text{Rs. } 100 \left[1,20,000 \text{ sq.ft.} - 1,20,000 \text{ sq.ft.} \times \frac{42,000 \text{ units}}{40,000 \text{ units}} \right]$$

$$= \text{Rs. } 6,00,000 \text{ (A)}$$

- (ii) Conversion cost and selling and customer service will not change since adequate capacity exists in 2007 to support 2008 output and customers. Hence variance

$$\text{Conversion cost} = 200 (50,000 - 50,000) = 0$$

$$\text{S \& Customer Service} = 25,000 (300 - 300) = 0$$

Increase in operating effect of Growth component is Rs. 14,00,000 (F)

B. Price recovery Component:

- (i) Revenue effect = Actual output in 2008 [Selling price per unit in 2008 less Selling price per unit in 2007]
 $= 42,000 \text{ units (Rs. 1,100 - Rs. 1,000)}$
 $= \text{Rs. 42,00,000 (F)}$

- (ii) Cost effect = Unit of input based on 2007 actual that would have been used to produce 2008 output {Input prices per unit in 2007 less Input prices per unit in 2008}

(a) Direct material = 1,26,000 sq. ft. (Rs. 100/sq. ft. - Rs. 110/sq. ft.)

$$= \text{Rs. 12,60,000 (A)}$$

(b) Conversion Cost = 50,000 units (Rs. 200/unit - Rs. 220/unit)
 $= \text{Rs. 10,00,000 (A)}$

(c) S & Customer Service = 300 customers (Rs. 24,000 - Rs. 25,000)
 $= \text{Rs. 3,00,000 (A)}$

$$= \text{Rs. 25,60,000 (A)}$$

Increase in Operating income due to Price Recovery is Rs. 16,40,000 (F)
{Rs. 42,00,000 - Rs. 25,60,000}

(C) Productivity Component

Productivity component = Input Prices in 08{Actual units of input which would have been used to produce year 2008 output on the basis of 2007 actual less Actual Input}

- (i) Direct Material: Rs. 110/sqft

$$(1,26,000 \text{ units} - 1,23,000 \text{ units}) = \text{Rs. 3,30,000 (F)}$$

- (ii) Conversion Cost: Rs. 200/unit

$$(50,000 \text{ units} - 50,000 \text{ units}) = 0$$

(iii) Selling & Customer = Rs. 25,000
 (300 customers – 290 customers) = Rs. 2,50,000 (F)
 = Rs. 5,80,000 (F)

The change in operating income from 2007 to 2008 is analysed as follows:

	(Amount in 000' Rs.)				
	2007	Growth component	Price recovery	Cost effect of productivity component	2008
Revenue	40,000	2,000 (F)	4,200 (F)	—	46,200
Cost	29,200	600 (A)	2,560 (A)	580 (F)	31,780
Operating Income	10,800	1,400(F)	1,640 (F)	580 (F)	14,420

Cost Sheet, Profitability Analysis & Reporting: Product Cost Sheet & Profitability Analysis

22. 1.

EXE Wood Company

Income Statement

For the year ended December 31, 2008

	Rs.	Rs.
Revenues		6,80,000
Cost of goods sold:		
Beginning finished goods, January 1, 2008	50,000	
Cost of goods manufactured (see schedule below)	<u>4,80,000</u>	
Cost of goods available for sale	5,30,000	
Deduct ending finished goods, December 31, 2008	<u>75,000</u>	<u>4,55,000</u>
Gross margin (or gross profit)		2,25,000
Operating costs		
Marketing promotions	30,000	
Marketing salaries	50,000	
Distribution costs	35,000	
Customer-service costs	<u>50,000</u>	<u>1,65,000</u>
Operating income		<u>60,000</u>

Rs.	Rs.
-----	-----

2. Direct material unit cost = direct materials used ÷ Units produced
= Rs. 2,25,000 ÷ 4,50,000 units = Re. 0.50 per unit

Plant-leasing unit cost = Plant-leasing costs ÷ Units produced
= Rs. 27,000 ÷ 4,50,000 units = Re. 0.06 per unit
3. The direct material costs are variable, so they would increase in total from Rs. 2,25,000 to Rs. 2,50,000 (5,00,000 units × Re. 0.50 per unit). However, their unit cost would be unaffected: Rs. 2,50,000 ÷ 5,00,000 units = Re. 0.50 per unit.

In contrast, the plant-leasing costs of Rs. 27,000 are fixed, so they would not increase in total. However, the plant leasing cost per unit would decline from Re. 0.060 to Re. 0.054: Rs. 27,000 ÷ 5,00,000 units = Re. 0.054 per unit.

Note : All the Questions are arranged in a sequence as per the syllabus of 'Advanced Management Accounting' (AMA) [Paper 5 of Final (New) Course]. This RTP contains chapter name followed by the topic against each theory/practical question

Linear Programming

24. The given L.P.P. is

$$\text{Minimize } Z = 2x_1 + x_2$$

Subject to

$$3x_1 + x_2 = 3$$

$$4x_1 + 3x_2 \geq 6$$

$$x_1 + 2x_2 \leq 3, \quad x_1, x_2 \geq 0$$

We shall convert the constraints into eqn.

$$3x_1 + x_2 = 3$$

$$4x_1 + 3x_2 - x_3 = 6$$

$$x_1 + 2x_2 + x_4 = 3$$

Where $x_1, x_2, x_3, x_4 \geq 0$ and x_3 is called surplus variables and x_4 is called slack variable.

We shall add artificial variables in the above equations.

$$3x_1 + x_2 + x_5 = 3$$

$$4x_1 + 3x_2 - x_3 + x_6 = 6$$

$$x_1 + 2x_2 + x_4 = 3$$

Here, x_5, x_6 are called artificial variable.

The no. of variables $n = 6$

The no. of constraints $m = 3$

$$\therefore n - m = 6 - 3 = 3.$$

Let us assume that

$$x_1 = 0, x_2 = 0, x_3 = 0$$

$\therefore$ The starting basic feasible solution is

$$x_5 = 3, x_6 = 6, x_4 = 3$$

Now, then new objective function.

$$Z = 2x_1 + x_2 + 0x_3 + 0x_4 + Mx_5 + Mx_6$$

$$C \quad (2 \quad 1 \quad 0 \quad M \quad M \quad 0)$$

C_B	Y_B	X_B	Y_1	Y_2	Y_3	Y_5	Y_6	Y_4	Min Ratio
M	Y_5	3	3	1	1	1	0	0	$\frac{3}{3} = 1$ ←
M	Y_6	6	4	3	-1	0	1	0	$\frac{6}{4} = 1.5$
0	Y_4	3	1	2	0	0	0	1	$\frac{3}{1} = 3$
$Z = 9M$			7M-2	4M-2	-M	0	0	0	

There Y_1 is the entering variable

Y_5 is the leaving variable

and 3 is the leading common element.

		C	(2	1	0	M	0)	
C_B	Y_B	X_B	Y_1	Y_2	Y_3	Y_6	Y_4	Min. Ratio
2	Y_1	1	1	1/3	0	0	0	$\frac{1}{1/3} = 3$
M	Y_6	2	0	5/3	-1	1	0	$2 \times \frac{3}{5} = 1.2$ ←
0	Y_4	2	0	5/3	0	0	1	$\frac{6}{5} = 1.2$
$Z = 2M+2$			0	$\frac{5M-1}{5}$	-M	0	0	

Y_2 is the entering variable

Y_6 is the leaving variable

$\frac{5}{3}$ is the leading common element.

		C (.2 1 0 0)				
C_B	Y_B	X_B	Y_1	Y_2	Y_3	Y_4
2	Y_1	3/5	1	0	1/5	0
1	Y_2	6/5	0	1	-3/5	0
0	Y_4	0	0	0	1	1
		$Z=12/5$	0	0	-1/5	0

Since all the element $Z_j - C_j$ of non-positive. The above table gives the optimum solution.

∴ The solution is $x_1 = \frac{3}{5}$, $x_2 = \frac{6}{5}$ and $Z = \frac{12}{5}$

Linear Programming

25. We shall convert the in-eqn. Given in L.P.P. as eqn.

$$-2x_1 + x_2 = 1 \quad \dots(1)$$

$$x_1 = 2 \quad \dots(2)$$

$$x_1 + x_2 = 3 \quad \dots(3)$$

Consider the line (1)

$$-2x_1 + x_2 = 1$$

When $x_2 = 0$

$$-2x_1 = 1$$

$$x_1 = -\frac{1}{2} = -0.5$$

then line (1) cuts x_1 axis at $(-0.5, 0)$

When $x_1 = 0$, $x_2 = 1$

The line (1) cuts x_1 axis at $(0, 1)$

Consider the line (2), $x_1 = 2$

Consider the line (3), $x_1 + x_2 = 3$

When,

$$x_2 = 0, x_1 = 3$$

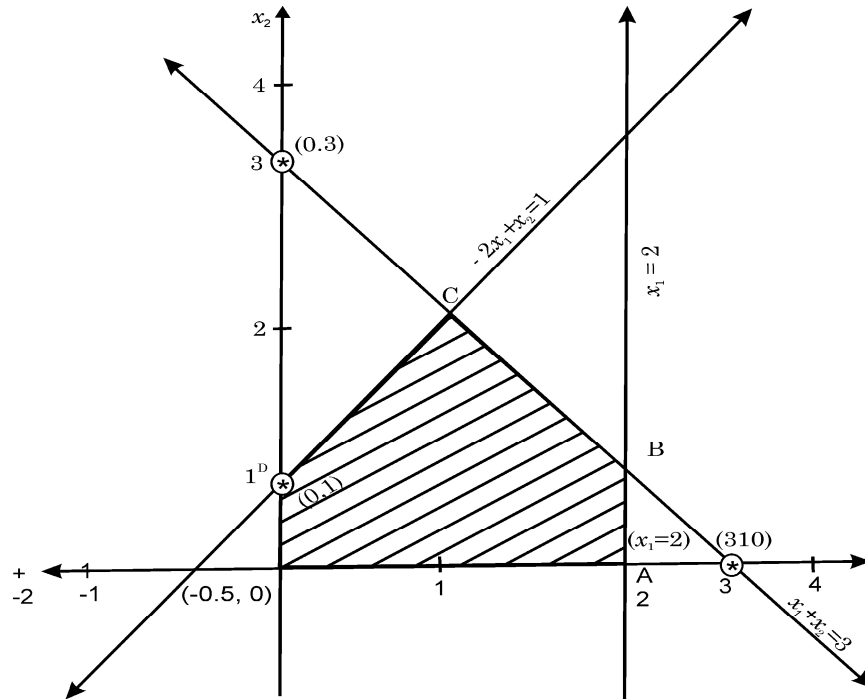
The line (3) cuts x_1 axis at (3, 0)

When,

$$x_1 = 0, x_1 + x_2 = 3$$

$$x_2 = 3$$

The line (3) cuts x_2 axis at (0, 3).



From the figure the region OABCD is called solution space.

The point O = (0, 0)

The point A = (2, 0)

The point D = (0, 1)

We shall find B, and C.

We shall solve B

$$x_1 = 2,$$

$$x_1 + x_2 = 3 \Rightarrow 2 + x_2 = 3$$

$$x_2 = 1$$

$\therefore$ The point B (2, 1)

We shall solve C

$$-2x_1 + x_2 = 1$$

$$x_1 + x_2 = 3$$

$$-3x_1 = -2$$

$$x_1 = \frac{2}{3} = .666 = .67$$

$$x_1 + x_2 = 3$$

$$.67 + x_2 = 3$$

$$x_2 = 3 - .67 = 2.33$$

$\therefore$ The point C (.67, 2.33)

No at O = (0, 0), Z = 0

At A = (2, 0), Z = 2 + 0 = 2

At B = (2, 1), Z = 2 + 1 = 3

At C = (0.67, 2.33) Z = 0.67 + 2.33 = 3.0

At D = (0, 1), Z = 0 + 1 = 1

$\therefore$ The solutions are $x_1 = 2, x_2 = 1$ and $x_1 = 0.67, x_2 = 2.33$

and Minimum Z = 3

Transportation Problem

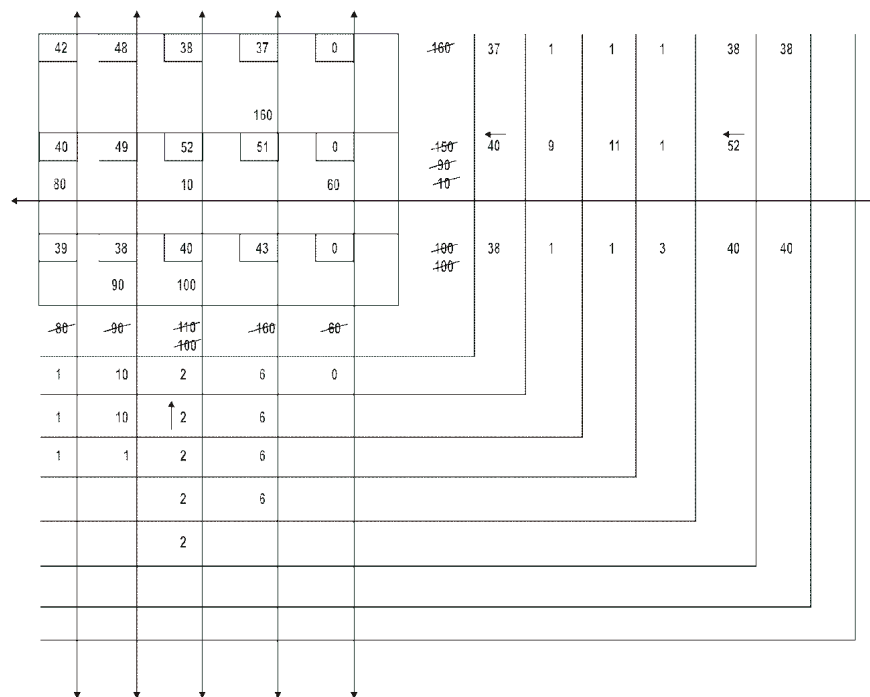
26. The given problem is un-balanced T.P.

$\therefore$ We add dummy column (E).

	A	B	C	D	E	
1	42	48	38	37	0	160
2	40	49	52	51	0	150
3	39	38	40	43	0	190
	80	90	110	160	60	500

Now, the above problem is balanced.

(i) First, using VAM method to find basic feasible solution.



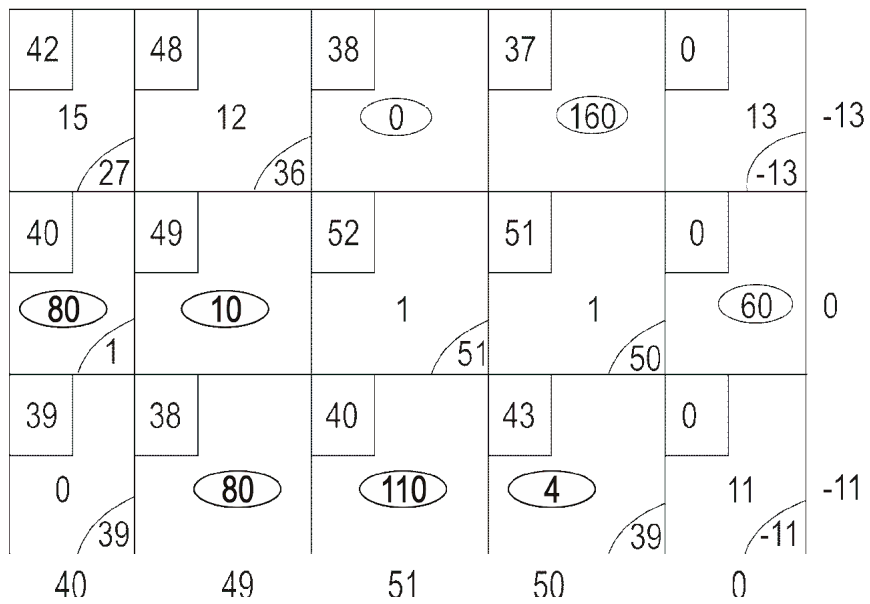
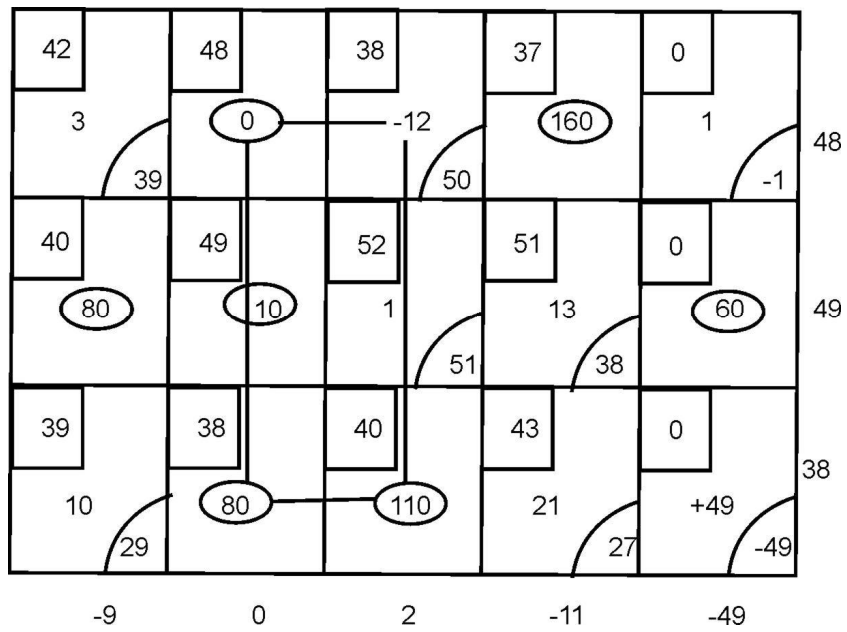
The transportation cost

$$\begin{aligned}
 &= 37 \times 160 + 40 \times 80 + 52 \times 10 + 0 \times 60 + 38 \times 90 + 40 \times 100 \\
 &= 5,920 + 3,200 + 520 + 3,420 + 4,000 \\
 &= 17,060.
 \end{aligned}$$

(ii) To find optimum solution using Modi Method.

42	48	38	37	0	
2	-2	-14	-160	0	0
40	49	52	51	0	
80	-1	10	14	60	0
39	38	40	43	0	
11	90	100	18	12	-12
40	50	52	37	0	

42	48	38	37	0	
2	-1	-13	160	0	0
40	49	52	51	0	
80	10	1	14	60	0
39	38	40	43	0	
10	80	110	17	11	-11
40	49	51	37	0	



∴ The above table gives the optimum cost.

$$\begin{aligned} \therefore \text{The optimum T. P. cost} &= 38 \times 0 + 37 \times 60 + 40 \times 80 + 49 \times 10 + 0 \times 60 + 38 \times \\ &\quad 80 + 40 \times 110 \\ &= 5,920 + 3,200 + 490 + 3,040 + 4,400 = 17,050. \end{aligned}$$

∴ The optimum cost = Rs. 17,050

The Assignment Problem

27.

Table 1

	A	B	C	D	E
1	8	2	0	12	0
2	0	16	12	19	4
3	0	14	8	11	4
4	19	3	0	5	5
5	11	7	0	5	1

Table : 2

	A	B	C	D	E
1	8	0	0	7	0
2	0	14	12	14	4
3	0	12	8	6	4
4	19	18	0	0	5
5	11	5	0	0	1

In table 2, the minimum number of lines = $N = 4$

The order of matrix = $n = 5$

∴ $N < n$.

Table : 3

	A	B	C	D	E
1	9	0	1	8	0
2	0	13	12	14	3
3	0	11	8	6	3
4	19	0	0	0	4
5	11	4	0	0	0

Here $N < n$

Table : 4

	A	B	C	D	E
1	12	0	1	18	0
2	0	10	9	11	0
3	0	8	5	3	0
4	22	0	0	0	4
5	14	4	0	0	0

Here $N = n$

We can set allocation assignment schedule.

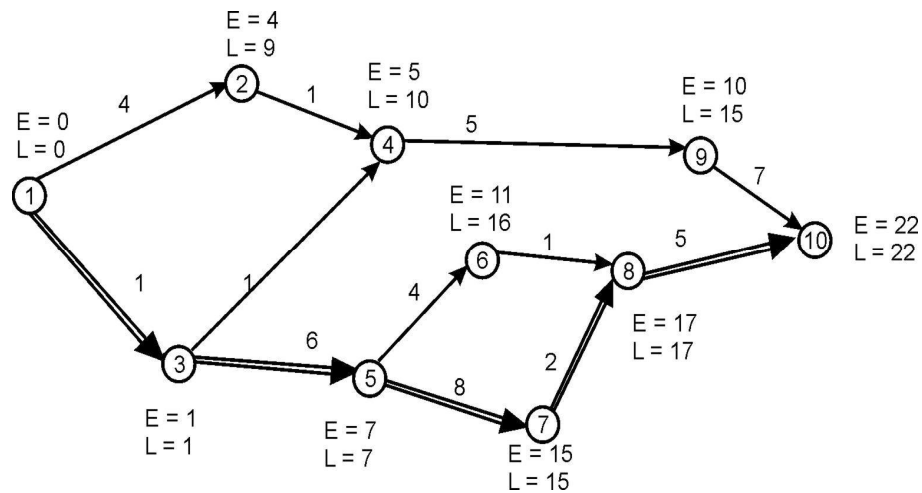
	A	B	C	D	E
1					
2					
3					
4					
5					

$\therefore$ 1 $\longrightarrow$ B
 2 $\longrightarrow$ E
 3 $\longrightarrow$ A
 4 $\longrightarrow$ C
 5 $\longrightarrow$ D

$$\begin{aligned}
 \therefore \text{Maximum Sales} &= 38 + 36 + 41 + 41 + 35 \\
 &= 191 \text{ units.}
 \end{aligned}$$

Critical Path Analysis and PERT

28. The given data results in a network shown in the figure. The figure along the arrows represent the activity times.



The earliest occurrence time (E) and the latest occurrence time (L) of each event are now computed by employing forward and backward pass calculations.

Network analysis table is given below :

Activity	Duration (week)	Start Time		Finish Time		Total float
		Earliest	Latest	Earliest	Latest	
1-2	4	0	5	4	9	5
1-3	1	0	0	1	1	0
2-4	1	4	9	5	10	5
3-4	1	1	9	2	10	8
3-5	6	1	1	7	7	0
4-9	5	5	10	10	15	5
5-6	4	7	12	11	16	5
5-7	8	7	7	15	15	0
6-8	1	11	16	12	17	5
7-8	2	15	15	17	17	0
8-10	5	17	17	22	22	0
9-10	7	10	15	17	22	5

∴ Path 1-3-5-7-8-10 with project duration of 22 weeks is the critical path.

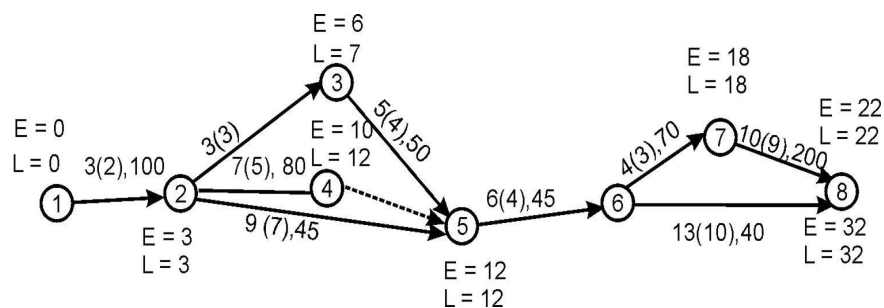
First, the cost slope for each activity and the normal direct cost of the project are calculated. This is shown in the table below :

Activity : 1-2 2-3 2-4 2-5 3-5 4-5 5-6 6-7 6-8 7-8
 Cost Slope : 100 – 80 45 50 – 45 70 40 200
 (Rs./Week)

Normal direct cost = Rs. 4,220.

Next, the network is drawn and the critical path is found. This is shown the network diagram.

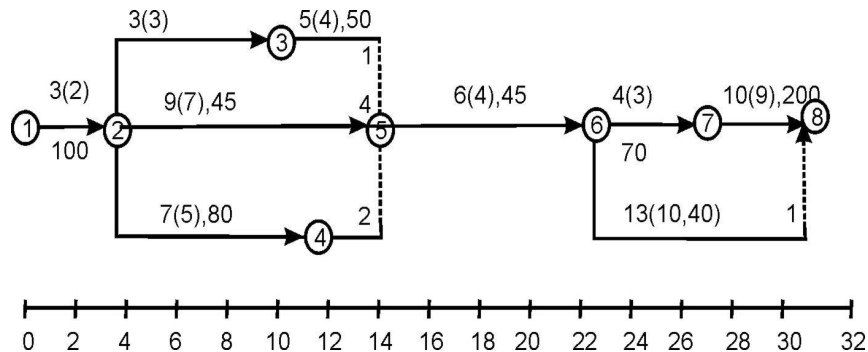
- (a) The critical path is 1-2-5-6-7-8
 (b) Normal project duration = 32 weeks.
 Normal project cost = Rs. (4,220 + 32 × 50)
 = Rs. 5,820



- (c) Total float for each activity is found in the table below :

Activity	Duration	Start		Finish		Total Float
		Earliest	Latest	Earliest	Latest	
1-2	3	0	0	3	3	0
2-3	3	3	4	6	7	1
2-4	7	3	5	10	12	2
2-5	9	3	3	12	12	0
3-5	5	6	7	11	12	1
4-5	0	10	12	10	12	2
5-6	6	12	12	18	18	0
6-7	4	18	18	22	22	0
6-8	13	18	19	31	32	1
7-8	10	22	22	32	32	0

- (d) Since the indirect cost is Rs. 50. Week and the network is to be crashed only upto optimum time and cost, only those activities need to be crashed for which the total cost slope is $\leq$ Rs. 50/- week. The time scaled diagram of the network is in the figure:



Crash activity 5-6 by 2 days at a crash cost of Rs. 45 per week.

Crash cost = Rs. (2×45) = Rs. 90

Project duration = 30 weeks.

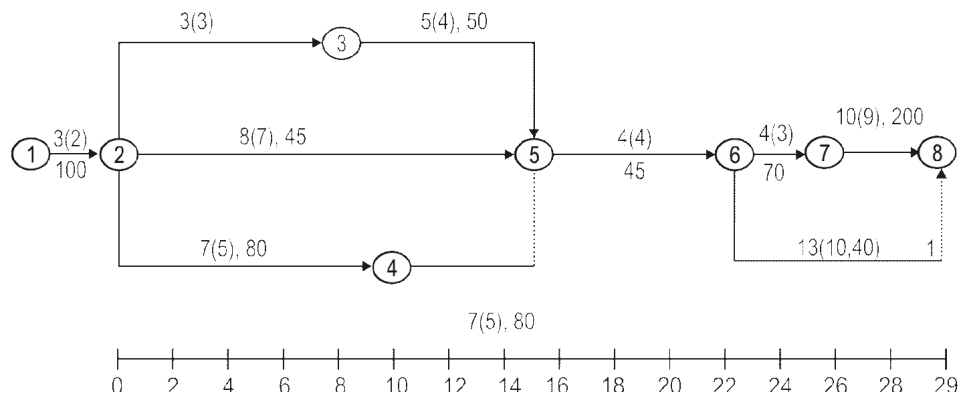
Crash activity 2-5 by 1 day at a crash cost of Rs. 45 per week

Crash cost = Rs. $(90 + 45)$ = Rs. 135.

Project duration = 29 weeks.

Critical Path Analysis and PERT

29. If the activities are crashed future the crash cost/week will be more than Rs. 50 and hence further crashing is not done. The project is in figure.



The above results are summarized in the table below:

Duration (Week)	Normal direct cost (Rs.)	Crash cost (Rs.)	Indirect cost (Rs.)	Total Cost (Rs.)
32	4220	—	1600	5820
31	4220	45	1550	5815
30	4220	90	1500	5810
29	4220	135	1450	5805

∴ Optimum project duration = 29 weeks.

Optimum total project cost = Rs. 5805.

Simulation

30. First of all, random numbers 00-99 are allocated in proportion to the probabilities associated with the sales of cars as given below:

Table 1

Sales of Car	Probability	Cumulative Probability	Range for random number
37	0.10	0.10	00-09
38	0.15	0.25	10-24
39	0.20	0.45	25-44
40	0.35	0.80	45-79
41	0.15	0.95	95-99
42	0.05	1.00	95-95

Based on the given random numbers, we simulate the estimated sales and calculate the profit/loss on the basis of specified units of production.

Table 2 :

Day	Random Numbers	Estimated Sale	Profit (Production 40 Cars /day) (Rs. laksh)	Profit (Production 39 cars /day)
1	9	37	$37 \times 1 - 3 \times 2 = 31$	$37 \times 1 - 2 \times 2 = 33$
2	98	42	$40 \times 1 - 2 \times 1 = 38$	$39 \times 1 - 3 \times 1 = 36$
3	64	40	$40 \times 1 = 40$	$39 \times 1 - 1 \times 1 = 38$
4	98	42	$40 \times 1 - 2 \times 1 = 38$	$39 \times 1 - 3 \times 1 = 36$
5	94	41	$40 \times 1 - 1 \times 1 = 39$	$39 \times 1 - 2 \times 1 = 37$
6	01	37	$37 \times 1 - 3 \times 2 = 31$	$37 \times 1 - 2 \times 2 = 33$
7	78	40	$40 \times 1 = 40$	$39 \times 1 - 1 \times 1 = 38$
8	10	38	$38 \times 1 - 2 \times 2 = 34$	$38 \times 1 - 1 \times 2 = 36$
9	15	38	$38 \times 1 - 2 \times 2 = 34$	$38 \times 1 - 1 \times 2 = 36$
10	19	38	$38 \times 1 - 2 \times 2 = 34$	$38 \times 1 - 1 \times 2 = 36$

Total = 359

Total = 359

There is no additional profit or loss if the company decides to reduce production to 39 cars per day.

Time Series Analysis & Forecasting

31. Calculation of seasonal indices by the method of link relatives.

Year	Quarter			
	I	II	III	IV
1995	—	108.3	120.0	111.5
1996	62.1	146.3	106.3	86.9
1997	93.2	95.6	143.1	68.8
1998	112.5	80.6	129.3	113.3
1999	77.5	110.6	109.6	88.8

Arithmetic average = $\frac{345.4}{4} = 86.35$	$\frac{541}{5} = 108.28$
$\frac{608.3}{5} = 121.66$	$\frac{469.3}{5} = 93.86$
Chain relatives 100	$\frac{100 \times 108.28}{100} = 108.28$
	$\frac{121.66 \times 108.28}{100} = 131.73$
	$\frac{93.86 \times 131.73}{100} = 123.65$
Corrected chain relatives 100	$108 - 1.675 = 106.605$
	$131.73 - 3.35 = 128.38$
	$123.64 - 5.025 = 118.615$
Seasonal indices	$\frac{100 \times 100}{113.4} \quad \frac{106.605}{113.4} \times 100 \quad \frac{128.38}{113.4} \times 100$
	$\frac{118.615}{113.4} \times 100$
	$= 88.18 \quad = 94.01 \quad = 113.21 \quad = 104.60$

The calculation in the above table are explained below :

Chain relative of the first quarter (on the basis of first quarter = 100)

Chain relative of the first quarter (on the basis of the last quarter)

$$= \frac{86.35 \times 123.64}{100} = 106.7$$

The difference between these chain relatives = $106.7 - 100 = 6.7$

$$\text{Difference per quarter} = \frac{6.7}{4} = 1.675$$

Adjusted chain relatives are obtained by subtracting 1×1.675 , 2×1.675 , 3×1.675 from the chain relatives of the 2nd, 3rd and 4th quarters respectively.

Average of corrected chain relatives

$$= \frac{100 + 106.605 + 128.38 + 118.615}{4} = \frac{453.6}{4} = 113.4$$

$$\text{Seasonal variation index} = \frac{\text{Correct chain relatives}}{113.4} \times 100$$

Time Series Analysis and Forecasting

32. Fitting straight line Trend by the Method of Least square

Year	Tourist Arrivals (in millions) Y	X	XY	X ²
1990	18	-3	-54	9
1991	20	-2	-40	4
1992	23	-1	-23	1
1993	25	0	0	0
1994	24	1	24	1
1995	28	2	56	4
1996	30	3	90	9

$$N = 7 \quad \Sigma y = 168 \quad \Sigma x = 0 \quad \Sigma xy = 53 \quad \Sigma x^2 = 28$$

The equation of the straight line trend is :

$$Y = a + bx$$

$$\text{Since } \Sigma x = 0, a = \frac{\Sigma y}{N} = \frac{168}{7} = 24$$

$$\text{And } b = \frac{\Sigma xy}{\Sigma x^2} = \frac{53}{28} = 1.893$$

$$\text{Hence } Y = 24 + 1.893x$$

Estimated Number of tourists that would arrive in 2000

$$Y = 24 + 1.893(7) = 24 + 13.251 = 37.251 \text{ million.}$$

Testing of hypothesis

34. In the usual notations, we are given $n = 200$. $x =$ No. of pieces conforming to specifications in the sample $= 200 - 18 = 182$.

$$\therefore P = \text{Proportion of pieces conforming to specifications in the sample} = \frac{182}{200} = 0.91.$$

Null hypothesis. $H_0 : P \geq 0.95$, i.e., the proportion of pieces conforming to specifications in the lot is at least 95%.

Alternative Hypothesis. $H_1 : P < 0.95$ (Left-tailed alternative).

It will suffice to test $H_0 : P = 0.95 \Rightarrow Q = 1 - P = 0.05$

Level of significance (i) $\alpha = 0.05$, (ii) $\alpha = 0.01$

Test statistic. Under H_0 , the test statistic is $Z = \frac{P - E(P)}{SE(P)} = \frac{P - P_0}{\sqrt{P_0 Q_0 / n}} \sim N(0, 1)$,

Since sample is large

$$= \frac{0.91 - 0.95}{\sqrt{0.95 \times 0.05 / 200}} = \frac{-0.04}{\sqrt{0.00237}} = \frac{-0.04}{0.0154} = -2.6.$$

- (i) Significance at 5% level of significance.

Since the alternative hypothesis is one-sided (left-tailed), we shall apply left-tailed test for testing significance of Z . The significant value of Z at 5% level significance for left-tail test is -1.645 .

Since computed value of $Z = -2.6$ is less than -1.645 (or since $|z| > 1.645$), we say Z is significant (as it lies in the critical region) and we reject the null hypothesis at 5% level of significances. Hence, the manufacturer's claim is rejected at 5% level of significance.

- (ii) Significance at 1% level of significance. The critical value of Z at 1% level of significance for single-tailed (left-tailed) test is -2.33 . Since the computed value $Z = -2.6$ is less than -2.33 (is $|z| > 2.33$),

$\therefore H_0$ is rejected at 1% level of significance also.

Testing of Hypothesis (Analysis of variance – ANOVA)

35. Null Hypothesis

- (a) The machines are homogenous

$$\text{i.e., } \mu_A = \mu_B = \mu_C = \mu_D$$

(b) The workers are homogeneous

$$\text{i.e., } \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

Alternative Hypothesis

(a) At least two of the machines differ significantly

(b) At least two of the workers differ significantly

In the usual notation, we have:

$$K = 5, H = 4, N = KH = 5 \times 4 = 20$$

$$G = \sum \sum X_{ij} = 20;$$

Calculation for Various S.S

Workers	Machine Type				Total
	A	B	C	D	
I	4	-2	7	-4	$R_1 = 5$
II	6	0	12	3	$R_2 = 21$
III	-6	-4	4	-8	$R_3 = -14$
IV	3	-2	6	-7	$R_4 = 0$
V	-2	2	9	-1	$R_5 = 8$
Total	$C_1 = 5$	$C_2 = -6$	$C_3 = 38$	$C_4 = -17$	$G = 20$

$$\text{Corrector Factor (CF)} = \frac{G^2}{n} = \frac{20^2}{20} = 20$$

$$\text{Raw S.S (RSS)} = \sum \sum X_{ij}^2$$

$$= [(16+4+49+16) + (36+0+144+9) + (36+16+16+64) + (9+4+36+49) + (4+4+81+1)]$$

$$= 594$$

$$\text{Total S.S} = \text{RSS} - \text{CF} = 594 - 20 = 574$$

$$\text{S.S Rows (Workers)} = \frac{R_1^2 + R_2^2 + R_3^2 + R_4^2 + R_5^2}{4} - \text{CF}$$

$$= \frac{5^2 + 21^2 + (-14)^2 + 0 + 8^2}{4} - 20$$

$$= \frac{25 + 441 + 196 + 64 - 80}{4} = \frac{646}{4} = 161.5$$

$$\begin{aligned} \text{S.S Columns (Machine Type)} &= \frac{C_1^2 + C_2^2 + C_3^2 + C_4^2}{5} - CF \\ &= \frac{5^2 + (-6)^2 + 38^2 + (-17)^2}{5} - 20 \\ &= \frac{25 + 36 + 1444 + 289 - 100}{5} \\ &= \frac{1694}{5} = 338.8 \end{aligned}$$

$$: \text{SSE} = \text{Error S.S} = \text{TSS} - \text{SSR} - \text{SSC}$$

$$= 574 - 161.5 - 338.8$$

$$= 73.7$$

Since the various sum of the squares are not affected by change of origin, the ANOVA table for the original data and the given data obtained on changing the origin to 20 will be same and is given in following table.

Degrees of Freedom for various S.S

$$\text{d.f for TSS} = n - 1 = 20 - 1 = 19$$

$$\text{d.f for Rows (Workers)} = 5 - 1 = 4$$

$$\text{d.f for Column (Machines)} = 4 - 1 = 3$$

$$\text{d.f for SSE} = 19 - (4 + 3) = 12$$

$$\text{OR d.f for SSE} = (\text{d.f for Rows}) \times (\text{d.f for columns})$$

$$= (3 \times 4) = 12$$

ANOVA TABLE

Sources of variation	d.f	S.S	$MSS = \frac{S.S}{d.f}$	Variance Ratio (F)
Rows (Workmen)	4	161.5	40.38	$\frac{40.38}{6.14} = 6.58 \sim F(4, 12)$

Columns (Machine)	3	33.8	112.93	$\frac{112.93}{6.14} = 18.39 \sim F(3,12)$
Errors	12	73.7	6.14	
Total	19	574		

Testing of Hypothesis (Chi-Square Distribution)

36. Let H_0 : Defective is good does not depend upon the shift run by the factory the first
Expected value is

$$= E = \frac{40 \times 60}{150} = 16$$

0	E	0-E	(0-E) ²	(0-E) ² /E
15	16	-1	1	0.063
20	20	0	0	0
25	24	1	1	0.042
5	8	-3	9	1.125
10	10	0	0	0
15	12	3	9	0.750
20	16	4	16	1.0
20	20	0	0	0
20	24	-4	16	0.667
				3.647

$$D: F = V = (r - 1)(c - 1) = (3 - 1)(3 - 1) = 4$$

$$\therefore \Psi^2(4, 0.05) = 9.488$$

Here, the calculated value of Ψ^2 is less than of table value.

Hence, the hypothesis is accepted.

i.e., the number of defective does not depend on shift run by the factory.