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Contents

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1 CHAPTER
Linear Programming and Its Applications

MCQ and NAT Questions

Q.1 A variable which has no physical meaning, but is used to obtain an initial basic feasible solution to the linear programming problem is referred to as
(a) Basic Variable (b) Non-Basic Variable
(c) Artificial Variable (d) Basis

Q.2 In simplex method, the variables which have not been assigned the value zero during the iteration are called
(a) Basic Variables (b) Actual Variables
(c) Artificial Variables (d) None of the above

Q.3 Simplex method of solving linear programming problem uses
(a) All the points in the feasible region
(b) Only the corner points of the feasible region
(c) Intermediate points within the infeasible region
(d) Only in the interior points in the feasible region

Q.4 The leaving basic variable in simplex method is the basic variable that
(a) has the lowest value
(b) has the largest coefficient in the key row
(c) has the smallest coefficient in the key row
(d) goes to zero first as the entering basic variable is increased

Q.5 A tie for leaving variables in simplex procedure implies
(a) Optimality (b) Cycling
(c) No solution (d) Degeneracy

Q.6 In a linear programming problem, if a basic solution has no more than m positive X_j ($j = 1, 2, \ldots, n$), it is called
(a) Basic feasible solution
(b) Unbounded solution
(c) Non-degenerate basic feasible solution
(d) None of the above

Q.7 In a linear programming problem, which one of the following is correct for graphical method?
(a) A point in the feasible region is not a solution to the problem.
(b) One of the corner points of the feasible region is not the optimum solution.
(c) Any point in the positive quadrant does not satisfy the non-negativity constraint.
(d) The lines corresponding to different values of objective functions are parallel.

Q.8 A linear programming problem with mixed constraints (some constraints of ≤ type and some of ≥ type) can be solved by which of the following methods?
(a) Big M method
(b) Hungarian Method
(c) Branch and Bound Technique
(d) Least Cost Method

Q.9 In the standard form of a linear programming problem, all constraints are
(a) of less than or equal to type
(b) of greater than or equal to type
(c) in the form of equations
(d) some constraints are of less than equal to type and some of greater than equal to type

Q.10 In case of solution of a two variable linear programming problem by graphical method, one constraint line comes parallel to the objective function line. Which one of the following is correct? The problem will have
(a) Infeasible solution
(b) Unbounded solution
(c) Degenerate solution
(d) Infinite number of optimal solutions

Q.11 Which one of the following is true in case of simplex method of linear programming?
(a) The constants of constraints equation may be positive or negative.

(b) Inequalities are not converted into equations.
(c) It cannot be used for two-variable problems.
(d) The simplex algorithm is an iterative procedure.

Q.12 While solving a LPP by simplex method, if all ratios of right hand side (b_i) to the coefficient, in the key row (a_{ij}) become negative, then the problem has which of the following types of solution?
(a) An unbound solution
(b) Multiple solutions
(c) A unique solution
(d) No solution

Q.13 If m is the number of constraints in a linear programming with two variables x and y and non-negativity constraints $x > 0$ and $y > 0$; the feasible region in the graphical solution will be surrounded by how many lines?
(a) m (b) $m + 1$
(c) $m + 2$ (d) $m + 4$

Q.14 Which one of the following statements is not correct?
(a) LPP with 2 variables and 3 constraints can be solved by graphical method.
(b) In big M-method if the artificial variable can not be driven out it depicts an optimal solution.
(c) Dual of dual is the primal problem.
(d) For mixed constraints either big M method or two phase method can be employed.

Q.15 The primal of a LP problem is maximization of objective function with 6 variables and 2 constraints. Which of the following correspond to the dual of the problem stated?
1. It has 2 variables and 6 constraints.
2. It has 6 variables and 2 constraints.
3. Maximization of objective function.
4. Minimization of objective function.

Select the correct answer using the codes given below :
(a) 1 and 3 (b) 1 and 4
(c) 2 and 3 (d) 2 and 4

Q.16 The best use of linear programming technique is to find an optimal use of
(a) Money (b) Manpower
(c) Machine (d) All of the above

Q.17 An Iso-Profit Line represents
(a) An infinite number of solutions all of which yield the same profit.
(b) An infinite number of solution all of which yield the same cost.
(c) An infinite number of optimal solutions.
(d) A boundary of the feasible region.

Q.18 While solving a LP model graphically, the area bounded by the constraints is called
(a) Feasible Region
(b) Infeasible Region
(c) Unbounded Region
(d) None of the above

Q.19 The solutions to a transportation problem with 'm' rows (supplies) and 'n' columns (destination) is feasible if number of positive allocation are
(a) $m + n$ (b) $m * n$
(c) $m + n - 1$ (d) $m + n + 1$

Q.20 The degeneracy in the transportation problem indicates that
(a) dummy allocations needs to be added.
(b) the problem has no feasible solution.
(c) the multiple optimal solution exist.
(d) (a) and (b) but not (c)

Q.21 An assignment problem is considered as a particular case of a transportation problem because
(a) The number of rows equals columns
(b) All $x_{ij} = 0$ or 1
(c) All rim conditions are 1
(d) All of the above

Q.22 Maximization assignment problem is transformed into a minimization problem by
(a) Adding each entry in a column from the maximization value in that column.
(b) Subtracting each entry in a column from the maximum value in that column.
(c) Subtracting each entry in the table from the maximum value in that table.
(d) Any one of the above.

Q.23 If there were n workers and n jobs, there would be
(a) n! solutions (b) $(n-1)!$ solutions
(c) $(n!)^n$ solutions (d) n solutions

Q.24 For a salesman who has to visit n cities which of the following are the ways of his tour plan?
(a) $n!$ (b) $(n+1)!$
(c) $(n-1)!$ (d) n

Q.25 If there are m sources and n destinations in a transportation matrix, the total number of basic variable in a basic feasible solution is
(a) $m+n$ (b) $m+n+1$
(c) $m+n-1$ (d) m

Q.26 The total number of decision variables in the objective function of an assignment problem of size $n \times n$ (n jobs and n machines) is
(a) n^2 (b) $2n$
(c) $2n-1$ (d) n

Q.27 The total number of constraints in the transportation problem of size $m \times n$ (m sources and n destinations) is
(a) $m \times n$ (b) $m+n$
(c) m^2 (d) n^2

Q.28 An optimal solution of an assignment problem can be obtained only if
(a) Each row and column has only one zero element.
(b) Each row and column has at least one zero element.
(c) The data is arranged in a square matrix
(d) None of the above

Q.29 In transportation problem, the solution is said to degenerate solution if occupied cells is :
(a) greater than $m+n-1$
(b) lesser than $m+n-1$
(c) greater than or equal to $m+n-1$
(d) lesser than or equal to $m+n-1$

Q.30 The canonical form of LPP, if the objective function is of minimization then all the constraints other than the non-negativity conditions are :
(a) greater than type
(b) lesser than type
(c) greater than or equal to type
(d) lesser than or equal to type

Q.31 Consider the following LPP :
Maximize $z = 3x_1 + 2x_2$
subject to $x_1 \le 4$
$x_2 \le 6$
$3x_1 + 2x_2 \le 18$
$x_1 \ge 0, x_2 \ge 0$
(a) The LPP has a unique optimal solution.
(b) The LPP is infeasible.
(c) The LPP is unbounded.
(d) The LPP has multiple optimal solution.

Q.32 A LPP is shown below :
Maximize, $3x + 4y$
subject to
$3x + 7y \le 10$
$4x + 6y \le 8$
$x, y \ge 0$
It has
(a) An unbounded objective function
(b) Exactly one optimal solution
(c) Exactly two optimal solution
(d) Infinitely many optimal solution

Q.33 For the LPP :
Maximize, $z = 3x_1 + 2x_2$
Subject to
$-2x_1 + 3x_2 \le 9$
$x_1 - 5x_2 \ge -20$
$x_1, x_2 \ge 0$
The above problem has
(a) Unbounded solution
(b) Infeasible solution
(c) Alternative optimal solution
(d) Degenerate solution

Q.34 Consider an objective function $z(x_1, x_2) = 3x_1 + 9x_2$ and the constraints
$x_1 + x_2 \le 8$
$x_1 + 2x_2 \le 4$
$x_1 \ge 0, x_2 \ge 0$
The maximum value of the objective function is _____.

Q.35 Objective function
Maximize $z = 5x_1 + 4x_2$
subject to $0 \le x_1 \le 12$
$0 \le x_2 \le 9$
$3x_1 + 6x_2 \le 66$
$x_1, x_2 \ge 0$
What is the optimum value?
(a) 6, 9 (b) 12, 5
(c) 4, 10 (d) 0, 9

Q.62 A company has three plants and four warehouses. The supply and demand in units and the corresponding transportation costs are given. The following table has been taken from the solution procedure of the transportation problem.

Plants	Warehouses				Supply
	I	*II*	*III*	*IV*	
A	5	10	4 [10]	5	10
B	6 [20]	8	7	2 [5]	25
C	4 [5]	2 [10]	5 [5]	7	20
Demand	25	10	15	5	55

Choose the correct option(s)

(a) The given solution is feasible.

(b) The given solution degenerate.

(c) The given solution is optimal.

(d) The given solution has multiple optimal solution.

Q.63 In Newton-Raphson method, used for unconstrained local optimization of single variable the first derivative of the function used is(are)

(a) Linear approximation

(b) Biquadratic approximation

(c) Quadratic approximation

(d) Cubical approximation

Q.64 Four new machines M_1, M_2, M_3 and M_4 are to be installed in a machine shop. There are fine vacant places A, B, C, D and E available. Because of limited space, machine M_2 cannot be placed at C and M_3 cannot be placed at A. C_{ij}, the assignment cost of machine i to place j in rupees is shown below.

	A	B	C	D	E
M_1	4	6	10	5	6
M_2	7	4	–	5	4
M_3	–	6	9	6	2
M_4	9	3	7	2	3

Then choose the correct option(s)

(a) The assignment is M_1-A, M_2-B, M_3-E, M_4-D

(b) Total assignment cost is Rs. 12

(c) The assignment is M_1-B, M_2-D, M_3-C, M_4-E

(d) Total assignment cost is Rs. 23

Q.65 Which of the following statement(s) describes the correct relationship between the primal and dual of the problem?

(a) The dual of the dual is the primal.

(b) The value of objective function Z for any feasible solution of the primal is ≤ the value of objective function W for any feasible solution of the dual.

(c) If either the primal or the dual problem has an unbounded solution, then the solution to the other problem is infeasible.

(d) If both primal and the dual problems have feasible solutions, then both have optimal solutions and max. Z ≥ min. W.

■■■■

Answers Linear Programming and Its Applications

1. (c)	**2.** (a)	**3.** (b)	**4.** (c)	**5.** (d)	**6.** (c)	**7.** (a)	**8.** (a)
9. (d)	**10.** (d)	**11.** (d)	**12.** (a)	**13.** (c)	**14.** (b)	**15.** (b)	**16.** (d)
17. (a)	**18.** (a)	**19.** (c)	**20.** (c)	**21.** (b)	**22.** (c)	**23.** (a)	**24.** (a)
25. (c)	**26.** (a)	**27.** (b)	**28.** (b)	**29.** (b)	**30.** (c)	**31.** (d)	**32.** (b)
33. (a)	**34.** (18)	**35.** (b)	**36.** (a)	**37.** (c)	**38.** (c)	**39.** (a)	**40.** (b)
41. (c)	**42.** (c)	**43.** (b)	**44.** (b)	**45.** (d)	**46.** (29)	**47.** (d)	**48.** (c)
49. (4)	**50.** (d)	**51.** (a)	**52.** (b)	**53.** (b)	**54.** (110)	**55.** (1493)	**56.** (10)
57. (280)	**58.** (61)	**59.** (20)	**60.** (1300)	**61.** (a, c,)	**62.** (a, c, d)	**63.** (a)	**64.** (a, b)
65. (a, b, c)							

Explanations Linear Programming and Its Applications

1. (c)

Artificial Variables are used to obtain an initial basic feasible solution to the linear programming problem.

2. (a)

In simplex method, basic variables are those which have not been assigned the value zero during the iteration.

3. (b)

Only the corner points of the feasible region are used to solve the LPP by simplex method.

4. (c)

The leaving basic variable in simplex method is the basic variable that has the smallest coefficient in the key row.

5. (d)

A tie for leaving variable in simplex procedure implies that there may be existence of degeneracy.

6. (c)

A non-degenerate basic feasible solution is the basic feasible solution which has exactly m positive x_j (j = 1, 2, ..., m). In other words, all 'm' basic variables are positive and the remaining 'n' variable will be all zero.

7. (a)

A point in the feasible region is not a solution to the problem of linear programming solved by graphical method.

8. (a)

A linear programming problem with mixed constraints (some constraints of ≤ type and some of ≥ type) can be solved by Big M method which involves :

(i) Objective function should be changed to maximization function.

(ii) If the constraint is ≥ type, along with a slack variable, an artificial variable is also used.

9. (d)

In the standard form of Lpp, some constraints are of less than equal to type and some of greater than equal to type.

10. (d)

If one constraint line becomes parallel to the objective function line, in the graphical method of LPP, then problem will have infinite number of optimal solutions.

11. (d)

Simplex method of LPP is an iterative procedure.

12. (a)

If the all ratio of RHS (b_i) to the coefficient, in the key row (a_{ij}) become negative, it means the problem is having unbounded solution (while using simplex method for LPP).

13. (c)

Since there are 'm' constraints and $x > 0$, $y > 0$ are two other constraints.

So, total number of constraints = $m + 2$.

$\therefore$ No. of lines = $m + 2$

14. (b)

- A LPP with 2 variable and 3 constraints can be solved by graphical method.
- Dual of dual is the primal problem.
- For mixed constraints either Big M-method or two phase method can be employed.

15. (b)

Primal	Dual
Maximization	Minimization
Variable	Constraints
Constraints	Variables

The dual of a given LPP will be minimization of objective function with 2 variables and 6 constraints.

16. (d)

LPP technique can be used for the optimal use of money, manpower and money.

17. (a)

In LPP, Iso-Profit line represents an infinite number of solutions all of which yield the same profit.