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

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[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

Min Z = 15 x1 + 10 x2 + 15 x3

subject to

3 x1 + 5 x2 + 2 x3 ≤ 15

2 x1 + x2 + 3 x3 ≤ 12

- 2 x1 - 3 x2 - 4 x3 ≤ -10

and x1, x2, x3 ≥ 0;

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

Problem is

Max Z = - 15 x1 - 10 x2 - 15 x3

subject to

3 x1 + 5 x2 + 2 x3 ≤ 15

2 x1 + x2 + 3 x3 ≤ 12

- 2 x1 - 3 x2 - 4 x3 ≤ -10

and x1, x2, x3 ≥ 0;

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



1. As the constraint-1 is of type ' \leq ' we should add slack variable S_1
2. As the constraint-2 is of type ' \leq ' we should add slack variable S_2
3. As the constraint-3 is of type ' \leq ' we should add slack variable S_3

After introducing slack variables

$$\text{Max } Z = -15x_1 - 10x_2 - 15x_3 + 0S_1 + 0S_2 + 0S_3$$

subject to

$$3x_1 + 5x_2 + 2x_3 + S_1 = 15$$

$$2x_1 + x_2 + 3x_3 + S_2 = 12$$

$$-2x_1 - 3x_2 - 4x_3 + S_3 = -10$$

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

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

$$+ R_3(\text{new}) = R_3(\text{old}) \div (-3)$$

$$+ R_1(\text{new}) = R_1(\text{old}) - 5R_3(\text{new})$$

$$+ R_2(\text{new}) = R_2(\text{old}) - R_3(\text{new})$$

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

$$+ R_1(\text{new}) = R_1(\text{old}) \div (-4.6667)$$



$$+ R_2(\text{new}) = R_2(\text{old}) - 1.6667R_1(\text{new})$$

$$+ R_3(\text{new}) = R_3(\text{old}) - 1.3333R_1(\text{new})$$

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	---	---	---	---	---	---

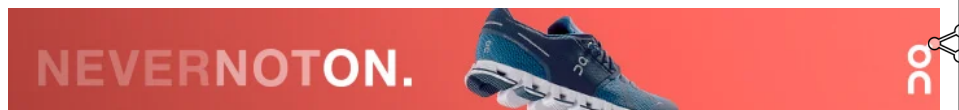
Since all $Z_j - C_j \geq 0$ and all $X_{Bi} \geq 0$ thus the current solution is the optimal solution.

Hence, optimal solution is arrived with value of variables as :

$$x_1 = 0, x_2 = 2.8571, x_3 = 0.3571$$

$$\text{Max } Z = -33.9286$$

$$\therefore \text{Min } Z = 33.9286$$



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