CS-51

ADCA / MCA (II Year)

Term-End Examination

June, 2007

CS-51 : OPERATIONS RESEARCH

Time : 3 hours *Maximum Marks : 75*

Note : *Question number 1 is* ***compulsory****. Attempt any* ***three*** *more questions from questions numbered 2 to 5.*

1. (a) A financial institution is in the process of formulating a loan policy involving \$12 million. Being a full service facility, the bank is obligated to grant loans to different clientele. The following table provides the types of loans, the interest rate charged by the bank, and the probability of bad debt as estimated from past experience :

Type of Loan	Interest Rate	Probability of Bad Debt
Personal	0·140	0·10
Car	0·130	0·07
House	0·120	0·03
Farm	0·125	0·05
Commercial	0·100	0·02

Bad debts are assumed irrecoverable and hence produce no interest revenue. Competition with other financial institutions in the area requires that the bank allocates at least 40% of the total funds to farms and commercial loans. To assist housing industry in the region, home loans must be at least 50% of the personal, car and home loans. The bank also has a stated policy specifying that the overall ratio for bad debts on all loans may not exceed 0·04.

Formulate the above so as to maximize net return that is comprised of the difference between the revenue from interest and lost funds to bad debts. *10*

(b) Answer the following in the context of simple method for LPP : *5*

(i) State the uses of slack, surplus and artificial variables.

(ii) Indicate the reasons for applying Big M and two-phase methods.

(c) An average of 10 cars per hour arrive at a single-server drive-in teller. Assume that the average service time for each customer is 4 minutes, and both inter-arrival time and service time are exponentially distributed.

(i) What is the probability that the teller is idle ?

(ii) What is the average number of cars waiting in line for the teller ?

(iii) What is the average amount of time a customer spends in the bank ? *8*

(d) The ABC Retail Company has the following data available in the context of inventory for one of its items : annual demand = 10,000 units; rate of ordering cost = Rs. 20; rate of inventory carrying cost = Rs. 6·25. Find

(i) EOQ,

(ii) frequency of orders, and

(iii) minimum total variable cost. 7

2. (a) Define the following terms and give one example of each (any ***four***) : 8

(i) Monte Carlo simulation

(ii) Value of game

(iii) Goal programming

(iv) Degeneracy

(v) Buffer stock

(b) Based on the past data, it is established that the probability distribution on the frequency of accidents, at a road-intersection point, is as follows : 7

No. of accidents/day	Probability
0	0·50
1	0·30
2	0·15
3	0·05

(i) Simulate the number of accidents over 10 days.

(ii) Compute mean of this simulated data, and compare it with the mean of the probability distribution.

[Use the sequence of random digits :
5746600791 5903816131]

3. (a) Suppose four professors are each capable of teaching any of the four courses — LP, DP, ILP and NLP. However, the average weekly class preparation time for any course varies from professor to professor. Since the professors' department is highly research oriented, the chairperson would like to assign each professor one and only one course to minimize the total of course preparation times. Preparation time for each course by each professor is given below :

Professors	Courses			
	LP	DP	ILP	NLP
Dantzig	2	10	9	7
Bellman	15	4	14	8
Little	13	14	16	11
Wilson	4	15	13	9

Formulate the Chairperson's problem as an optimization problem, and provide the solution. *10*

(b) Use the graphical method to demonstrate that the following problem has no feasible solution : 5

Maximize $z = 5x_1 + 7x_2$

subject to $2x_1 - x_2 \leq -1$

$$-x_1 + 2x_2 \leq -1$$

$$x_1, x_2 \geq 0.$$

4. (a) Consider the following optimization problem : 8

Maximize $z = 21x_1 + 11x_2$

subject to $7x_1 + 4x_2 \leq 13$

$$x_1, x_2 \geq 0, \text{ integers.}$$

List all feasible solutions, and hence obtain optimal solution.

(b) If the probability of a defective bolt is 0·01, find mean and standard deviation of the number of defective bolts in a random sample of 400 bolts. Further, in a random sample of 4 bolts, find the probability that we observe (i) no defective bolt, (ii) at least one defective bolt. 7

5. (a) One of the main products of P&T Company is canned peas. The peas are prepared at three canneries, and then shipped by truck to four distributing warehouses. Because the shipping costs are substantial, management has initiated a study to reduce them as much as possible. For the upcoming season, an estimate has been made about the output from each cannery, each warehouse has been allocated a certain amount from the total supply of peas. This information (in units of truckloads), along with the shipping cost per truckload for each cannery-warehouse combination is given below.

Canneries	Cost (Rs.) per truck-load				Output (truck-loads)
	W_1	W_2	W_3	W_4	
C_1	464	513	654	867	75
C_2	352	416	690	791	125
C_3	995	682	388	685	100
Allocation (truck-loads)	80	65	70	85	

Give a formulation for the minimum shipping cost plan, and obtain initial feasible solution by Vogel's Approximation Method (VAM). *9*

(b) What is integer linear programming problem ? How can the optimal solution of an integer programming problem be compared with that of the linear programming problem ? 6