** 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

Find Random New

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 $Z = 20x_1 + 10x_2 + 15x_3$

subject to

$3x_1 + 5x_2 + 2x_3 \le 15$

$2x_1 + x_2 + 3x_3 \le 12$

$2x_1 + 3x_2 + 4x_3 \ge 10$

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 ' $\le$ ' we should add slack variable S_1

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

3. As the constraint-3 is of type ' $\ge$ ' we should subtract surplus variable S_3 and add artificial variable A_1

After introducing slack,surplus,artificial variables

Max $Z = 20x_1 + 10x_2 + 15x_3 + 0S_1 + 0S_2 + 0S_3 - MA_1$

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 $x_1, x_2, x_3, S_1, S_2, S_3, A_1 \ge 0$

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	$-M$	
		$Z_j - C_j$	$-2M - 20$	$-3M - 10$	$-4M - 15 \uparrow$	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.

$\therefore$ The pivot element is 4.

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

+ R_3(new) = R_3(old) ÷ 4

+ R_1(new) = R_1(old) - $2R_3$(new)

+ R_2(new) = R_2(old) - $3R_3$(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(new) = R_1(old) ÷ 2

+ R_2(new) = R_2(old) - $0.5R_1$(new)

+ R_3(new) = R_3(old) - $0.5R_1$(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(new) = R_2(old) ÷ 0.625

+ R_1(new) = R_1(old) - $0.25R_2$(new)

+ R_3(new) = R_3(old) + $0.375R_2$(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 $Z = 102$

Solution provided by AtoZmath.com

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

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