Simplex

Operations Research

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Simplex Algorithm

The simplex is a method to solve lineal programming problems. This is a mechanical method that search for the best or optimal solution for a lineal programming(LP) problem. It was invented by George Danzig in 1947. It uses operations over a matrix to search for the optimal solution. It begin from a feasible region and it starts to do some operations, depending if you are maximizing or minimizing that search for the candidate column and the pivot, and after all the numbers are positive or negative, depends if maximizing or minimizing, that it give you the best solution.

Original Problem

Problema 7

Maximize

- $Z = -5x1 - 3x2 - 1x3$

Constraints

1. $1x1 + 1x2 + 3x3 \leq 6$
2. $5x1 + 3x2 + 6x3 \leq 15$

Initial Table

Initial Table

Z	x1	x2	x3	s_1	s_2	•
1	-5	-3	-1	0	0	0
0	1	1	3	1	0	6
0	5	3	6	0	1	15

Cuadro 1: Initial Table.

Intermediates Tables

Intermediate Table #1

Z	x1	x2	x3	s_1	s_2	•
1	-5	-3	-1	0	0	0
0	1	1	3	1	0	6
0	**5**	3	6	0	1	15

Cuadro 2: Intermediate Table 1, during the pivoteo.

Calculations: 6/1 = 6 | **15/5 = 3**

Intermediate Table #2

Z	x1	x2	x3	s_1	s_2	•
1	0	0	5	0	1	15
0	0	0,4	1,8	1	-0,2	3
0	1	0,6	1,2	0	0,2	3

Cuadro 3: Intermediate Table 2, with the column 2 canonized.

Final Table

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Z	x1	x2	x3	s_1	s_2	•
1	0	0	5	0	1	15
0	0	0,4	1,8	1	-0,2	3
0	1	0,6	1,2	0	0,2	3

Cuadro 4: Final Table.

Solution

Solution

Optimal solution

Problema 7

- $Z = 15$
- $x_2 = 5$

Especial Cases

The problem had the following special cases:

1. Problem with multiple solutions

In the following slides this will be explained.

Problema con soluciones múltiples

The problem comes to having multiple solutions when a feasible basis is obtained that we take as the solution to the problem. However, there is a non-basic variable with a zero in the first row.
In the next two slides the 4 alternative solutions will be given

Multiple Solutions 1 y 2

Alternative solution #1

- x1 = 3
- x2 = 0
- x3 = 0

Alternative solution #2

- x1 = 0
- x2 = 5
- x3 = 0

Multiple Solutions 3 y 4

Alternative solution #3

- x1 = 1,5
- x2 = 2,5
- x3 = 0

Alternative solution #4

- x1 = 0,8
- x2 = 3,8
- x3 = 0

- final slide -