LAB QUESTIONS ON SIMPLEX METHOD

Instructions: Make a menu driven program with the following options (a) List of all BFS (b) Number of Iterations to solve the problem (c) List of all Non-basic variables along with net evaluations in i^{th} (user input) iteration (d) List of Basic variables along with min ratios in i^{th} iteration (e) simplex table of i^{th} (user input) iteration (f) optimal solution (if exists otherwise generate report showing reason for infeasibility, unboundedness, alternative optimum etc.)

FOLLOW THE INSTRUCTIONS ABOVE CAREFULLY

Consider the following LPP:

$$\max c^T x \quad s.to \quad Ax = b, x \geq 0, b_i \geq 0$$

where $c = (c_1, c_2, ..., c_n)$, a column vector. A is a $m \times n$ real matrix (a_{ij}), $i = 1, 2, ..., m; j = 1, 2, ..., n$

$b = (b_1, b_2, ..., b_m)$. $x = (1, 2, ..., n)$.

1. Write code to express any LPP in standard form as above using slack/surplus variables.

2. Write code to print

   - $a^{(j)} = col(a_{1j}, a_{2j}, ..., a_{mj})$
   - $A = [a^{(1)}, a^{(2)}, ..., a^{(j)}, ...a^{(n)}]$
   - $B = (b^{(1)}, b^{(2)}, ..., b^{(m)})$, which is basis matrix.
   - Basic solution $x_B = B^{-1}b = col(x_{B_i}, i = 1, 2, ..., m)$
   - $c_B = col(c_{B_1}, c_{B_2}, ..., c_{B_m})$, c_{B_i} being the coefficient of basic variable $x_{B_i}, i = 1, 2, ..., m$ in the objective function.
   - $y^{(j)} = col(y_{1j}, y_{2j}, ..., y_{ij}, ..., y_{mj}) = B^{-1}a^{(j)}, j = 1, 2, ..., n$

- $z(x_B) = c_B^T x_B$ and $z_j = c_B^T y^{(j)}, j = 1, 2, ..., n$

3. Write code to calculate $z_j - c_j$ for all j.

4. Write code to determine pivot element and minimum ratio. Declare pivot row and pivot column.

5. Write code to revise the simplex table and complete one iteration. Then print next solution, objective value.

6. Write code to solve the following LPP by SIMPLEX method.

$$\max \quad s.to \quad Ax \leq b, x_j \geq 0, bi \geq 0$$

7. Test the following numerical problems using your code.

(A) MAX Z = 5x1 + 10x2 + 8x3
subject to
3x1 + 5x2 + 2x3 $\leq$ 60
4x1 + 4x2 + 4x3 $\leq$ 72
2x1 + 4x2 + 5x3 $\leq$ 100
and x1,x2,x3 $\geq$ 0

(B) MAX Z = 4x1 + 3x2
subject to
2x1 + x2 $\leq$ 1000
x1 + x2 $\leq$ 800
x1 $\leq$ 400
x2 $\leq$ 700
and x1,x2 $\geq$ 0

(C) MAX Z = 3x1 + 3x2 + 2x3 + x4
subject to
2x1 + 2x2 + 5x3 + x4 $\leq$ 12
3x1 + 3x2 + 4x3 $\leq$ 11
and x1,x2,x3,x4 $\geq$ 0

(D) MAX Z = 3x1 + 5x2 + 4x3

subject to

$2x1 + 3x2 \leq 8$

$2x2 + 5x3 \leq 10$

$3x1 + 2x2 + 4x3 \leq 15$

and $x1,x2,x3 \geq 0$

(E) MIN Z = 3x1 + 3x2 + 2x3 - x4

subject to

$2x1 + 2x2 + 5x3 + x4 \geq 43$

$3x1 - 3x2 + 4x3 \geq 11$

$4x1 - 2x2 + 3x3 - x4 \geq 25$

and $x1,x2,x3,x4 \geq 0$

(F) MAX Z = 6x1 + 4x2

subject to

$2x1 + 3x2 \leq 30$

$3x1 + 2x2 \leq 24$

$x1 + x2 \geq 3$

and $x1,x2 \geq 0$