

Gurukripa's Guideline Answers to Nov 2010 Final Exam Qns Cost Management (Old Syllabus)

Question No.1 is compulsory (4 X 5 = 20 Marks).

Answer **any five** questions from the **remaining six** questions (16 X 5 = 80 Marks).

Question 1(a): Standard Costing

5 Marks

The Standard Cost for producing 180 kgs of a product whose Raw Material inputs are A and B is given below –

Material A 60 kgs at Rs.10 per kg Rs.600

Material B 140 kgs at Rs.2 per kg Rs.280

Rs.880

The Actual Prices of A and B were Rs.12 and Rs.8 per kg respectively. Consumption of B was 108 kg. The Actual Output at 80% yield was 144 kg. Calculate the following Direct Material Variances – (i) Mix Variance, (ii) Yield Variance, (iii) Price Variance, and (iv) Usage Variance.

Solution:

1. Computation of Actual Output:

(a) Actual Output at 80% yield = 144 Kg (given)

(b) So, Actual Input = $\frac{144}{80\%} = 180$ Kg. Out of the above, B = 108 Kg (given). So, A = 180 – 108 = 72 Kg.

2. Computation of Standard Quantity:

(a) Given: 60 + 140 = 200 Kg of Raw Material can produce 180 Kg of Finished Goods.

(b) Hence, for 144 Kg of Output, Standard Quantity of Raw Material required = 160 Kg.

(c) Given A and B are in the Std Ratio 6:14. Therefore, A = 48 and B = 112.

3. Computation of Revised Actual Quantity (RAQ)

(a) Total AQ Consumed = 180 kg. This is apportioned between A and B in the ratio 6:14.

(b) Hence, RAQ for A and B are 54 kg and 126 kg respectively.

4. Variance Computation Chart:

Particulars	SQ × SP	AQ × AP	AQ × SP	RAQ × SP
	(1)	(2)	(3)	(4)
Material A	48 kg × Rs.10 = 480	72 kg × Rs.12 = 864	72 kg × Rs.10 = 720	54 kg × Rs.10 = 540
Material B	112 kg × Rs.2 = 224	108 kg × Rs.8 = 864	108 kg × Rs.2 = 216	126 kg × Rs.2 = 252
Total	Rs.704	Rs.1728	Rs.936	Rs.792

Variances:

Material Cost Variance = (1) – (2) = 1,024 A

Material Price Variance = (3) – (2) = 792 A

Material Usage Variance = (1) – (3) = 232 A

Material Mix Variance
= (4) – (3) = 144 A

Material Yield Variance
= (1) – (4) = 88 A

Question 1(b): Budgetary Control

5 Marks

Sportswear Ltd manufactures Sportswear Shirts and Shorts. The Production Budget for these two products has to be prepared for the next three months, November 2010, December 2010 and January 2011.

The following information is given:

- Sales Volume every month will be 2% more than the previous month's volume for each product.
- The Company carries Stock of finished garments sufficient to meet 40% of the next month's sale.
- Closing Stock for October 2010 was 6,000 Shirts and 8,000 Shorts.

You are required to prepare the Production Budget for each product for November, December 2010 and January 2011.

Solution:

Production Budget

Particulars	Shirts			Shorts		
	Nov	Dec	Jan	Nov	Dec	Jan
Budg. Sales	6,000 ÷ 40% = 15,000	15,000 + 2% = 15,300	15,300 + 2% = 15,606	8,000 ÷ 40% = 20,000	20,000 + 2% = 20,400	20,400 + 2% = 20,808
Add: Closing Stock	15,300 × 40% = 6,120	15,606 × 40% = 6,243	(15,606+2%) × 40% = 6,368	20,400 × 40% = 8,160	20,808 × 40% = 8,324	(20,808+2%) × 40% = 8,490
	21,120	21,543	21,974	28,160	28,724	29,298
Less: Op. Stock	6,000	6,120	6,243	8,000	8,160	8,324
Budg. Prod.	15,120	15,423	15,731	20,160	20,564	20,974

Question 1(c): Learning Curve Effect

5 Marks

A Factory has a special offer to produce 4 units of a labour intensive product by using its existing facilities after the regular shift timings. The product can be produced by using only overtime hours which entails normal rate plus 25%, so that usual production is not affected. Two workers are interested in taking up this additional job every evening after their usual shift is over. One is an experienced man who has been working on a similar product. His normal wages are Rs. 48 per hour. The other worker is a new person who earns Rs. 42 an hour as normal wages. He can be safely considered to have a Learning Curve ratio of 90% for this work. The Company wants to minimize labour cost for the order and only one person is to be chosen for the job. The experienced man will take 20 hours for the first unit while the new worker will take 30 hours for the first unit. Evaluate who should be chosen for the job.

Solution:

- If the First Worker is chosen (i.e. no Learning Effect)
Labour Cost = (4 units × 20 hours per unit) × Rs.48 per hour × 125%(OT) = **Rs.4,800**

- If the Second Worker is chosen (i.e. with 90% Learning effect)

Addnl. Qtty	Cumulative Qtty.	Avg. Time per unit	Cumulative Hours
1	1	Given 30 hours	30 hours
1	2	90% of 30 = 27 hours	2 units × 27 = 54 hours
2	4	90% of 27 = 24.3 hours	4 units × 24.3 = 97.2 hours

Labour Cost = 97.2 hours × Rs.42 per hour × 125%(OT) = **Rs.5,103.**

- Conclusion:** First Worker (i.e. without Learning Effect) is preferable due to lower labour cost.

Question 1(d): Linear Programming

5 Marks

You are given the following Linear Program. Introduce appropriate variables and re-state the problem to set up the Simplex Tableau. (Do not attempt further solution.)

Maximize: $8x_1 + 4x_2 - 3x_3 + 10x_4$
 Subject to:
 $2x_1 - x_2 + x_3 + 2x_4 \geq 40$
 $3x_1 - x_3 + x_4 \leq 90$
 $2x_1 + x_2 + x_4 = 60$
 $x_1, x_2, x_3, x_4 > 0$

Solution:

Given Constraint	Nature	Variable to be introduced	Revised Constraint
$2x_1 - x_2 + x_3 - 2x_4 \geq 40$	$\geq$ Inequality	Surplus (S) & Artificial (A_1)	$2x_1 - x_2 + x_3 + 2x_4 - S + A_1 = 40$
$3x_1 - x_3 + x_4 \leq 90$	$\leq$ Inequality	Slack Variable x_5	$3x_1 - x_3 + x_4 + x_5 = 90$
$2x_1 + x_2 + x_4 = 60$	Equality	Artificial Variable A_2 (See Note)	$2x_1 + x_2 + x_4 + A_2 = 60$

Revised Objective: Maximise $8x_1 + 4x_2 - 3x_3 + 10x_4 + 0x_5 - 0S - MA_1 - MA_2$, Where M = Infinity Cost.

Non Negativity assumption will be: $x_1, x_2, x_3, x_4, x_5, S, A_1, A_2 \geq 0$

Initial Program Variables will be A_1, x_5 and A_2 .

Note: Instead of an Artificial Variable, the given Equality Constraint can be divided into two inequalities ($\geq$ and $\leq$) and we can introduce a Slack, Surplus and Artificial Variable in the respective constraints.

Question 2(a): Transfer Pricing**9 Marks**

M Ltd makes two products, X and Y, in their respective divisions. Each unit of Y needs one unit of X. Division X and Y are Profit Centres and can function according to their divisional interests. In the external domestic market, X can sell either 6,000 units at Rs.1,000 per unit or 5,000 units at Rs.1,120 per unit. X has a production capacity of 7000 units, with each unit requiring 2 hours. Y also has a production and demand of 7,000 units.

Y can buy product X from outside as follows:

Order Quantity (units)	Price for the entire Order (Rs./ Unit)
6,001–7,000	900
4,001–6,000	920
2,001–4,000	1,000
0–2,000	1,120

Y resorts to bulk purchase to avail maximum possible discount.

- There is an export order (that may either be fully accepted or fully rejected) for X to supply 800 units at Rs.900 per unit.
- There is an offer to hire out X's capacity of 1600 hours at Rs 130 per hour. The hiring offer may either be fully accepted or fully rejected.
- Y will not buy from X at any price more than it will incur in the outside market. Y does not place restrictions on quantities to be supplied by X, provided its pricing condition is not violated.

Given that any one or more of the offers may be accepted, what will be X's best strategy? What will be the corresponding Transfer Price? [A detailed Cost Statement is not essential. Only figures relevant for decision-making are required to be considered under each analysis.]

Solution:**1. Assumptions**

- Total Capacity of Division X = 7,000 units × 2 hours = 14,000 hours.
- It is assumed that X has to meet compulsorily any one of the existing external domestic market demand, i.e. either 5,000 units at Rs.1,120 per unit or 6,000 units at Rs.1,000 per unit. This will require 5,000 × 2 = 10,000 hours or 6,000 × 2 = 12,000 hours, leaving balance capacity of 4,000 hours or 2,000 hours respectively, which can be used for –
 - Accepting Export Offer for 800 units at Rs.900 per unit, **and/or**
 - Hiring out 1,600 hours at Rs.130 per hour.
- It is assumed that Variable Cost per unit of X's product is Rs.750.
- It is assumed that Y Division will be willing to pay X the same price as per its schedule for outside purchases.

2. Revenue Options available for Division X

Options	Contribution	Hrs Used
A	Contrib. from sale of 5,000 units at Rs.1,120 = 5,000 uts × (Rs.1,120 – Rs.750) = Rs.18,50,000.	5,000 uts × 2 = 10,000 hrs
B	Contrib. from sale of 6,000 units at Rs.1,000 = 6,000 uts × (Rs.1,000 – Rs.750) = Rs.15,00,000.	6,000 uts × 2 = 12,000 hrs
C	Contribution from Hiring = 1,600 hours – Rs.130 per hour = Rs.2,08,000.	Given Time = 1,600 hrs
D	Contribution from Export Offer = 800 units × (Rs.900 – Rs.750) = Rs.1,20,000.	800 uts × 2 = 1,600 hrs

3. Contribution of Division X from External Sources and Internal Transfers

Option	From External Sources		From Internal Transfers		Total
	Time used	Contribution	Hrs used	Contribution earned	
A only	10,000 hours	Rs.18,50,000	4,000 hours	2,000 units × (1120–750) = 7,40,000	25,90,000
A & C	11,600 hours	Rs.20,58,000	2,400 hours	1,200 units × (1120–750) = 4,44,000	25,02,000
A & D	11,600 hours	Rs.19,70,000	2,400 hours	1,200 units × (1120–750) = 4,44,000	24,14,000
A, C, D	13,200 hours	Rs.21,78,000	800 hours	400 units × (1120–750) = 1,48,000	23,26,000
B only	12,000 hours	Rs.15,00,000	2,000 hours	1,000 units × (1120–750) = 3,70,000	18,70,000
B & C	13,600 hours	Rs.17,08,000	400 hours	200 units × (1120–750) = 74,000	17,82,000
B & D	13,600 hours	Rs.16,20,000	400 hours	200 units × (1120–750) = 74,000	16,94,000

Note: Hours used for Internal Transfers = Total Capacity (14,000 hours) less Hours allotted for External Sources.

4. Conclusion: From the above chart, it is observed that the best strategy for Division X is **A only**, i.e. sell 5,000 units in the external domestic market at Rs.1,120 per unit, and transfer 2,000 units to Division Y. Transfer Price will be similar to the Price Schedule available with Division Y for its external procurement, which constitutes the Maximum Transfer Price that Division Y will pay Division X for the internal transfer.

Note: Alternative Assumptions and Treatments with respect to Division X Strategy exist.

Question 2(b): Pricing Decisions

9 Marks

State the Pricing Strategy that you would advise in the following situations which are independent of each other –

	Situation	Pricing Strategy	Reason
(i)	A New product is to be launched. It has had high promotional expenditure and its demand in the market is not known.	Going Rate Pricing – Competitive Pricing	Demand is not known, but Firm should not charge a lower price than what is charged by the Competitors.
(ii)	A New product is to be launched. It is to be mass manufactured.	Penetration Pricing	Mass manufacture, lower Cost of Production per unit, and higher sales volumes, creates overall beneficial impact for the Firm.
(iii)	A Product which has an External Market demand is to be transferred to another division of the same company. For the external market, Variable Selling Costs of Rs.10 per unit and Fixed Selling Costs amounting to Rs.10 Lakhs p.a. are incurred. These costs are not applicable to divisional transfer. The divisional transfer can take up only 20% of the output produced.	Options: (a) External Selling Price less Rebate for SOH not incurred for internal transfers.	To motivate the Recipient Department into internal purchases.
		(b) Conversion Cost Pricing, i.e. Conversion Cost + Reasonable Margin on Conversion Cost + Material Cost	To motivate the Recipient Department into internal purchases.
		(c) Relevant Cost Pricing, i.e. Variable Cost upto the point of internal transfer + Specific Fixed Costs + Opportunity Cost, if applicable	To provide minimum benchmark Price for the Transferring Department.
		(d) Rate of Return Pricing	To evaluate the performance of the Divisions when they are treated as Investment Centres, and to give incentive to both divisions for internal transfer / procurement.
(iv)	A special one-time order for the use of idle capacity is offered. This order will not impact the existing sales of the Company. The product has competition in the market.	Incremental Cost (Both Variable and Fixed Cost) with Reasonable Mark-up, if possible	In case of Idle Capacity and no impact on existing sales, one-time orders can be accepted at Incremental Cost, with or without reasonable mark-up.
(v)	There is stock of a discontinued product. It has severe competition and the product is perishable.	Any Price, even below Variable Cost	As the goods are in perishable nature, it can be sold at any price to minimize the loss.

Question 3(a): Activity Based Costing

9 Marks

ABC Ltd manufactures four products A, B, C & D in the same factory. The following information is given for a certain period –

Product	A	B	C	D
Good Output (number of units)	720	600	480	504
Average Yield (%)	80	80	96	90
Machine Hours per unit of Input	4	3	2	1

The Plant works such that after machining, the defectives in each run are automatically segregated and dumped separately in a container. The good units pass through the process and are further checked for quality by the inspectors of quality control who charge by the number of batches inspected.

The total Production and Selling Overheads of the Company are the following for the period –

Machine Operation and Maintenance	Rs.66,375
Set-up Costs	Rs.19,200
Stores Receiving	Rs.21,400
Inspection	Rs.24,000
Finished Goods – packing / despatch	Rs.14,400

The following additional information is given –

1. A Material Requisition is made for every 25 units of output.
2. Machines need to be set-up and tuned after each Production Run.
3. Production is in batches of 24 good units for all the products.
4. Units of A and B are packed in boxes that have 24 units capacity each and C and D are packed in smaller boxes of 12 units capacity. The smaller box costs half the price of the bigger box. Each box contains only one type of product. There is no product mix up in packing.

Choose appropriate Activity Cost Drivers for each Overhead Cost and calculate the Overhead Cost per unit of good output for each of the products under the ABC System.

Solution:

1. Basic Computations

Particulars	A	B	C	D	Total
1. Good Output (number of units) (given)	720	600	480	504	
2. Average Yield (given)	80%	80%	96%	90%	
3. Input (1 ÷ 2)	900	750	500	560	
4. Machine hours p.u. of input (given)	4	3	2	1	
5. Total Machine Hours required (3 × 4)	3,600	2,250	1,000	560	7,410
6. No. of Material Requisitions (3) ÷ 25	36	30	20	22.40	108.40
7. No. of Prodn Runs (i.e. Set-ups) (1) ÷ 24	30	25	20	21	96
8. No. of Boxes	(720 ÷ 24) = 30	(600 ÷ 24) = 25	(480 ÷ 12) = 40	(504 ÷ 12) = 42	
9. Box Cost / Quantity Ratio	1	1	0.5	0.5	
10. Equivalent No. of Big Boxes (8 × 9)	30	25	20	21	96

2. Computation of ABC Recovery Rate

Activity	Activity Pool	Cost Driver	Quantity of Cost Driver	ABC Rate
Machine Operation & Maintenance	Rs.66,375	Machine hours	7,410 Machine Hours	Rs.8.957 per Machine Hour
Setup	Rs.19,200	No. of Production Runs	96 Batches	Rs.200 per Batch
Stores Receiving	Rs.21,400	Material Requisition	108.40 Mat. Requisitions	Rs.197.42 per Material Requisition
Inspection	Rs.24,000	No. of Production Runs	96 Batches	Rs.250 per Batch
Finished Goods Packing	Rs.14,400	No. of Equivalent Boxes	96 Equivalent Boxes	Rs.150 per Equivalent Box

Note: In respect of Finished Goods Packing, Cost per Big Box for A and B (24 units) = Rs.150 per box, and Cost per Small Box for C and D (12 units) = Rs.150 ÷ 2 = Rs.75 per box.

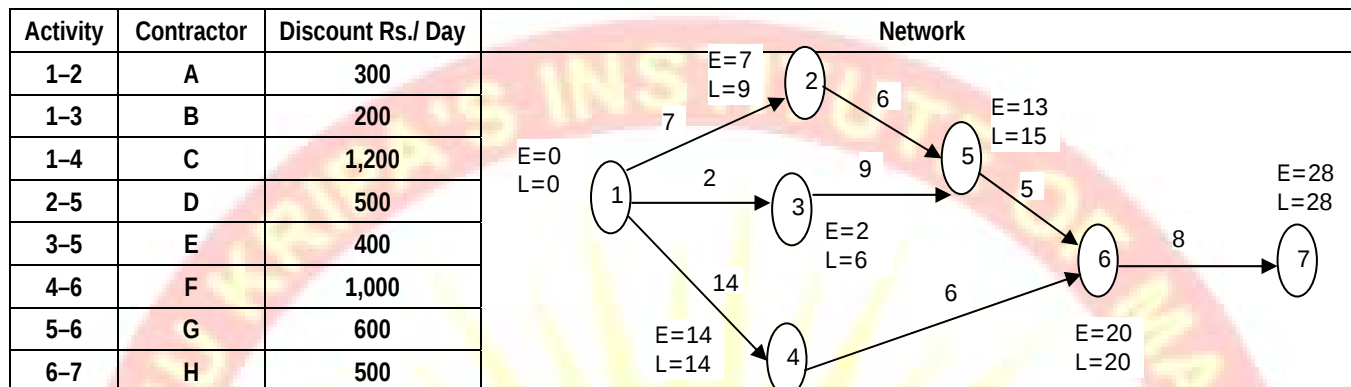
3. Cost Statement under Activity Based Costing

Product	A	B	C	D	Total
Machine Operation	3,600 × 8.957 = 32,246	2,250 × 8.957 = 20,154	1,000 × 8.957 = 8,957	560 × 8.957 = 5,018	66,375
Setup	30 × 200 = 6,000	25 × 200 = 5,000	20 × 200 = 4,000	21 × 200 = 4,200	19,200
Stores Receiving	36 × 197.42 = 7,107	30 × 197.42 = 5,923	20 × 197.42 = 3,948	22.40 × 197.42 = 4,422	21,400
Inspection	30 × 250 = 7,500	25 × 250 = 6,250	20 × 250 = 5,000	21 × 250 = 5,250	24,000
Fin.Goods Packing	30 × 150 = 4,500	25 × 150 = 3,750	20 × 150 = 3,000	21 × 150 = 3,150	14,400
Total Overhead Cost	Rs.57,353	Rs.41,077	Rs.24,905	Rs.22,040	Rs.1,45,375
Good Output	720 units	600 units	480 units	504 units	
Overhead Rate p.u.	Rs.79.66	Rs.68.46	Rs.51.89	Rs.43.73	

Question 3(b): Network Analysis

7 Marks

At the end of Activity 6–7, a product is to be launched and the date has been announced for the inaugural function, based on the Normal Duration of activities as given in the Network below. Activities have been sub-contracted by the Project Manager to Contractors A,B,C,D,E,F,G & H as indicated in the Table below. Each Sub-Contractor offer a discount on his Contract Price for each day given to him in addition to the normal days indicated in the Network. What will be the maximum discount that the Project Manager may earn for the Company without delaying the launch of the product?



Solution: Network Diagram and Duration is given in the question. E and L values are computed as part of answer.

1. Network Table

Activity	Duration	EST	LST	EFT	LFT	Total Float	Free Float	Total Discount
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
1-2	7	0	2	7	9	2	0	
1-3	2	0	4	2	6	4	0	
1-4	14	0	0	14	14	0	0	
2-5	6	7	9	13	15	2	0	
3-5	9	2	6	11	15	4	2	2 × 400 = Rs.800
4-6	6	14	14	20	20	0	0	
5-6	5	13	15	18	20	2	2	2×600 = Rs.1,200
6-7	8	20	20	28	28	0	0	
Maximum Discount								Rs.2,000

Note: Free Float is the period by which an activity can be delayed without affecting the duration of the subsequent activities. Hence, the activities having Free Float can be granted additional days to the extent of such Free Float.

Alternative Approach using Paths Analysis:

Paths	Duration (Days)
Path X: 1-2-5-6-7	7+6+5+8 = 26
Path Y: 1-3-5-6-7	2+9+5+8 = 24
Path Z: 1-4-6-7	14+6+8 = 28 (Critical Path)

- From the above listing of Paths, it is observed that the Project Duration is 28 days with Critical Path as **Path Z**, and Paths X and Y have a time advantage of 2 days and 4 days respectively.
- In Path X, either (1 – 2) or (2 – 5) or (5 – 6) can be delayed for 2 days. **[Note: 6 – 7 cannot be delayed, since it lies on the Critical Path also.]** Of the above activities, (5 – 6) has the maximum discount of Rs.600 per day. Hence, it is preferable to allot 2 more days to Contractor G for Activity (5 – 6). Discount = Rs.600 × 2 days = Rs.1,200.
- Since (5 – 6) is a common activity on Path Y also, the revised duration of Path X and Path Y will now be 28 days and 26 days respectively. Now, delay is permissible only on Path Y, for a period of further two days.
- In Path Y, either (1 – 3) or (3 – 5) can be delayed for 2 days. **[Note: (5 – 6) and (6 – 7) cannot be delayed further.]** Of the two, (3 – 5) has the maximum discount of Rs.400 per day. Hence, it is preferable to allot 2 more days to Contractor E for Activity (3 – 5). Discount = Rs.400 × 2 days = Rs.800.
- Total Discount that can be availed = Step 2 + Step 4 = **Rs.2,000**.

Question 4(a): Costing of Service Sector**7 Marks**

The Manager of a Hotel providing lodging facilities wants to expand his services to include Manual Booking (Reservation or Cancellation) of Railway Tickets for his Clients. He does not want to have Electronic Booking due to operational difficulty. He has the following information:

Rs. per month

Proportion of Rent allocated for Office Space	4,000
General Telephone Expenses allocated to this service	2,400
Proportion of Security Charges / Maintenance Expenses allocated	1,600
Salary to Person exclusively doing the booking of Tickets	20,000
Mobile Phone Charges exclusive to person booking Ticket	3,000
Share of General Miscellaneous Fixed Expenses allocated	1,000
Conveyance incurred to Book Tickets (to and fro charges to the nearest booking station) [fixed per month]	4,000

The Manager estimates that there will be 2,500 bookings per month for 3 months of peak season, 1,000 bookings per month for 2 months of moderate business and 700 bookings per month during the remaining period. He cannot charge more than the prevailing rate of Rs.30 per booking charged by other agents.

1. Calculate the Total Cost per booking.
2. What is the Estimated Profit the Manager hopes to achieve for the full year?
3. What should be the average minimum volume to justify the setting up of the new service?
(Detailed break-up of monthly revenues or costs is not essential.)

Solution:**1. Simplified Approach (based on Total Fixed Costs)**

1.	Total Costs p.a. = $(4,000 + 2,400 + 1,600 + 20,000 + 3,000 + 1,000 + 4,000) \times 12$ months = Rs.36,000 $\times$ 12 months	= Rs.4,32,000
2.	Total Bookings p.a. = $(2,500 \times 3) + (1,000 \times 2) + (700 \times 7) = 7,500 + 2,000 + 4,900$	= 14,400 bookings
3.	Cost per Booking = $\text{Rs.4,32,000} \div 14,400$ bookings	= Rs.30
4.	Since Maximum Revenue is Rs.30 per booking, which is equal to the Total Fixed Cost per booking as above, the Estimated Profit per annum	= Nil
5.	Minimum Volume p.a. to justify the new service = $\text{Rs.4,32,000} \div \text{Rs.30}$ per booking	= 14,400 bookings

2. Detailed Approach (recognizing difference between Specific and General Fixed Costs)

1.	Specific Service Related Fixed Costs = Salary + Mobile Phone + Conveyance = $(20,000 + 3,000 + 4,000) \times 12$ months	= Rs.3,24,000
2.	General / Apportioned Fixed Costs = Total Rs.4,32,000 – Specific Rs.3,24,000	= Rs.1,08,000
3.	Total Bookings p.a. = $(2,500 \times 3) + (1,000 \times 2) + (700 \times 7) = 7,500 + 2,000 + 4,900$	= 14,400 bookings
4.	Total Cost per Booking = $\text{Rs.4,32,000} \div 14,400$ bookings Specific Service Related Fixed Costs per booking = $\text{Rs.3,24,000} \div 14,400$ bookings General / Apportioned Fixed Costs per booking = $\text{Rs.1,08,000} \div 14,400$ bookings	= Rs.30.00 = Rs.22.50 = Rs. 7.50
5.	Assuming Revenue at Rs.30 per booking, Contribution from this service = $14,400 \text{ bookings} \times (\text{Rs.30} - \text{Rs.22.50})$ Rs.1,08,000 Less: Apportioned Fixed Costs Rs.1,08,000	So, Profit = Nil
5.	Minimum Volume p.a. to justify the new service (to recover Specific Service Related Fixed Costs) = $\text{Rs.3,24,000} \div \text{Rs.30}$ per booking	= 10,800 bookings

Question 4(b): Performance Measurement**9 Marks**

A Manufacturing Company makes 4 products that are sold through 8 Regional Offices countrywide. The products pass through 3 production processes in a Factory. A separate Market Research Division monitors outside competition. This division is outside the Sales Management hierarchy. As a Management Accountant, suggest some routine reports for performance measurement to be made to – (a) The Sales Management, (b) The Works Manager.

Solution:**Refer Page 15.4, Q.No.9, Pt.2 & 4**

Question 5(a): Transportation

10 Marks

A Company has 3 Factories F₁, F₂ and F₃, which supply the same product to 5 agencies, A₁, A₂, A₃, A₄ and A₅. Unit Production Costs, Shipping Costs and Selling Prices differ among the different sources and destinations and are given below –

		F ₁	F ₂	F ₃	
Production Cost (Rs./unit)		28	35	29	
Production Capacity (No. of units)		110	240	125	
Agencies	A ₁	A ₂	A ₃	A ₄	A ₅
Selling Price Rs./unit	40	48	42	45	41
Demand (No. of Units)	80	100	75	45	125
Shipping Costs Rs./unit	A ₁	A ₂	A ₃	A ₄	A ₅
F ₁	3	9	8	12	8
F ₂	6	10	6	2	5
F ₃	3	10	3	6	8

- Set up the Initial Transportation Matrix for minimization.
- After doing (1) above, you are given the following additional information:
 - 40 units must be transported from F₂ to A₂ as per an earlier agreement made by F₂ with A₂'s customer. This quantity is included in the figures given for total production and demand at these locations.
 - Not more than 30 units may be sent from F₁ to A₁, since the Transporter's vehicle lacks space in this route.
 Incorporating conditions (a) and (b) above, obtain the initial solution by Vogel's Approximation Method. (Do not attempt to continue for the full and final solution.)
- After doing the Initial Solution as in (3) above, you are informed that the route from F₂ to A₁ is blocked by sudden flooding of the roads. Without actual re-calculation, briefly explain how your solution is likely to be affected.

Solution:

Situation 1: Initial Transportation Matrix based on given data

The Profit Matrix is constructed as **Profit = Selling Price – Production Cost – Shipping Cost.**

	A-1	A-2	A-3	A-4	A-5	Production
F – 1	40 – 28 – 3 = 9	48 – 28 – 9 = 11	42 – 28 – 8 = 6	45 – 28 – 12 = 5	41 – 28 – 8 = 5	110
F – 2	40 – 35 – 3 = -1	48 – 35 – 10 = 3	42 – 35 – 6 = 1	45 – 35 – 2 = 8	41 – 35 – 5 = 1	240
F – 3	40 – 29 – 3 = 8	48 – 29 – 10 = 9	42 – 29 – 3 = 10	45 – 29 – 6 = 10	41 – 29 – 8 = 4	125
Demand	80	100	75	45	125	

- In the above matrix, the Objective is maximization of profit. This is converted into an Opportunity Cost Minimization Objective by subtracting each element from the highest element, i.e. 11.
- Also, the above matrix is Unbalanced Data, since Total Production Capacity is 475 units and Total Demand Requirement is 425 units. This is converted into a Balanced Data by introducing the Dummy Agency A-6 with zero entries.

The Revised Matrix (Balanced Minimization) is given below.

Factory / Agency	A-1	A-2	A-3	A-4	A-5	A-6	Production
F – 1	2	0	5	6	6	0	110
F – 2	12	8	10	3	10	0	240
F – 3	3	2	1	1	7	0	125
Demand	80	100	75	45	125	50	475

The above matrix is now amenable for applying VAM.

Situation 2: Condition (a), i.e. 40 units compulsory transfer from F-2 to A-2 will be reduced from both Demand and Production at the respective locations. Condition (b), i.e. maximum 30 units from F-1 to A-1 will be allocated based on VAM allocation if it arises in that Cell. Initial Basic Feasible Solution (IBFS) is determined as under –

	A-1	A-2	A-3	A-4	A-5	A-6	Production	Cost Differences in Stage				
								I	II	III	IV	V
F-1	2 30	0 60	5	6	6 20	0	110 / 50 / 20 / 0	0	0	2	2	4
F-2	12	8	10	3 45	10 105	0 50	200 / 150 / 105 / 0	3	3	5	2	2
F-3	3 50	2	1 75	1	7	0	125 / 50 / 0	1	1	1	1	4
Demand	80/50/0	60 / 0	75 / 0	45 / 0	125 / 0	50 / 0	435					
Cost Differences:												
Stage I	1	2	4	2	1	0	In the above IBFS, Number of Allocated Cells is 8. $m + n - 1$ (i.e. Rows + Columns - 1) $= 6 + 3 - 1 = 8$. Hence, there is no degeneracy. This can be tested for optimality.					
Stage II	1	2	—	2	1	0						
Stage III	1	2	—	—	1	—						
Stage IV	1	2	—	—	1	—						
Stage V	1	—	—	—	1	—						

Note: In Stage V, the Selected Least Cost Cell is F-1 to A-1. However, Maximum Allocation possible there is either 50 Production or 80 Demand or 30 as per Condition (b), whichever is **lower**. Hence, allocation is only **30 units**.

After allocation of 30 units as above, the next Least Cost Cell is selected, i.e. F-3 to A-1, where Demand = Production = 50 units. Hence, allocation is completed as indicated above.

Situation 3: Effect of Prohibited Route F-2 to A-1

If the route from F-2 to A-1 is flooded, then it shall be considered as a Prohibited Route and hence Infinity Costs "M" shall be identified in that route. However, as there is no allocation made in F-2 to A-1 Cell in the IBFS, and as it is already the highest cost cell in the entire matrix, the solution will not be affected in this case, even if it is a Prohibited Route.

Question 5(b): Marginal Costing

6 Marks

The Selling Price per unit of a product is Rs.14. For the forthcoming period, the demand will be only 5,000 units. The Fixed Expenses at 50% activity (5,000 units) will be Rs.30,000. The Company is thinking of shutting down operations, in which case an additional amount of Rs.2,000 will have to be incurred for shutting down and only Rs.20,000 of the above Fixed Costs can be avoided. What should be the Variable Cost per unit to recommend a shut-down?

Solution:

Let Variable Cost per unit be Rs.X

Particulars	Continue Operations	Shutdown
1. Revenue	5,000 units × Rs.14 = Rs.70,000	Nil
2. Variable Cost	5,000 X	Nil
3. Contribution (1-2)	70,000 - 5,000 X	Nil
4. Fixed Costs	30,000	30,000 - 20,000 + 2,000 = 12,000
5. Profit (3-4)	40,000 - 5,000 X	(12,000)

For indifference between Continue and Close Down Options, the profits of the two options should be equal.

So, $40,000 - 5,000X = -12,000$, $-5,000X = -52,000$ On solving, **X = 10.40** = Desired Variable Cost p.u.

Conclusion: If Variable Cost per unit is greater than Rs.10.40, Shut-Down Option is preferable.

Question 6(a): Costing of Service Sector

12 Marks

Aero Ltd has hired an Aircraft to specially operate between Cities A and B. All the seats of the Aircraft are economy class. The following information is available –

Seating Capacity of the Aircraft	320 Passengers
Average Number of Passengers per Flight	240 Passengers
Average one-way fare from A to B	Rs.5,000 per Passenger
Variable Fuel Costs per Flight from A to B	Rs.90,000
Food Cost (no charge to Passenger)	Rs.300 per passenger
Commission to Travel Agents (All tickets are through Agents)	10% of the Fare
Annual Lease Costs allocated to each Flight	Rs.2,00,000
Ground Services, Baggage Handling / Check-In Services Costs per Flight A to B	Rs.40,000
Flight Crew Salaries per Flight A to B	Rs.48,000

There is an offer from another Airlines Operator, Mid Air Ltd, for a stop-over at destination D, which is on the way from A to B. Due to this, the Flight will operate from A to D, then D to B. The following terms are to be considered for the stop-over:

- 50 Seats will be booked by Mid Air at Rs.2,500 per ticket, whether or not Mid Air is able to sell them to its customers. No Agent's Commission is payable on these tickets.
- 60 new passengers will be booked by Aero's Travel Agents for travel from A to D at a Fare of Rs.2,000 per Passenger.
- Since the stop-over wastes more time, 25 of Aero's original passengers from A to B will drop out and seek other airlines which fly directly from A to B.
- Due to the stop-over, Fuel Costs will increase from Rs.90,000 to Rs.1,35,000. Additional Airport Landing / Baggage Handling Charges of Rs.19,000 per stop-over will have to be incurred by Aero Ltd.
- Aero Ltd will have to serve snacks to all passengers in the D to B Sector at no charge to Passengers. Each snack will cost Aero Ltd Rs.200. This will be in addition to the original food at Rs.300 served in the A to D Sector.
- You may assume that fuel costs are not affected by the actual number of passengers in a Flight. You may ignore non-financial considerations, additional wear and tear to aircraft due to extra landing / take off.

1. Without considering Mid Air's offer,

- What is the profit earned by Aero Ltd per Flight from A to B?
- What is the break-even number of passengers for each Flight from A to B?

2. Considering the effects of Mid Air's offer, evaluate whether Aero should accept the offer. (A detailed profitability statement is not essential, a Relevant Cost-Revenue Analysis would suffice).

Solution:

1. Without considering Mid-Air's Offer

Profit Statement	Rs.	Computation of Break Even No. of Passengers
Revenue Rs.5,000 × 240 Passengers	12,00,000	(a) For Break Even purposes, Fixed Costs to be recovered per Flight = Rs.2,88,000 + Fuel Rs.90,000 = Rs.3,78,000
Less: Variable Costs:		(b) Net Contribution per Passenger = Revenue Rs.5,000 less Food Rs.300 less Commission Rs.500 = Rs.4,200.
Fuel 90,000		(c) Break Even Number of Passengers = Rs.3,78,000 ÷ Rs.4,200 = 90 Passengers per Flight.
Food (Rs.300 × 240) 72,000		Note: It is assumed that all costs and revenues per flight will behave evenly throughout the financial period.
Commission 10% 1,20,000	2,82,000	
Contribution per Flight A to B	9,18,000	
Less: Fixed Costs		
Lease Costs 2,00,000		
Ground Services 40,000		
Crew Salaries 48,000	2,88,000	
Profit per Flight A to B	6,30,000	

2. Evaluation of Mid-Air's Offer

- Since Seating Capacity per Flight is 320 and 50 seats are blocked by Mid-Air, balance seats available for booking by Aero = 320 – 50 = 270 seats.
- Also, Aero will have Original 240 less drop-out 25 = 215 Passengers in A to B Sector, and 60 Passengers in A to D Sector. Hence, Total Passengers Demand = 215 + 60 = 275, but available seats are only 270.
- These seats can be booked by Aero in two different **scenarios**, and the Profitability is analysed as below –

Particulars	Scenario 1	Scenario 2
Details of Aero's 270 seats booking	60 Passengers for A to D at Rs.2,000 each and 210 Passengers (270 – 60) for A to B at Rs.5,000 each.	55 (270 – 215) Passengers for A to D at Rs.2,000 each and 215 Passengers for A to B at Rs.5,000 each.
Revenue	(50×2,500)+(60×2,000)+(210×5,000) = 1,25,000 + 1,20,000 + 10,50,000 = 12,95,000	(50×2,500)+(55×2,000)+(215×5,000) = 1,25,000 + 1,10,000 + 10,75,000 = 13,10,000
Less: Variable Costs:		
Fuel	1,35,000	1,35,000
Food	(320 × 300) + (210 × 200) = 1,38,000	(320 × 300) + (215 × 200) = 1,39,000
Commission	(1,20,000+10,50,000)×10%=1,17,000	(1,10,000+10,75,000)×10%=1,18,500

Particulars	Scenario 1	Scenario 2
Contribution per Flight	9,05,000	8,17,500
Less: Fixed Costs		
Lease Costs	2,00,000	2,00,000
Ground Services	40,000 + 19,000 = 59,000	40,000 + 19,000 = 59,000
Crew Salaries	48,000	48,000
Profit per Flight	5,98,000	6,10,500

Note: It is assumed that all 50 seats blocked by Mid–Air, are for A to D Sector only, and all such seats are fully occupied (for the purpose of calculation of Food Costs).

Conclusion: Since the Profit per Flight is lower than existing operations, Mid–Air Offer is not worthwhile.

Question 6(b): Simulation

4 Marks

How can Simulation be applied in practical situations?

Solution: Refer Page 20.1, Q.No.2

Question 7(a) & (b): JIT, MRP & ERP – Theory

4 Marks each

7(a)	Discuss the impact of JIT systems on Overhead Costs.	Solution: Page 11.4, Q.No.10
7(b)	What are benefits of Enterprise Resource Planning?	Solution: Page 11.12, Q.No.27

Question 7(c): Target Costing and Life Cycle Costing

4 Marks

A Company's four products, M, N, O and P are in the market. Identify the phase of Life Cycle for each product with brief reason.

- M:** There is a lot of competition. Quantity sold has been increasing at 10%, 8% and 7% in the last 3 years.
- N:** Until last year, N had no competition. Suddenly the company finds 4 few products very similar to N in the market. However, N continues to have good sales.
- O:** There is intense competition. Achieving targeted sales is becoming increasingly difficult. Hence the company is introducing slightly modified features in the market which are priced lesser than P, but have the same utility as P.
- P:** Huge Inventory of P is available. P is being sold but there are many products in the market which are priced lesser than P, but have the same utility as P.

Solution:

Product	Stage	Reasons
M	Maturity	(a) Rise in Sales levels at decreasing rates, (b) Fierce Competition.
N	Growth	(a) Entry of new Competitors, (b) Increase in Sales.
O	Maturity	(a) Intense Competition, (b) Modifications of features in fresh production.
P	Decline	(a) Huge Inventory, (b) Availability of Cheaper Substitutes, etc.

Question 7(d): Assignment

4 Marks

Three different Salesman X, Y and Z are to be assigned three different regions A, B and C so that the Company's revenue is maximize. The following matrix gives the Sales Revenue. Use the Assignment technique to maximize revenue.

	X	Y	Z
A	10	60	30
B	20	30	15
C	60	40	10

Solution:

I Revenue Matrix

	X	Y	Z
A	10	60	30
B	20	30	15
C	60	40	10

II Opportunity Loss Matrix

	X	Y	Z
A	50	0	30
B	40	30	45
C	0	20	50

III Row Operations

	X	Y	Z
A	50	0	30
B	10	0	15
C	0	20	50

IV Column Operation

	X	Y	Z
A	50	0	15
B	10	0	0
C	0	20	35

No. of Lines = Order of Matrix = 3

V Optimal Assignment

	X	Y	Z
A	50	0	15
B	10	0	0
C	0	20	35

VI. Answer

Region	Salesman	Revenue
A	Y	60
B	Z	15
C	X	60
		135

Question 7(e): Theory of Constraints

4 Marks

TP Ltd produces a Product which passes through two processes – Cutting and Finishing.

The following information is provided –

Particulars	Cutting	Finishing
Hours available per annum	50,000 hours	60,000 hours
Hours needed per unit of product	5	12
Fixed Operating Costs per annum excluding Direct Material	Rs.10,00,000	Rs.10,00,000

The Selling Price of the product is Rs.1,000 per unit and the only Variable Cost per unit is Direct Material, which Cost Rs.400 per unit. There is demand for all units produced.

Evaluate each of the following proposals independent of each other:

1. An Outside Agency is willing to do the Finishing Operation of any number of units between 5,000 and 7,000 at Rs.400 p.u.
2. An Outside Agency is willing to do the Cutting Operation of 2,000 units at Rs.200 per unit.
3. Additional Equipment for cutting can be bought for Rs.10,00,000 to increase the Cutting facility by 50,000 hours, with annual Fixed Costs increased by Rs.2 Lakhs.

Solution:

Similar to Page 15.25 & 15.26 Exercise 3 & 4

1. Basic Computations

Throughput Contribution p.u. = Selling Price Rs.1,000 – Variable Cost Rs.400 = **Rs.600**

Particulars	Cutting	Finishing
Hours available p.a.	50,000	60,000
Hours required p.u. of product	5	12
Capacity in units	50,000 ÷ 5 = 10,000 units	60,000 ÷ 12 = 5,000 units
Whether Bottleneck Resource?	No	Yes

Observation:

- Even though Cutting Process has a capacity of 10,000 units, the Finishing Process has capacity to complete only 5,000 units. Hence, the overall Effective Output of the Company is only 5,000 units.
- Finishing Process will operate to full capacity (5,000 units), and there will be spare capacity of 10,000 – 5,000 = 5,000 units in the Cutting Process.

2. Evaluation of Options

1. There is spare capacity in Cutting Process for additional 5,000 units, in order to supply the required cut material to the Outside Agency. So, Finishing Process can be outsourced for 5,000 units, since Additional Contribution = (Throughput Contribution Rs.600 – Outsourcing Cost Rs.400) × 5,000 units = Rs.10,00,000.
2. Cutting Process already has spare capacity upto 5,000 units. Outsourcing the Cutting Process will not lead to any saving in Fixed Operating Costs, but will increase outsourcing cost and pile up WIP Inventory, without generating any saleable output. Hence, this proposal of outsourcing Cutting Process for 2,000 units at Rs.200 p.u. is not worthwhile.
3. Cutting Process already has spare capacity upto 5,000 units. Purchasing additional equipment for Rs.10,00,000 will lead increase in Fixed Operating Costs and pile up WIP inventory, without generating any saleable output. Hence, this proposal of purchasing Cutting Equipment is not worthwhile.

STUDENTS' NOTES



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