

2019

COMMERCE

Paper : CC-203

(Operations Research)

Full Marks : 40

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

Module — I

Answer *any two* questions.

1. (a) A news-boy purchases newspapers everyday in bulk. The surplus at the end of the day is dead loss. A newspaper costs him ₹ 3 and it can be sold for ₹ 4 each. The distribution of demand for papers for last 100 days is as follows :

Demand	50	60	70	80	90
No. of Days	10	20	30	25	15

- (i) Obtain the pay-off matrix and regret matrix for the news-boy.
- (ii) Obtain the decision by Laplace and Hurwicz principle of decision making under uncertainty (with the index of optimism = 0.4).
- (iii) Compute EPPI and EVPI for the above problem.
- (b) Mr. Rahul Srivastava received retirement benefits, namely, Provident Fund, Leave Salary and Gratuity etc. at the time of his retirement from XY International Ltd. He was contemplating as to how much funds he should invest in various alternatives available to him so as to maximise his return on investments. Being confused, he approached one investment analyst who provided him the following details of the investment avenues along with his subjective estimate of the risk involved on a fine 10 point scale. The relevant data on the return on investment, the number of years for which the funds will be blocked to earn his return on investment and the subjective risk involved are shown below :

Investment Alternatives	Return (%)	No. of Years	Risk
Government Bonds	6	15	1
Blue Chip Stocks	15	3	3
Speculative Stocks	20	6	7
Time Deposits in Bank	10	3	2
NSC	12	6	1
Real Estate	25	10	2

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According to the requirement of Mr. Srivastava, the investment analyst advised that average risk should not be more than 4 and funds should not be locked up for more than 15 years. He would also necessarily invest at least 30% in real estate.

How should Mr. Srivastava invest the funds so as to maximise his total return on investment? Formulate a linear programming model for the above problem (Do not solve it). (2+2+2)+4

2. (a) The management of a company is considering marketing a new product. The fixed cost required for the project is ₹ 3,00,000/-. The management has the following data :

Selling Price (₹)	Probability	Variable Cost (₹)	Probability	Sales Volume (Units)	Probability
400	0.35	100	0.25	2000	0.20
500	0.40	200	0.45	3000	0.55
600	0.25	300	0.30	4000	0.25

Simulate the average profit for the above project on the basis of 10 trials. You may use the following random numbers :

Selling Price : 61, 85, 16, 45, 88, 08, 56, 49, 33, 72

Variable Cost : 71, 81, 46, 41, 38, 78, 53, 41, 83, 52

Sales Volume : 63, 35, 17, 15, 80, 09, 36, 79, 53, 79

- (b) Solve the following linear programming problem by Simplex Method :

$$\text{Maximise } Z = 8x_1 - 4x_2$$

$$\text{Subject to, } 4x_1 + 5x_2 \leq 20$$

$$-x_1 + 3x_2 \geq -23$$

$$x_1, x_2 \geq 0$$

3. (a) Formulate the LPP of the following game with the pay-off matrix as follows and explain the duality concept of LPP:

	B ₁	B ₂	B ₃	B ₄
A ₁	2	3	1	3
A ₂	3	1	3	-1
A ₃	-1	3	-1	6

- (b) The following matrix is an initial basic feasible solution of a minimization problem for transportation cost. The unit transportation costs are given at the right hand top corners of each cell and the encircled values are the allocation (in units) in each cell. Δ_{ij} values are also given in boxes in unallocated cells.

From \ To	D ₁	D ₂	D ₃	Supply
F ₁	8	5	6	120
F ₂	15	10	12	80
F ₃	3	9	10	80
Demand	150	80	50	280

Find out optimal solution and the minimum transportation cost.

5+5

4. (a) Two food manufacturers A and B are competing for an increased market share. The pay-off matrix shows the increase in market share for A and decrease in market share for B. Determine optimal strategies for both the players and the value of the game.

A \ B	B			
	Give Coupons	Decrease Price	Maintain Present Strategy	Increase Advertising
Give Coupons	2	-2	4	1
Decrease Price	6	1	12	3
Maintain Present Strategy	-3	2	0	6
Increase Advertising	2	-3	7	1

- (b) The Indian Cricket Control Board (ICCB) has decided to carry out major repair and renovation works in four international cricket stadium situated at Kolkata, Bangalore, Delhi and Mumbai. The Board has sanctioned a grant of ₹ 2.28 crores towards the cost with the condition that the repair and renovation works should be carried out at the lowest cost. For this purpose, they invite E-Tender from the contractors worldwide. Tender includes the condition that only one stadium will be awarded to one contractor. Five contractors have sent in their bids for all the stadiums situated at Kolkata (K), Bangalore (B), Delhi (D) and Mumbai (M). The bids are shown below :

Cost of Repairs and Renovation (₹ in Lakhs)				
Contractors	Stadiums			
	Kolkata (K)	Bangalore (B)	Delhi (D)	Mumbai (M)
C1	36	56	76	60
C2	28	68	80	78
C3	36	72	84	76
C4	40	48	72	72
C5	40	60	84	64

You are informed that the Board has decided that C1 and C5 should get stadiums located at Kolkata and Bangalore respectively in order to minimise costs.

You are required to calculate the minimum cost allocation.

5+5

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Module — II

Answer *any two* questions.

5. (a) Explain briefly the differences in replacement policies of items which deteriorates gradually and items which fail completely.
- (b) The cost of a machine is ₹ 6,500 and its scrap value is only ₹ 500 whenever disposed. The maintenance costs are as follows :

Year :	1	2	3	4	5	6	7	8
Maintenance Cost (₹) :	100	250	400	600	900	1250	1800	2500

When the machine should be replaced to get maximum advantage.

- (c) In a car-wash service facility, cars arrive for service according to a Poisson distribution with mean 5 per hour. The time for washing and cleaning each car varies but is found to follow an exponential distribution with mean 10 minutes per car. The facility cannot handle more than one car at a time and has a total of 5 parking spaces.
- (i) Find the effective arrival rate.
- (ii) What is the probability that an arriving car will get service immediately upon arrival?
- (iii) Find the expected number of parking spaces occupied.
- (iv) What is the expected waiting time of a car to get the service? 2+4+
6. (a) We have Six jobs, each of which must go through machines A, B, C in the order ACB. Processing time (in hrs) are given in the following table :

Jobs :	1	2	3	4	5	6
Machine A:	12	10	9	14	7	9
Machine B:	7	6	6	5	4	4
Machine C:	6	5	6	4	2	4

Determine a sequence of these six jobs that minimises the total elapsed time.

- (b) A large computer installation contains 2000 components of identical nature, which are subject to failure as per probability distribution :

Month End :	1	2	3	4	5
% Failure to Date :	10	25	50	80	100

Find out average cost of replacement per month, if only individual replacements are done. 6+

7. (a) A small project is composed of nine activities whose time estimates are listed in the table as follows :

Activity	Estimated Duration (weeks)		
	Optimistic Time	Most likely Time	Pessimistic Time
1 – 2	4	7	16
1 – 3	1	5	15
2 – 4	6	12	30
2 – 5	2	5	8
4 – 6	5	11	17
5 – 6	3	6	15
3 – 7	3	9	27
6 – 8	1	4	7
7 – 8	4	19	28

- (i) Draw the PERT network diagram.
(ii) Find the expected duration and variance of each activity.
(iii) What is the probability that the project will be completed 7 weeks earlier than expected?
(iv) What duration will have 95% confidence for project completion?

[Given $\Phi(1.40) = 0.4192$; $\Phi(1.64) = 0.4495$; $\Phi(1.65) = 0.4505$; $\Phi(1.645) = 0.4500$]

- (b) For production inventory system of ball bearing parts of lathe machine the following information are provided —

- (i) Demand p.m. — 500 units
(ii) Units cost — ₹ 40
(iii) Set-up cost — ₹ 500
(iv) Production rate p.a. — 36,000 units
(v) Holding cost p.a. — ₹ 8
(vi) Shortage cost p.u and p.a. — ₹ 20

Determine —

- (A) optimal lot size
(B) number of shortages. (2+2+1+1)+(2+2)

8. (a) The surface transport ABC Tours has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservations. Customers arrive at a rate of 8 per hour and the clerk can serve on average 12 customers per hour. After starting usual assumption, answer the following :

- (i) What is the average number of customer waiting for the service of the clerk?
(ii) What is the average time a customer has to wait before being served?

Please Turn Over

(iii) The management is contemplating to install a computer system for handling information and reservations. This is expected to reduce the service time from 5 minutes to 3 minutes. The additional cost of having the new system works out to ₹ 50 per day. If the cost of goodwill of having to wait is estimated to be 12 paise, per minute spent waiting, before being served, should the company install the computer system?

Assume an 8 hours working day.

(b) A Shopkeeper has a uniform demand of an item @ 50 items per month. He buys from a supplier at a cost of ₹ 6 per item and the cost of ordering is ₹ 10 each time. If the stock holding costs are 20% per year of stock value, how frequently should he replenish his stock?

Suppose the supplier offers a 5% discount on orders between 200 and 999 items and 10% discount on orders exceeding or equal to 1000.

Can the shopkeeper reduce his cost by taking advantage of either of these discounts? (2+2+2)+4