** check different types of Dual simplex method examples
Algorithm and examples

Method 3. Dual simplex method

Solve the Linear programming problem using Dual simplex method calculator

Type your linear programming problem

```
MIN Z = 15x1 + 10x2 + 015x3
subject to
3x1 + 5x2 + 2x3 <= 15
2x1 + x2 + 3x3 <= 12
-2x1 - 3x2 - 4x3 <= -10
and x1,x2,x3 >= 0
```

OR

Total Variables : 3 Total Constraints : 3 Generate

Min Z = 15 x1 + 10 x2 + 015 x3

Subject to constraints

3	x1 +	5	x2 +	2	x3	<=	15
2	x1 +	1	x2 +	3	x3	<=	12
-2	x1 +	-3	x2 +	-4	x3	<=	-10

and x1,x2,x3 >= 0

Mode : Decimal

☑ Zj-Cj (display in steps) ☐ Alternate Solution (if exists) ☑ Artificial Column Remove ☑ Subtraction Steps

Find Random New

Solution Help

Solution will be displayed step by step (In 3 parts)

Solution

Find solution using dual-simplex method
MIN Z = 15x1 + 10x2 + 015x3
subject to
3x1 + 5x2 + 2x3 <= 15
2x1 + x2 + 3x3 <= 12
-2x1 - 3x2 - 4x3 <= -10
and x1,x2,x3 >= 0

Solution:
Problem is

$$\text{Min } Z = 15x_1 + 10x_2 + 15x_3$$

subject to

$$3x_1 + 5x_2 + 2x_3 \le 15$$
$$2x_1 + x_2 + 3x_3 \le 12$$
$$-2x_1 - 3x_2 - 4x_3 \le -10$$

and $x_1, x_2, x_3 \ge 0$;

In order to apply the dual simplex method, convert Min Z to Max Z
Problem is

$$\text{Max } Z = -15x_1 - 10x_2 - 15x_3$$

subject to

$$3x_1 + 5x_2 + 2x_3 \le 15$$
$$2x_1 + x_2 + 3x_3 \le 12$$
$$-2x_1 - 3x_2 - 4x_3 \le -10$$

and $x_1, x_2, x_3 \ge 0$;

The problem is converted to canonical form by adding slack, surplus and artificial variables as appropiate

1. As the constraint-1 is of type ' ≤ ' we should add slack variable S_1

2. As the constraint-2 is of type ' ≤ ' we should add slack variable S_2

3. As the constraint-3 is of type ' ≤ ' we should add slack variable S_3

After introducing slack variables

Max $Z = -15x_1 - 10x_2 - 15x_3 + 0S_1 + 0S_2 + 0S_3$

subject to

$$3x_1 + 5x_2 + 2x_3 + S_1 = 15$$
$$2x_1 + x_2 + 3x_3 + S_2 = 12$$
$$-2x_1 - 3x_2 - 4x_3 + S_3 = -10$$

and $x_1, x_2, x_3, S_1, S_2, S_3 \geq 0$

Iteration-1		C_j	-15	-10	-15	0	0	0
B	**C_B**	**X_B**	**x_1**	**x_2**	**x_3**	**S_1**	**S_2**	**S_3**
S_1	0	15	3	5	2	1	0	0
S_2	0	12	2	1	3	0	1	0
S_3	0	-10	-2	**(- 3)**	-4	0	0	1
Z = 0		**Z_j**	**0**	**0**	**0**	**0**	**0**	**0**
		$Z_j - C_j$	15	10	15	0	0	0
		Ratio = $\frac{Z_j - C_j}{S_3, j}$ and $S_3, j < 0$	-7.5	-3.3333 ↑	-3.75	---	---	---

Minimum negative X_B is -10 and its row index is 3. So, the leaving basis variable is S_3.

Maximum negative ratio is -3.3333 and its column index is 2. So, the entering variable is x_2.

∴ The pivot element is -3.

Entering = x_2, Departing = S_3, Key Element = - 3

+ R_3(new) = R_3(old) ÷ (- 3)

+ R_1(new) = R_1(old) - 5R_3(new)

+ R_2(new) = R_2(old) - R_3(new)

Iteration-2		C_j	-15	-10	-15	0	0	0
B	**C_B**	**X_B**	**x_1**	**x_2**	**x_3**	**S_1**	**S_2**	**S_3**
S_1	0	-1.6667	-0.3333	0	**(- 4.6667)**	1	0	1.6667
S_2	0	8.6667	1.3333	0	1.6667	0	1	0.3333
x_2	-10	3.3333	0.6667	1	1.3333	0	0	-0.3333
Z = - 33.3333		**Z_j**	**-6.6667**	**-10**	**-13.3333**	**0**	**0**	**3.3333**
		$Z_j - C_j$	8.3333	0	1.6667	0	0	3.3333
		Ratio = $\frac{Z_j - C_j}{S_1, j}$ and $S_1, j < 0$	-25	---	-0.3571 ↑	---	---	---

Minimum negative X_B is -1.6667 and its row index is 1. So, the leaving basis variable is S_1.

Maximum negative ratio is -0.3571 and its column index is 3. So, the entering variable is x_3.

∴ The pivot element is -4.6667.

Entering = x_3, Departing = S_1, Key Element = - 4.6667

+ R_1(new) = R_1(old) ÷ (- 4.6667)

+ R_2(new) = R_2(old) - 1.6667R_1(new)

+ R_3(new) = R_3(old) - 1.3333R_1(new)

Iteration-3		C_j	-15	-10	-15	0	0	0
B	**C_B**	**X_B**	**x_1**	**x_2**	**x_3**	**S_1**	**S_2**	**S_3**
x_3	-15	0.3571	0.0714	0	1	-0.2143	0	-0.3571
S_2	0	8.0714	1.2143	0	0	0.3571	1	0.9286
x_2	-10	2.8571	0.5714	1	0	0.2857	0	0.1429
Z = -33.9286		**Z_j**	**-6.7857**	**-10**	**-15**	**0.3571**	**0**	**3.9286**
		$Z_j - C_j$	8.2143	0	0	0.3571	0	3.9286
		Ratio	---	---	---	---	---	---

Since all $Z_j - C_j \geq 0$ and all $X_{Bi} \geq 0$ thus the current solution is the optimal solution.

Hence, optimal solution is arrived with value of variables as :
$x_1 = 0, x_2 = 2.8571, x_3 = 0.3571$

Max Z = - 33.9286

∴ Min Z = 33.9286

Solution provided by AtoZmath.com

Any wrong solution, solution improvement, feedback then **Submit Here**

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