2018

M.Sc.

4th Semester Examination

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MTM-405 (Unit-II : OR)

Subject Code—21

(Practical)

Full Marks : 25

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Answer any *one* question. 1×20

1. Write a script in MATLAB & LINGO to solve the following LPP using Revised Simplex Method.

$$\text{Max } z = x_1 + x_2$$
$$\text{Subject to, } 3x_1 + 2x_2 \leq 6$$
$$x_1 + 4x_2 \leq 4$$
$$x_1, x_2 \geq 0$$

2. Write a program in LINGO & MATLAB to find the Nash equilibrium strategy and Nash equilibrium outcome of the following bi-matrix game.

$$A = \begin{bmatrix} 1 & 0 \\ 2 & -1 \end{bmatrix} \quad B = \begin{bmatrix} 3 & 2 \\ 0 & 1 \end{bmatrix}$$

3. Write a program in LINGO & MATLAB to solve the following Queuing theorem problem.

Arrivals at a telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean 3 minutes.

(a) What is the probability that a person arriving at the booth will have to wait ?

(b) What is the average length of queues that form from time to time ?

(c) The telephone company will install a second booth when convinced that an arrival would expect to have to wait at least 3 minutes for the phone. By how much must the flow of arrivals be increased to justify a second booth?

(d) Find the average number of units in the system.

(e) What is the probability that an arrival has to wait more than 10 minutes before the phone is free ?

(f) Estimate the fraction of a day that the phone will be in use (or busy).

4. Write a program in LINGO & MATLAB to solve the following problem of Inventory.

An engineering factory consumes 5000 units of a component per year. The ordering, receiving and handling cost are Rs. 300 per order while trucking cost is Rs. 1200 per order, internet cost Re. 0.06 per unit per year, Deterioration and obsolence cost Re. 0.004 per year and storage cost Rs. 1000 per year for 5000 units. Calculate the economic order quantity and minimum average cost.

5. Write a program in LINGO & MATLAB to solve the following Stochastic Programming Problem.

A Manufacturing firm produces two machine parts using lathes, milling machines and grinding machines. The machining times available per week on different machines and the profit on machine part are given below. The machining times required on different machines for each part are not known precisely (as they vary from worker to worker) but are known to follow normal distribution with mean and standard deviations as indicated in the following table.

Type of Machine	Machining time required per unit (minutes)				Maximum time available per week (minutes)
	Part I		Part II		
	Mean	Standard deviation	Mean	Standard deviation	
Lathes	$\bar{a}_{11} = 10$	$\sigma_{a11} = 6$	$\bar{a}_{12} = 4$	$\sigma_{a12} = 4$	$b_1 = 2500$
Milling machines	$\bar{a}_{21} = 4$	$\sigma_{a21} = 6$	$\bar{a}_{22} = 10$	$\sigma_{a22} = 7$	$b_2 = 2000$
Grinding machine	$\bar{a}_{31} = 1$	$\sigma_{a31} = 2$	$\bar{a}_{32} = 1.5$	$\sigma_{a31} = 3$	$b_3 = 450$
Profit per unit (Rs)	$c_1 = 50$		$c_2 = 100$		

Determine the number of machine parts I and II to be manufactured per week to maximize the profit without exceeding the available machining times more than once in 100 weeks.

6. Write a program in LINGO & MATLAB to solve the following Geometric Programming Problem.

Minimize $f(x) = 7x_1x_2^{-1} + 7x_2x_3^{-2} + 5x_1^{-3}x_2x_3 + x_1x_2x_3$

7. Write a program in LINGO & MATLAB to solve the following LPP using simplex method.

$$\text{Min } z = 3x_1 + 4x_2$$

$$\text{Subject to, } x_1 + x_2 \leq 8$$

$$2x_1 + 5x_2 \leq 22$$

$$x_2 \leq 0$$

$$x_1, x_2 \geq 0$$

20. Write a program in LINGO & MATLAB to solve the following Stochastic Programming Problem.

A manufacturing firm produces two machine parts using lathes, milling machines and grinding machines. The machining times required on different machines for each part and the profit on machine part are given below. If the machining times available on different machines are probabilistic (normally distributed) with parameters as given in the following table, find the number of machine parts I and II to be manufactured per week to maximize the profit. The constraint have to be satisfied with a probability of at least 0.99.

Type of Machine	Machining time required per piece (minutes)		Maximum time available per week (minutes)	
	Part I	Part II	Mean	Standard deviation
Lathes	$a_{11} = 10$	$a_{12} = 5$	$b_1 = 2500$	$\sigma_{b1} = 500$
Milling Machines	$a_{21} = 4$	$a_{22} = 10$	$b_2 = 2000$	$\sigma_{b2} = 400$
Grinding Machines	$a_{31} = 1$	$a_{32} = 1.5$	$b_3 = 450$	$\sigma_{b3} = 50$
Profit per unit (Rs)	$c_1 = 50$		$c_2 = 100$	

21. Write a program in LINGO & MATLAB to solve the following LPP using simplex method.

$$\text{Max } z = 3x_1 + 4x_2$$
$$\text{Subject to, } x_1 + x_2 \leq 10$$
$$2x_1 + 3x_2 \leq 18$$
$$x_1 \leq 8$$
$$x_2 \leq 6$$
$$x_1, x_2 \geq 0$$

22. Write a script in MATLAB & LINGO to solve the following LPP using Revised Simplex Method.

$$\text{Max } z = 3x_1 + 5x_2$$
$$\text{Subject to, } x_1 \leq 4$$
$$x_2 \leq 6$$
$$V3x_1 + 2x_2 \leq 18$$
$$x_1, x_2 \geq 0$$

23. Write a program in LINGO & MATLAB to solve the following QPP using Wolfe's modified simplex method.

$$\text{Max } z = 2x_1 + x_2 - x_1^2$$
$$\text{Subject to, } 2x_1 + 3x_2 \leq 6$$
$$2x_1 + x_2 \leq 4$$
$$x_1, x_2 \geq 0$$

24. Write a program in LINGO & MATLAB to solve the following Integer Programming Problem using Gomory's cutting plane method.

$$\text{Max } z = 11x_1 + 4x_2$$
$$\text{Subject to, } -x_1 + 2x_2 \leq 4$$
$$5x_1 + 2x_2 \leq 16$$
$$2x_1 - x_2 \leq 4$$
$$x_1, x_2 \geq 0 \text{ and are integers.}$$

25. Write a program in LINGO & MATLAB to solve the following Problem using Dynamic Programming technique.

$$\text{Max } z = y_1^2 + y_2^2 + y_3^2$$

$$\text{Subject to, } y_1 y_2 y_3 \leq 4$$

where y_1, y_2, y_3 are positive integers.

26. Write a program in LINGO & MATLAB to solve the following Geometric Programming Problem.

Minimize $f(x) = 5x_1x_2^{-1}x_3^2 + x_1^{-2}x_2^{-1} + 10x_2^2 + 2x_1^{-1}x_2x_3^{-2}$

27. Write a program in LINGO & MATLAB to find the Nash equilibrium strategy and Nash equilibrium outcome of the following bi-matrix game.

$$A = \begin{bmatrix} 1 & 0 \\ 2 & -1 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}$$

28. Write a program in LINGO & MATLAB to solve the following Queuing theorem problem.

In a car wash service facility information gather indicates that cars arrive for service according to a Poisson distribution with mean 5 per hour. The time for washing and cleaning for each car varies but is found to follow an exponential

distribution with mean 10 minutes per car. The facility can not handle more than one car at a time and has a total of 5 parking spaces. If the parking spot is full, newly arriving cars balk to 6 services elsewhere.

(a) How many customers the manager of the facility is loosing due to the limited parking spaces ?

(b) What is the expected waiting time until a car is washed ?

29. Write a program in LINGO & MATLAB to solve the following problem of Inventory.

The demand for an item is deterministic and constant over time and is equal to 600 units per year. The unit cost of the item is Rs. 50.00 while the cost of placing an order is Rs. 100.00.The inventory carrying cost is 20% of the item and the shortage cost per month is Re. 1. Find the optimal ordering quantity. If shortages are not allowed, what would be the loss of the company ?

30. Write a program in LINGO & MATLAB to solve the following Stochastic Programming Problem.

A manufacturing firm produces two machine parts using lathes, milling machines and grinding machines. The machining times available per week on different machines

8. Write a program in LINGO & MATLAB to solve the following QPP using Wolfe's modified simplex method.

$$\text{Max } z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$$

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

$$x_1, x_2 \geq 0$$

9. Write a program in LINGO & MATLAB to solve the following Integer Programming Problem using Gomory's cutting plane method.

$$\text{Max } z = 7x_1 + 9x_2$$

$$\text{Subject to, } -x_1 + 3x_2 \leq 6$$

$$7x_1 + x_2 \leq 35$$

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

10. Write a program in LINGO & MATLAB to solve the following Problem using Dynamic Programming technique.

$$\text{Max } z = y_1y_2y_3$$

$$\text{Subject to, } y_1 + y_2 + y_3 = 5$$

$$y_1, y_2, y_3 \geq 0$$

11. Write a program in LINGO & MATLAB to solve the following LPP using simplex method.

$$\text{Max } z = 2x_1 + 3x_2 - x_3$$

$$\text{Subject to, } 2x_1 + 5x_2 - x_3 \leq 5$$

$$x_1 + x_2 + 2x_3 = 6$$

$$2x_1 - x_2 + 3x_3 = 7$$

$$x_1, x_2 \geq 0$$

12. Write a script in MATLAB & LINGO to solve the following LPP using Revised Simplex Method.

$$\text{Min } z = x_1 + x_2$$

$$\text{Subject to, } x_1 + 2x_2 \geq 7$$

$$4x_1 + x_2 \geq 6$$

$$x_1, x_2 \geq 0$$

13. Write a program in LINGO & MATLAB to solve the following QPP using Wolfe's modified simplex method.

$$\text{Max } z = 2x_1 + 3x_2 - x_1^2$$

$$\text{Subject to, } x_1 + 2x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

14. Write a program in LINGO & MATLAB to solve the following Integer Programming Problem using Gomory's cutting plane method.

$$\text{Max } z = x_1 + x_2$$

$$\text{Subject to, } 3x_1 + 2x_2 \leq 5$$

$$x_2 \leq 2$$

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

15. Write a program in LINGO & MATLAB to solve the following Problem using Dynamic Programming technique.

$$\text{Min } z = y_1^2 + y_2^2 + y_3^2$$

$$\text{Subject to, } y_1 + y_2 + y_3 \geq 15$$

$$y_1, y_2, y_3 \geq 0$$

16. Write a program in LINGO & MATLAB to solve the following Geometric Programming Problem.

$$\text{Minimize } f(x) = 5x_1x_2^{-1} + 2x_1^{-1}x_2 + 5x_1 + x_2^{-1}$$

17. Write a program in LINGO & MATLAB to find the Nash equilibrium strategy and Nash equilibrium outcome of the following bi-matrix game.

$$A = \begin{bmatrix} 8 & 0 \\ 30 & 2 \end{bmatrix} \qquad B = \begin{bmatrix} 8 & 30 \\ 0 & 2 \end{bmatrix}$$

18. Write a program in LINGO & MATLAB to solve the following Queuing theorem problem.

A telephone exchange has two long distance operators. The telephone company finds that, during the peak load long distance all arrive in a Poisson fashion at an average rate of 15 per hour. The length of service on this call is approximately exponentially distributed with mean length 5 minutes.

(a) What is the probability that a subscriber will have to wait for this long distance call during the peak hours of the day ?

(b) If the subscriber waits and are serviced in turn, what is the expected waiting time.

19. Write a program in LINGO & MATLAB to solve the following Integer Programming Problem using Gomory's cutting plane method.

$$\text{Max } z = 3x_1 - 2x_2 + 5x_3$$

$$\text{Subject to, } 5x_1 + 2x_2 + 7x_3 \leq 28$$

$$4x_1 + 5x_2 + 5x_3 \leq 30$$

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

and the machining times required on different machines for each part are given below. Assuming that the profit per unit of each of the machine parts I and II is a normally distributed random variable, find the number of machine parts to be manufactured per week to maximize the profit. The mean value and standard deviation of profit are Rs. 50 and 20 per unit for part I and Rs. 100 and 50 per unit for part II.

Type of Machine	Machining time required per piece (minutes)		Maximum time available per week (minutes)
	Part I	Part II	
Lathes	$a_{11} = 10$	$a_{12} = 5$	$b_1 = 2500$
Milling Machines	$a_{21} = 4$	$a_{22} = 10$	$b_2 = 2000$
Grinding Machines	$a_{31} = 1$	$a_{32} = 1.5$	$b_3 = 450$

31. Write a program in LINGO & MATLAB to solve the following Problem using Dynamic Programming technique.

$$\text{Max } z = 2x_1 + 5x_2$$

$$\text{Subject to, } 2x_1 + x_2 \leq 43$$

$$2x_2 \leq 46$$

$$x_1, x_2 \geq 0$$

32. Write a program in LINGO & MATLAB to solve the following Geometric Programming Problem.

$$\text{Minimize } f(x) = 2x_1 + 4x_2 + 10x_1^{-1} x_2^{-1}$$

33. Write a program in LINGO & MATLAB to solve the following Queuing theorem problem.

A car serving station has 3 stalls where service can be offered simultaneously. The cars wait in such a way that when a stall becomes vacant the car at the head of the line pulls up to it. The station can accommodate at most 4 cars waiting at one time. The service time is exponential with mean 6 minutes. Find the average no. of cars in the service station during peak hours. The average waiting time and the average number of cars per hour that cannot enter the station because of full capacity. The arrivals of cars is 1 per min. and follows Poisson distribution.

34. Write a program in LINGO & MATLAB to approximate the value of π using Monte Carlo simulation technique.

35. Write a program in LINGO & MATLAB to solve the following Problem of Inventory.

The demand for an item in a company is 18000 units per year. The company can produce the item at a rate of 3000 per month. The cost of one set-up is Rs. 500 and the holding cost of one unit per month is Re. 0.15. The shortage cost of one unit is Rs. 20 per month. Determine the optimum manufacturing quantity. Also determine the manufacturing time and the time between set-up.

36. Write a program in LINGO & MATLAB to solve the following LPP using simplex method.

$$\text{Max } z = 5x_1 - x_2 + 3x_3$$
$$\text{Subject to, } 2x_1 + 2x_2 - x_3 \geq 2$$
$$3x_1 - 4x_2 \leq 3$$
$$x_2 + 3x_3 \leq 5$$
$$x_1, x_2 \geq 0$$

37. Write a script in MATLAB & LINGO to solve the following LPP using Revised Simplex Method.

$$\text{Max } z = 10x_1 + 9x_2$$
$$\text{Subject to, } 8x_1 + 15x_2 \geq 10$$
$$10x_1 + 6x_2 \leq 10$$
$$6x_1 + 24x_2 \leq 12$$
$$x_1, x_2 \geq 0$$

38. Write a program in LINGO & MATLAB to solve the following QPP using Wolfe's modified simplex method.

$$\text{Max } z = 18x_1 + 3x_2 - 0.001x_1^2 - 0.005x_2^2 - 100$$
$$\text{Subject to, } 2x_1 + 3x_2 \leq 2500$$
$$x_1 + 2x_2 \leq 1500$$
$$x_1, x_2 \geq 0$$

39. Write a program in LINGO & MATLAB to solve the following problems of Inventory.

A constructer has to supply 10,000 bearing per day to an automobile manufacturer. He find that when he start a production run, he can produce 25,000 bearing per day. The cost of holding a bearing in stock for one year is Rs. 2 and set up cost for producing run is Rs. 180. How frequently should the production ?

Laboratory Note Book and Viva including Field Work : 5
