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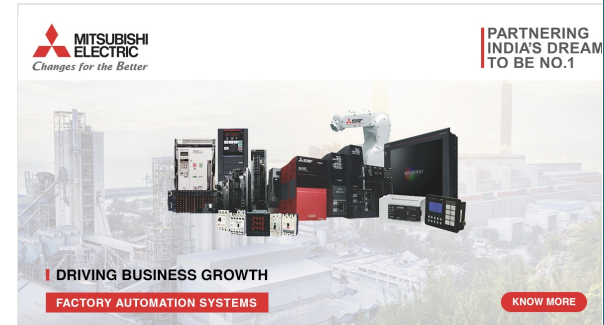
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Home > [Operation Research calculators](#) > Simplex method calculator

**** check different types of Simplex method examples Algorithm and examples**

Method

1. Simplex method (BigM method)

Solve the Linear programming problem using Simplex method calculator

Type your linear programming problem

MAX Z = 20x1 + 10x2 + 15x3
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](#)

Max

▼

 Z =

20

 x1 +

10

 x2 +

15

 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 and unrestricted in sign ☐ x1, ☐ x2, ☐ x3

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 Simplex method (BigM method)
MAX Z = 20x1 + 10x2 + 15x3
subject to
3x1 + 5x2 + 2x3 <= 15
2x1 + x2 + 3x3 <= 12
2x1 + 3x2 + 4x3 >= 10
and x1,x2,x3 >= 0

Solution:
Problem is

Max Z = 20 x_1 + 10 x_2 + 15 x_3
subject to
 $3x_1 + 5x_2 + 2x_3 \leq 15$
 $2x_1 + x_2 + 3x_3 \leq 12$
 $2x_1 + 3x_2 + 4x_3 \geq 10$
and $x_1, x_2, x_3 \geq 0$;

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

- As the constraint-1 is of type ' \leq ' we should add slack variable S_1
- As the constraint-2 is of type ' \leq ' we should add slack variable S_2
- As the constraint-3 is of type ' \geq ' we should subtract surplus variable S_3 and add artificial variable A_1

After introducing slack,surplus,artificial variables
Max Z = 20 x_1 + 10 x_2 + 15 x_3 + 0 S_1 + 0 S_2 + 0 S_3 - $M A_1$
subject to
 $3x_1 + 5x_2 + 2x_3 + S_1 = 15$
 $2x_1 + x_2 + 3x_3 + S_2 = 12$
 $2x_1 + 3x_2 + 4x_3 - S_3 + A_1 = 10$
and $x_1, x_2, x_3, S_1, S_2, S_3, A_1 \geq 0$

Iteration-1		C_j	20	10	15	0	0	0	-M	
B	C_B	X_B	x_1	x_2	x_3	S_1	S_2	S_3	A_1	MinRatio $\frac{X_B}{x_3}$
S_1	0	15	3	5	2	1	0	0	0	$\frac{15}{2} = 7.5$
S_2	0	12	2	1	3	0	1	0	0	$\frac{12}{3} = 4$
A_1	-M	10	2	3	(4)	0	0	-1	1	$\frac{10}{4} = 2.5 \rightarrow$
Z = -10M		Z_j	-2M	-3M	-4M	0	0	M	-M	
		$Z_j - C_j$	-2M - 20	-3M - 10	-4M - 15 ↑	0	0	M	0	

Negative minimum $Z_j - C_j$ is -4M - 15 and its column index is 3. So, the entering variable is x_3 .

Minimum ratio is 2.5 and its row index is 3. So, the leaving basis variable is A_1 .

∴ The pivot element is 4.

Entering = x_3 , Departing = A_1 , Key Element = 4



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+ $R_3(\text{new}) = R_3(\text{old}) \div 4$

+ $R_1(\text{new}) = R_1(\text{old}) - 2R_3(\text{new})$

+ $R_2(\text{new}) = R_2(\text{old}) - 3R_3(\text{new})$

Iteration-2		C_j	20	10	15	0	0	0	
B	C_B	X_B	x_1	x_2	x_3	S_1	S_2	S_3	MinRatio $\frac{X_B}{x_1}$
S_1	0	10	(2)	3.5	0	1	0	0.5	$\frac{10}{2} = 5 \rightarrow$
S_2	0	4.5	0.5	-1.25	0	0	1	0.75	$\frac{4.5}{0.5} = 9$
x_3	15	2.5	0.5	0.75	1	0	0	-0.25	$\frac{2.5}{0.5} = 5$
$Z = 37.5$		Z_j	7.5	11.25	15	0	0	-3.75	
		$Z_j - C_j$	-12.5 ↑	1.25	0	0	0	-3.75	

Negative minimum $Z_j - C_j$ is -12.5 and its column index is 1. So, the entering variable is x_1 .

Minimum ratio is 5 and its row index is 1. So, the leaving basis variable is S_1 .

∴ The pivot element is 2.

Entering = x_1 , Departing = S_1 , Key Element = 2

+ $R_1(\text{new}) = R_1(\text{old}) \div 2$

+ $R_2(\text{new}) = R_2(\text{old}) - 0.5R_1(\text{new})$

+ $R_3(\text{new}) = R_3(\text{old}) - 0.5R_1(\text{new})$

Iteration-3		C_j	20	10	15	0	0	0	
B	C_B	X_B	x_1	x_2	x_3	S_1	S_2	S_3	MinRatio $\frac{X_B}{S_3}$
x_1	20	5	1	1.75	0	0.5	0	0.25	$\frac{5}{0.25} = 20$
S_2	0	2	0	-2.125	0	-0.25	1	(0.625)	$\frac{2}{0.625} = 3.2 \rightarrow$
x_3	15	0	0	-0.125	1	-0.25	0	-0.375	---
$Z = 100$		Z_j	20	33.125	15	6.25	0	-0.625	
		$Z_j - C_j$	0	23.125	0	6.25	0	-0.625 ↑	

Negative minimum $Z_j - C_j$ is -0.625 and its column index is 6. So, the entering variable is S_3 .

Minimum ratio is 3.2 and its row index is 2. So, the leaving basis variable is S_2 .

∴ The pivot element is 0.625.

Entering = S_3 , Departing = S_2 , Key Element = 0.625

+ $R_2(\text{new}) = R_2(\text{old}) \div 0.625$

+ $R_1(\text{new}) = R_1(\text{old}) - 0.25R_2(\text{new})$

+ $R_3(\text{new}) = R_3(\text{old}) + 0.375R_2(\text{new})$

Iteration-4		C_j	20	10	15	0	0	0	
B	C_B	X_B	x_1	x_2	x_3	S_1	S_2	S_3	MinRatio
x_1	20	4.2	1	2.6	0	0.6	-0.4	0	
S_3	0	3.2	0	-3.4	0	-0.4	1.6	1	
x_3	15	1.2	0	-1.4	1	-0.4	0.6	0	
$Z = 102$		Z_j	20	31	15	6	1	0	
		$Z_j - C_j$	0	21	0	6	1	0	

Since all $Z_j - C_j \geq 0$

Hence, optimal solution is arrived with value of variables as :
 $x_1 = 4.2, x_2 = 0, x_3 = 1.2$

Max $Z = 102$



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