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| **SESSION** | **AUG-Sep’23** |
| **PROGRAM** | **MASTER OF BUSINESS ADMINISTRATION (MBA)** |
| **SEMESTER** | **III** |
| **course CODE & NAME** | **DOMS304 & Applications of Operations Research** |
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**Assignment Set – 1**

**1. a) A farmer has a 100 acre farm. He can sell all tomatoes, Lettuce or radishes and can get a price of Rs. 1.00 per kg for tomatoes, Rs. 0.75 a heap for lettuce and Rs. 2.00 per kg for radishes. The average yield per acre is 2,000 kg of tomatoes, 3,000 heaps of lettuce and 1,000 kg of radishes. Fertilizers are available at Rs. 0.50 per kg and the amount required per acre is 100 kg each for tomatoes and lettuce and 50 kg for radishes. Labour required for sowing, cultivating and harvesting per acre is 5 man-days for tomatoes and radishes and 6 man-days for lettuce. A total of 400 man-days of labour are available at Rs. 20 per man-day. Formulate this problem as linear programming problem. 5**

**Ans 1a.**

Linear Programming Formulation:

Decision variables:

• T: Acres of land allocated for tomatoes

• L: Acres of land allocated for lettuce

• R: Acres of land allocated for radishes

Objective function (maximization):

Maximize total revenue

**b) Define sensitivity analysis in LPP. Write the limitation of sensitivity analysis. 5**

**Ans 1b.**

**Sensitivity Analysis in Linear Programming Problems (LPP)**

Sensitivity analysis in Linear Programming Problems (LPP) is a crucial technique used to understand how the optimal solution to an LPP might change in response to variations in its

**2. Solve the given LPP using simplex method:**

**Maximize Z = 5x1 + 2x2 +10x3**

**Subject to: x1- x3≤ 10**

**x2- x3 ≥ 10**

**x1 + x2+ x3≤ 10**

**x1, x2, x3 ≥ 0**

**Ans 2.**

The standard form of a linear programming problem is as follows:

Maximize Z=c₁x₁+c₂x₂+c₃x₃

Subject to:

a₁₁x₁+a₁₂x₂+a₁₃x₃≤b₁

a₂₁x₁+a₂₂x₂+a₂₃x₃≤b₂

a₃₁x₁+a₃₂x₂+a₃₃x₃≤b₃

x₁,

**3. Solve the following linear programming problem using Revised Simplex Method:**

**Maximize Z = x1 + 2x2**

**Subject to: x1+x2 ≤ 3**

**x1 + 2x2 ≤ 5**

**3x1 + x2 ≤ 6**

**where x1, x2 ≥ 0**

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**Ans 3.**

Writing the standard form of the given LPP:

Maximize Z=x1+2x2+0.s1+0.s2+0.s3

Subject to:

x1+x2+s1=3

x1+2x2+s2=5

3x1+x2+s3=6

x1,x2,s1,s2,s3≥0

Where

**Assignment Set – 2**

**1. A soft drink distributor takes the contract for the sale of soft drinks at a cricket stadium during a one-day match. He has five sales boys to assign to three areas of the stadium. The table shows the estimated sales that can be made with different assignments.**

|  |  |  |  |
| --- | --- | --- | --- |
| **No. of persons**  **assigned** | **East stand** | **North stand** | **Club stand** |
| **1** | **15** | **45** | **30** |
| **2** | **30** | **90** | **60** |
| **3** | **60** | **135** | **90** |
| **4** | **120** | **180** | **120** |
| **5** | **150** | **180** | **150** |

**Using Dynamic programming problem, how he should assign the boys in order to maximize his sales.**

**Ans 1.**

We will perform the following activities using a Dynamic programming problem to identify how the soft drink distributor should assign the boys to maximize sales:

The following are the activities we will perform to identify how the soft drink distributor should assign the boys to maximize sales:

1. Defining the decision variables
2. Formulating the objective function
3. Formulating the constraints

**The**

**2. Solve the following integer programming problem using Branch and Bound method:**

**Maximize Z = 6x1 + 8x2**

**Subject to: x1 + 4x2 ≤ 8**

**7x1 + 2x2 ≤ 14**

**and x1, x2 are non-negative integers**

Ans 2.

The Branch and Bound method is an algorithm used to solve integer programming problems by systematically exploring the solution space. The steps involve branching on fractional solutions and bounding the objective function to eliminate certain branches. Let's apply this method to the given problem.

The problem is to maximize Z=6x1​+8x2​ subject to the constraints:

x1​+4x2​≤8

7x1​+2x2​≤14

x1​,x2​≥0 and

**3. a) Solve the following Non-linear programming problem using Kuhn-Tucker conditions:**

**Maximize Z = x12- x1x2 - 2x22**

**Subject to: 4x1 + 2x2 ≤ 24**

**5x1 + 10x2 ≤ 20**

**and x1, x2 ≥ 0**

**Ans 3a.**

## Solving Non-linear Programming Problem using Kuhn-Tucker Conditions

**Part 1: Lagrangian Function and KKT Conditions**

1. Lagrangian Function:

We first form the Lagrangian function, L(x1,x2,λ1,λ2), by incorporating the objective function and the constraints with Lagrange multipliers (λ1 and λ2):

L(x1,x2,λ1,λ2) = x1^2 - x1x2 - 2x2^2 - λ1(4x1 + 2x2 - 24) - λ2(5x1 + 10x2 - 20)

2. KKT

**b) Write short note on the following**

**i) Quadratic Programming problem**

**ii) Metaheuristics techniques**

**Ans 3b.**

**Quadratic Programming Problem**

Quadratic programming (QP) is a special type of mathematical optimization problem. It involves minimizing or maximizing an objective function that is quadratic (i.e., a polynomial of degree two), subject to linear constraints. The general form of a quadratic programming problem can