**التمرين الأول:**

 باستخدام طريقة السمبلكس أوجد الحلول المثلى لنماذج البرمجة الخطية أدناه.

|  |  |  |
| --- | --- | --- |
| *Min Z= -6 x1 -7 x2 -8 x3*  *Soumise aux contraintes*  *x1 + 2 x2+ x3 ≤100* *3 x1 + 4 x2+2 x3 ≤ 120* *2 x1 + 4 x2+ 6 x3 ≤ 200* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0* | *Max Z= 7 x1+4 x2 +6 x3  Soumise aux contraintes*  *4 x1 + 2 x2+ 4 x3 ≤100* *2 x1 + 2 x2+ x3 ≤ 80* *x1 + 3 x2+ 2 x3 ≤ 40* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0*  | *Max Z= 40 x1+60 x2 -20 x3  Soumise aux contraintes*  *3 x1 + 6 x2 ≤300* *4 x1 + 2 x2+ x3 ≤ 220* *x2+ x3 ≤ 100* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0*  |

**حل التمرين الأول:**

**أولا:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | -20 | 60 | 40 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 50 | 300 | 0 | 0 | 1 | 0 | 6 | 3 | ***S1*** | 0 |
| 110 | 220 | 0 | 1 | 0 | 1 | 2 | 4 | ***S2*** | 0 |
| 100 | 100 | 1 | 0 | 0 | 1 | 1 | 0 | ***S3*** | 0 |
| **Z = 00** | 0 | 0 | 0 | 0 | 0 | 0 | ***Zj =∑Cj xj*** |
| 0 | 0 | 0 | -20 | 60 | 40 | ***Z=Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | -20 | 60 | 40 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 100 | 50 | 0 | 0 | 1/6 | 0 | 1 | 1/2 | ***x2*** | 60 |
| 40 | 120 | 0 | 1 | -1/3 | 1 | 0 | 3 | ***S2*** | 0 |
| / | 50 | 1 | 0 | -1/6 | 1 | 0 | -1/2 | ***S3*** | 0 |
| **Z = 3000** | 0 | 0 | 10 | 0 | 60 | 30 | ***Zj =∑Cj xj*** |
| 0 | 0 | -10 | -20 | 0 | 10 | ***Z=Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | -20 | 60 | 40 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 30 | 0 | -1/6 | 2/9 | -1/6 | 1 | 0 | ***x2*** | 60 |
|  | 40 | 0 | 1/3 | -1/9 | 1/3 | 0 | 1 | ***x1*** | 40 |
|  | 70 | 1 | 1/6 | -2/9 | 7/6 | 0 | 0 | ***S3*** | 0 |
| **Z = 3400** | 0 | 10/3 | 80/9 | 10/3 | 60 | 40 | ***Zj =∑Cj xj*** |
| 0 | -10/3 | -80/9 | -50/3 | 0 | 0 | ***Z=Cj - Zj*** |

**الحل الأمثل هو:**  *x1=40, x2=30, x3=0, S1=0, S2=0, S3=70*

**ثانيا:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | 06 | 04 | 07 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 25 | 100 | 0 | 0 | 1 | 4 | 2 | 4 | ***S1*** | 0 |
| 40 | 80 | 0 | 1 | 0 | 1 | 2 | 2 | ***S2*** | 0 |
| 40 | 40 | 1 | 0 | 0 | 2 | 3 | 1 | ***S3*** | 0 |
| **Z = 00** | 0 | 0 | 0 | 0 | 0 | 0 | ***Zj =∑Cj xj*** |
| 0 | 0 | 0 | 06 | 04 | 07 | ***Z=Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | 06 | 04 | 07 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 50 | 25 | 0 | 0 | 1/4 | 1 | 1/2 | 1 | ***x1*** | 07 |
| 30 | 30 | 0 | 1 | -1/2 | -1 | 1 | 0 | ***S2*** | 0 |
| 06 | 15 | 1 | 0 | -1/4 | 1 | 5/2 | 0 | ***S3*** | 0 |
| **Z = 175** | 0 | 0 | 7/4 | 07 | 7/2 | 07 | ***Zj =∑Cj xj*** |
| 0 | 0 | -7/4 | -01 | 1/2 | 0 | ***Z=Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | 06 | 04 | 07 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 22 | -1/5 | 0 | 3/10 | 4/5 | 0 | 1 | ***x1*** | 07 |
|  | 24 | -2/5 | 1 | -2/5 | -7/5 | 0 | 0 | ***S2*** | 0 |
|  | 06 | 2/5 | 0 | -1/10 | 2/5 | 1 | 0 | ***x2*** | 04 |
| **Z = 178** | 1/5 | 0 | 17/10 | 36/5 | 04 | 07 | ***Zj =∑Cj xj*** |
| -1/5 | 0 | -17/10 | -6/5 | 0 | 0 | ***Z=Cj - Zj*** |

**الحل الأمثل هو:**  *x1=22, x2=6, x3=0, S1=0, S2=24, S3=0*

**ثالثا:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | -08 | -07 | -06 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 100 | 100 | 0 | 0 | 1 | 1 | 2 | 1 | ***S1*** | 0 |
| 60 | 120 | 0 | 1 | 0 | 2 | 4 | 3 | ***S2*** | 0 |
| 50 | 200 | 1 | 0 | 0 | 4 | 6 | 2 | ***S3*** | 0 |
| **Z = 00** | 0 | 0 | 0 | 0 | 0 | 0 | ***Zj =∑Cj xj*** |
| 0 | 0 | 0 | -08 | -07 | -06 | ***Z=Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | -08 | -07 | -06 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 100 | 50 | -1/4 | 0 | 1 | 0 | 1/2 | 1/2 | ***S1*** | 0 |
| 10 | 20 | -1/2 | 1 | 0 | 0 | 1 | 2 | ***S2*** | 0 |
| 100 | 50 | 1/4 | 0 | 0 | 1 | 3/2 | 1/2 | ***x3*** | -08 |
| **Z = - 400** | -02 | 0 | 0 | -08 | -12 | -04 | ***Zj =∑Cj xj*** |
| 02 | 0 | 0 | 0 | 05 | -02 | ***Z=Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | -08 | -07 | -06 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 45 | -1/8 | -1/4 | 1 | 0 | 3/4 | 0 | ***S1*** | 0 |
|  | 10 | -1/4 | 1/2 | 0 | 0 | 1/2 | 1 | ***x1*** | -06 |
|  | 45 | 3/8 | -1/4 | 0 | 1 | 5/4 | 0 | ***x3*** | -08 |
| **Z = - 420** | -3/2 | -01 | 0 | -08 | -13 | 06 | ***Zj =∑Cj xj*** |
| 3/2 | 01 | 0 | 0 | 06 | 0 | ***Z=Cj - Zj*** |

**الحل الأمثل هو:**  *x1=10, x2=0, x3=45, S1=45, S2=0, S3=0*

**التمرين الثاني:**

 باستخدام طريقة السمبلكس أوجد الحلول المثلى لنماذج البرمجة الخطية أدناه.

|  |  |  |
| --- | --- | --- |
| *Min Z= 80 x1+120 x2 +84 x3*  *Soumise aux contraintes*  *5x1 +15 x2+7 x3 ≥ 20* *10 x1 + 12 x2+21 x3 ≥ 15* *4 x1 + 5 x2+ 3 x3 ≥ 18* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0* | *Min Z= 100 x1+80 x2 +40 x3  Soumise aux contraintes*  *4 x1 + 2 x2+ x3 ≥ 7* *2 x1 + 2 x2+3 x3 ≥ 4* *4x1 + x2+ 2 x3 ≥ 6**x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0*  | *Min Z=100 x1+120 x2 +200 x3  Soumise aux contraintes*  *x1 + 3 x2 + 2x3 ≥ 6* *2 x1 + 4 x2+6 x3 ≥ 7* *x1+ 2x2 +4 x3 ≥ 8* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0* |

**حل التمرين الثاني:**

|  |  |  |
| --- | --- | --- |
| *Min Z=100 x1+120 x2 +200 x3+M a1+M a2+Ma3*  *Soumise aux contraintes*  *x1 + 3 x2 + 2x3 - S1+a1 = 6* *2 x1 + 4 x2+6 x3 - S2+a2 = 7* *x1+ 2x2 +4 x3 - S3+a3 =8* *x1 ≥ 0, x2 ≥ 0, x3 ≥ 0,*  *S1 ≥ 0, S2 ≥ 0, S3 ≥ 0≥ 0, a1 ≥ 0, a2 ≥ 0, a3 ≥ 0* | ⇒ | *Min Z=100 x1+120 x2 +200 x3  Soumise aux contraintes*  *x1 + 3 x2 + 2x3 ≥ 6* *2 x1 + 4 x2+6 x3 ≥ 7* *x1+ 2x2 +4 x3 ≥ 8* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0* |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 200 | 120 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 02 | 06 | 0 | 0 | 1 | 0 | 0 | -1 | 2 | 3 | 1 | ***a1*** | M |
| 7/4 | 07 | 0 | 1 | 0 | 0 | -1 | 0 | 6 | 4 | 2 | ***a2*** | M |
| 04 | 08 | 1 | 0 | 0 | -1 | 0 | 0 | 4 | 2 | 1 | ***a3*** | M |
| **Z = 21 M** | M | M | M | - M | - M | - M | 12M | 9M | 4M | ***Zj***  |
| 0 | 0 | 0 | M | M | M | 200-12M | 120-9M | 100-4M | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 200 | 120 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 01 | 3/4 | 0 | / | 1 | 0 | 3/4 | -1 | -5/2 | 0 | -1/2 | ***a1*** | M |
| / | 7/4 | 0 | / | 0 | 0 | -1/4 | 0 | 3/2 | 1 | 1/2 | ***x2*** | 120 |
| 08 | 9/2 | 1 | / | 0 | -1 | 1/2 | 0 | 1 | 1 | 0 | ***a3*** | M |
| **210+21/4 M** | M | / | M | - M | -30+5/2M | - M | 180-3/2M | 120 | 60-1/2M | ***Zj***  |
| 0 | / | 0 | M | 30-5/2M | M | 20+3/2M | 0 | 100-4M | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 200 | 120 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| / | 01 | 0 | / | / | 0 | 1 | -4/3 | -10/3 | 0 | -2/3 | ***S2*** | 0 |
| 03 | 02 | 0 | / | / | 0 | 0 | -1/3 | 2/3 | 1 | 1/3 | ***x2*** | 120 |
| 3/2 | 04 | 1 | / | / | -1 | 0 | 2/3 | 8/3 | 0 | 1/3 | ***a3*** | M |
| **Z = 240+4 M** | M | / | / | - M | 0 | -40+2/3M | 80+8/3M | 120 | 40+1/3M | ***Zj***  |
| 0 | / | / | M | 0 | 40-2/3M | 120-8/2M | 0 | 60-1/3M | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 200 | 120 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 06 | / | / | / | -5/4 | 1 | -1/2 | 0 | 0 | -1/4 | ***S2*** | 0 |
|  | 01 | / | / | / | 1/4 | 0 | -1/2 | 0 | 1 | 1/4 | ***x2*** | 120 |
|  | 3/2 | / | / | / | -3/8 | 0 | 1/4 | 1 | 0 | 1/8 | ***x3*** | 200 |
| **Z = 420** | / | / | / | - 45 | 0 | - 10 | 200 | 120 | 145 | ***Zj***  |
| / | / | / | 45 | 0 | 10 | 0 | 0 | - 45 | ***Cj - Zj*** |

**الحل الأمثل هو:**  *x1=0, x2=01, x3=3/2, S1=0, S2=06, S3=0*

|  |  |  |
| --- | --- | --- |
| *Min Z=100 x1+120 x2 +200 x3+M a1+M a2+Ma3*  *Soumise aux contraintes*  *4 x1 + 2 x2 + x3 - S1+a1 = 7* *2 x1 + 2 x2 +3 x3 - S2+a2 = 4* *4 x1 + x2 + 2 x3 - S3+a3 =6* *x1 ≥ 0, x2 ≥ 0, x3 ≥ 0,*  *S1 ≥ 0, S2 ≥ 0, S3 ≥ 0≥ 0, a1 ≥ 0, a2 ≥ 0, a3 ≥ 0* | ⇒ | *Min Z=100 x1+80 x2 +40 x3  Soumise aux contraintes*  *4 x1 + 2 x2 + x3 ≥ 7* *2 x1 + 2 x2 +3 x3 ≥ 4* *4 x1 + x2 + 2 x3 ≥ 6* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0* |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 40 | 80 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 7/4 | 07 | 0 | 0 | 1 | 0 | 0 | -1 | 1 | 2 | 4 | ***a1*** | M |
| 03 | 06 | 0 | 1 | 0 | 0 | -1 | 0 | 3 | 2 | 2 | ***a2*** | M |
| 01 | 04 | 1 | 0 | 0 | -1 | 0 | 0 | 2 | 1 | 4 | ***a3*** | M |
| **Z = 17 M** | M | M | M | - M | - M | - M | 6M | 5M | 10M | ***Zj***  |
| 0 | 0 | 0 | M | M | M | 40-6M | 80-5M | 100-10M | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 40 | 80 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 01 | 01 | / | 0 | 1 | 1 | 0 | -1 | -1 | 1 | 0 | ***a1*** | M |
| 2/3 | 01 | / | 1 | 0 | 1/2 | -1 | 0 | 2 | 3/2 | 0 | ***a2*** | M |
| 06 | 3/2 | / | 0 | 0 | -1/4 | 0 | 0 | 1/2 | 1/4 | 1 | ***x1*** | 100 |
| **Z=150+2 M** | / | M | M | -25+3/2M | -M | - M | 50+M | 25+5/2M | 100 | ***Zj***  |
| / | 0 | 0 | 25-3/2M | M | M | 10 - M | 55-5/2M | 0 | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 40 | 80 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 1/2 | 1/3 | / | / | 1 | 2/3 | 2/3 | -1 | -7/3 | 0 | 0 | ***a1*** | M |
| 02 | 2/3 | / | / | 0 | 1/3 | -2/3 | 0 | 4/3 | 1 | 0 | ***x2*** | 80 |
| / | 4/3 | / | / | 0 | -1/3 | 1/6 | 0 | 1/6 | 0 | 1 | ***x1*** | 100 |
| **560/3+1/3 M** | / | / | M | -20/3+2/3M | -110/3+2/3M | - M | 370/3-7/3M | 80 | 100 | ***Zj***  |
| / | / | 0 | 20/3-2/3M | 110/3+2/3M | M | -250/3-7/3M | 0 | 0 | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 40 | 80 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| / | 1/2 | / | / | / | 1 | 1 | -3/2 | -7/3 | 0 | 0 | ***S3*** | 0 |
| 1/5 | 1/2 | / | / | / | 0 | -1 | 1/2 | 5/2 | 1 | 0 | ***x2*** | 80 |
| 3/2 | 3/2 | / | / | / | 0 | 1/2 | -1/2 | 1 | 6 | 1 | ***x1*** | 100 |
| **Z = 190** | / | / | / | 0 | -30 | -10 | 100 | 80 | 100 | ***Zj***  |
| / | / | / | 0 | 30 | 10 | -60 | 0 | 0 | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 40 | 80 | 100 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 6/5 | / | / | / | 1 | -2/5 | -4/5 | 0 | 7/5 | 0 | ***S2*** | 0 |
|  | 1/5 | / | / | / | 0 | -2/5 | 1/5 | 1 | 2/5 | 0 | ***x3*** | 40 |
|  | 17/10 | / | / | / | 0 | 1/10 | -3/10 | 0 | 2/5 | 1 | ***x1*** | 100 |
| **Z = 178** | / | / | / | 0 | 0 | - 22 | 40 | 104 | 100 | ***Zj***  |
| / | / | / | 0 | 0 | 0 | 0 | 24 | 0 | ***Cj - Zj*** |

**الحل الأمثل هو:**  *x1=17/10, x2=0, x3=1/5, S1=0, S2=6/5, S3=0*

|  |  |  |
| --- | --- | --- |
| *Min Z=100 x1+120 x2 +200 x3+M a1+M a2+Ma3*  *Soumise aux contraintes*  *5 x1 + 15 x2 +7 x3 - S1+a1 = 20* *10 x1 + 12 x2 +21 x3 - S2+a2 = 15* *4 x1 + 5 x2 + 3 x3 - S3+a3 =18* *x1 ≥ 0, x2 ≥ 0, x3 ≥ 0,*  *S1 ≥ 0, S2 ≥ 0, S3 ≥ 0≥ 0, a1 ≥ 0, a2 ≥ 0, a3 ≥ 0* | ⇒ | *Min Z=80 x1+120 x2 +84 x3  Soumise aux contraintes*  *5 x1 + 15 x2 +7 x3 ≥ 20* *10 x1 + 12 x2 +21 x3 ≥ 15* *4 x1 + 5 x2 + 3 x3 ≥ 18* *x1 ≥ 0 , x2 ≥ 0, x3 ≥ 0* |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Ri*** | ***B*** ***rayon*** | M | M | M | 0 | 0 | 0 | 84 | 120 | 80 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 4/3 | 20 | 0 | 0 | 1 | 0 | 0 | -1 | 7 | 15 | 5 | ***a1*** | M |
| 5/4 | 15 | 0 | 1 | 0 | 0 | -1 | 0 | 21 | 12 | 10 | ***a2*** | M |
| 18/5 | 18 | 1 | 0 | 0 | -1 | 0 | 0 | 3 | 5 | 4 | ***a3*** | M |
| **Z = 53 M** | M | M | M | - M | - M | - M | 37M | 32M | 19M | ***Zj***  |
| 0 | 0 | 0 | M | M | M | 84-31M | 120-32M | 80-19M | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 84 | 120 | 80 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| 1 | 5/4 | 0 | / | 1 | 0 | 5/4 | -1 | -77/4 | 0 | -15/2 | ***a1*** | M |
| / | 5/4 | 0 | / | 0 | 0 | -1/12 | 0 | 7/4 | 1 | 5/6 | ***x2*** | 120 |
| 141/5 | 47/4 | 1 | / | 0 | -1 | 5/12 | 0 | -23/4 | 0 | -1/6 | ***a3*** | M |
| **Z = 150+13 M** | M | / | M | - M | -10+5/3M | - M | 210+25M | 120 | 100-91/6M | ***Zj***  |
| 0 | / | 0 | M | 10-5/3M | M | -126 +25 M | 0 | -20+91/6M | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 84 | 120 | 80 | *Cj* |
| ***t3*** | ***t2*** | ***t1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| / | 1 | 0 | / | / | 0 | 1 | -4/5 | -77/3 | 0 | -6 | ***S2*** | 0 |
| 4 | 4/3 | 0 | / | / | 0 | 0 | -1/15 | 7/15 | 1 | 1/3 | ***x2*** | 120 |
| 34/7 | 34/3 | 1 | / | / | -1 | 0 | 1/3 | 2/3 | 0 | 7/3 | ***a3*** | M |
| **160+34/3 M** | M | / | / | -M | 0 | 8+1/3M | 56+2/3M | 120 | 40+7/3M | ***Zj***  |
| 0 | / | / | M | 0 | -8-1/3M | 28+2/3M | 0 | 40-7/3M | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Ri*** | ***B*** ***rayon*** | M | M | M | 0 | 0 | 0 | 84 | 120 | 80 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 25 | 0 | / | / | 0 | 1 | -2 | -7 | 18 | 0 | ***S2*** | 0 |
|  | 04 | 0 | / | / | 0 | 0 | -1/5 | 7/5 | 3 | 1 | ***x1*** | 80 |
|  | 02 | 1 | / | / | -1 | 0 | 4/5 | 13/5 | -7 | 0 | ***a3*** | M |
| **Z = 320+2M** | M | / | / | -M | 0 | -16+4/5M | 112-13/5M | 240-7M | 80 | ***Zj***  |
| 0 | / | / | M | 0 | 16-4/5M | -28+13/5M | -120+7M | 0 | ***Cj - Zj*** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | M | M | M | 0 | 0 | 0 | 84 | 120 | 80 | *Cj* |
| ***a3*** | ***a2*** | ***a1*** | ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 30 | / | / | / | -5/2 | 1 | 0 | -27/2 | 1/2 | 0 | ***S2*** | 0 |
|  | 9/2 | / | / | / | -1/4 | 0 | 0 | 3/4 | 5/4 | 1 | ***x1*** | 80 |
|  | 5/2 | / | / | / | -5/4 | 0 | 1 | -13/4 | -35/4 | 0 | ***S1*** | 0 |
| **Z = 360** | / | / | / | -20 | 0 | 0 | 60 | 100 | 80 | ***Zj***  |
| / | / | / | 20 | 0 | 0 | 24 | 20 | 0 | ***Cj - Zj*** |

**الحل الأمثل هو:**  *x1=9/2, x2=0, x3=0, S1=5/2, S2=30, S3=0*

**التمرين الأول:** لتكن نماذج البرمجة الخطية التالية:

|  |  |
| --- | --- |
| *Max Z= 20 x1+15 x2 +18 x3**Soumise aux contraintes* *5x1 + 10x2 +4x3 ≤ 80**15x1 + 12x2 +5x3 ≤ 120* *7x1 + 21x2 +3x3 ≤ 84* *x1≥0, x2≥0, x3≥0* | *Max Z= 10 x1+15 x2**Soumise aux contraintes**2x1 + 4x2 ≤ 40**6x1 + 2x2 ≤ 60* *0x1≥0, x2≥0* |
| ***x1=0, x2=0, x3=20* الحل الأمثل:**  | **الحل الأمثل: *x1=8, x2=6*** |
| *Min W= 30 y1+24 y2 +18y3* *Soumise aux contraintes**5y1 + 2y2+ y3 ≥ 80* *3y1 + 3y2+ 3y3 ≥ 84**y1≥0, y2≥0, y3≥0* | *Min W= 4200y1+2250y2 +2600y3+4200y4* *Soumise aux contraintes**3y1 + y2+ 2y3+ y4 ≥ 66* *4y1 + 3y2+2 y3 ≥ 84**y1≥0, y2≥0, y3≥0, y4≥0* |
| ***y1=13, y2=0, y3=15* الحل الأمثل:** | ***y1=18, y2=0, y3=6, y4=0* الحل الأمثل:** |

**المطلوب:**

**1-** أوجد النماذج الثنائية للنماذج الأصلية، و العكس؛

**2-** باستخدام نظرية الفجوة المكملة، و انطلاقا من الحلول المثلى للنماذج الأولية أوجد الحلول المثلى للنماذج الثنائية و العكس.

**حل التمرين الأول:**

**1- إيجاد النموذج الثنائي للنموذج الأولي:**

|  |  |  |
| --- | --- | --- |
| *Min W=80 y1+120 y2 +84 y3**Soumise aux contraintes**5y1 + 15y2 +7y3 ≥ 20**10y1 + 12y2 +21y3 ≥ 15**4y1 + 5y2 +3y3 ≥ 18**y1≥0, y2≥0, y3≥0* | ⇒ | *Max Z= 20 x1+15 x2 +18 x3**Soumise aux contraintes**5x1 + 10x2 +4x3 ≤ 80**15x1 + 12x2 +5x3 ≤ 120**7x1 + 21x2 +3x3 ≤ 84**x1≥0, x2≥0, x3≥0* |

**2- استنتاج الحل الأمثل للنموذج الثنائي بناءً على نظرية الفجوات المكملة (*Si y′i=0* و *ki x′i=0*):**

*Max Z= 20 x1+15 x2 +18 x3*

*Soumise aux contraintes*

*5(0)+ 10(0)+4(20)+* ***S1*** *= 80* ⇒***S1*** *= 0* ⇒***y1*** *˃ 0*

*15(0)+ 12(0)+5(20)+* ***S2*** *= 120* ⇒***S2*** *= 20* ⇒***y2*** *= 0*

*7(0)+ 21(0)+3(20)+* ***S3*** *= 84* ⇒***S3*** *= 24* ⇒***y3*** *= 0*

*Min W=80 y1+120 y2 +84 y3*

*Soumise aux contraintes*

*5y1 + 15(0)+7(0)-* ***k1*** *= 20*

*10y1 + 12(0)+21(0)-* ***k2*** *= 15*

*4y1 + 5(0)+3(0)-* ***(0)*** *= 18* ⇒***y1****= 9/2*

*5(9/2) -* ***k1*** *= 20* ⇒***k1****= 5/2*

*10(9/2)-* ***k2*** *= 15* ⇒***k2****= 30*

**الحل الأمثل للنموذج الثنائي هو:** *y1=9/2, y2=0, y3=0, k1=5/2, k2=30, k3=0*

**1- إيجاد النموذج الثنائي للنموذج الأولي:**

|  |  |  |
| --- | --- | --- |
| *Min W=40 y1+60 y2* *Soumise aux contraintes**2 y1 + 6 y2 ≥ 10**4 y1 + 2 y2 ≥ 15* *y1≥0, y2≥0* | ⇒ | *Max Z= 10 x1+15 x2**Soumise aux contraintes**2 x1 + 4 x2 ≤ 40**6 x1 + 2 x2 ≤ 60* *x1≥0, x2≥0* |

**2- استنتاج الحل الأمثل للنموذج الثنائي بناءً على نظرية الفجوات المكملة (*Si y′i=0* و *ki x′i=0*):**

*Max Z= 10 x1+15 x2*

*Soumise aux contraintes*

*2 (8)+ 4 (6)+* ***S1*** *= 40* ⇒***S1*** *= 0* ⇒***y1*** *˃ 0*

*6 (8)+ 2 (6)+* ***S2*** *= 60* ⇒***S2*** *= 0* ⇒***y2*** *˃ 0*

*Min W=40 y1+60 y2*

*Soumise aux contraintes*

*2 y1 + 6 y2 -* ***k1*** *= 10* ⇒ *2 y1 + 6 y2 -* ***(0)*** *= 10* ⇒ *2 y1 + 6 y2 = 10*

*4 y1 + 2 y2 -* ***k2*** *= 15* ⇒ *4 y1 + 2 y2 -* ***(0)*** *= 15* ⇒ *-12 y1 - 6 y2 = - 45*

*-10 y1 = - 45* ⇒  *y1 = 9/2*

*2 (9/2)+ 6 y2 = 10* ⇒  *y2 = 1/6*

**الحل الأمثل للنموذج الثنائي هو:** *y1=9/2, y2=1/6, k1=0, k2=0*

**1- إيجاد النموذج الأولي للنموذج الثنائي:**

|  |  |  |
| --- | --- | --- |
| *Max Z= 80 x1+84 x2* *Soumise aux contraintes**5x1 + 3x2 ≤ 30* *2x1 + 3x2 ≤ 24**x1 + 3x2 ≤ 18* *x1≥0, x2≥0* | ⇒ | *Min W= 30 y1+24 y2 +18y3* *Soumise aux contraintes**5y1 + 2y2+ y3 ≥ 80* *3y1 + 3y2+ 3y3 ≥ 84* *y1≥0, y2≥0, y3≥0* |

**2- استنتاج الحل الأمثل للنموذج الأولي بناءً على نظرية الفجوات المكملة (*Si y′i=0* و *ki x′i=0*):**

*Min W= 30 y1+24 y2 +18y3*

*Soumise aux contraintes*

*5(13)+ 2(0)+ (15) -* ***k1****= 80* ⇒***k1*** *= 0* ⇒***x1*** *˃ 0*

 *3(13)+ 3(0)+ 3(15) -* ***k2****= 84* ⇒***k2*** *= 0* ⇒***x2*** *˃ 0*

*Max Z= 80 x1+84 x2*

*Soumise aux contraintes*

*5x1 + 3x2 +****(0)****= 30 5x1 + 3x2 = 30*

*2x1 + 3x2 +****S2*** *= 24* ⇒ *- x1 - 3x2 = -18* ⇒ *4 x1 = 12* ⇒***x1 = 3*** *,* ***x2 = 5***

 *x1 + 3x2 +****(0)****= 18*

**الحل الأمثل للنموذج الأولي هو:** *S2=0, S3=0**x1=3, x2=5, S1=0,*

**1- إيجاد النموذج الأولي للنموذج الثنائي:**

|  |  |  |
| --- | --- | --- |
| *Max Z= 66 x1+84 x2* *Soumise aux contraintes**3x1 + 4x2 ≤ 4200* *x1 + 3x2 ≤ 2250**2x1 + 2x2 ≤ 2600* *x1 ≤ 4200* *x1≥0, x2≥0* | ⇒ | *Min W= 4200y1+2250y2 +2600y3+4200y4* *Soumise aux contraintes**3y1 + y2+ 2y3+ y4 ≥ 66* *4y1 + 3y2+2 y3 ≥ 84**y1≥0, y2≥0, y3≥0, y4≥0* |

**2- استنتاج الحل الأمثل للنموذج الأولي بناءً على نظرية الفجوات المكملة (*Si y′i=0* و *ki x′i=0*):**

*Min W= 4200y1+2250y2 +2600y3+4200y4*

*Soumise aux contraintes*

*3(18)+ (0)+ 2(6)+ (0) -* ***k1****= 66* ⇒***k1*** *= 0* ⇒***x1*** *˃ 0*

*4(18)+ 3(0)+2 (6) -* ***k2****= 84* ⇒***k2*** *= 0* ⇒***x2*** *˃ 0*

*Max Z= 66 x1+84 x2*

*Soumise aux contraintes*

*3x1+ 4x2 +****(0)****= 4200* ⇒ *3x1+ 4x2 = 4200*  ⇒ *3x1+ 4x2 = 4200*

 *x1+ 3x2 +****S2*** *= 2250 2x1+ 2x2 = 2600 - 4x1 - 4x2 = -5200* ⇒ ***x1=1000***

*2 x1+ 2x2 +****(0)****= 2600*

*x1+****S4*** *= 4200*

*3(1000)+ 4x2 = 4200* ⇒ ***x2 = 300***

 *(1000)+ 3(300)+****S2*** *= 2250* ⇒ ***S2 = 350***

*2 (1000)+ 2(300)= 2600*

*1000+****S4*** *= 4200* ⇒ ***S4*** *= 3200*

**الحل الأمثل للنموذج الأولي هو:** *S2=350, S3=0, S4=3200**x1=1000, x2=300, S1=0,*

**التمرين الثاني:** ليكن نموذج البرمجة الخطية التالي:

*Max Z=5x1+3x2+6x3*

*Soumise aux contraintes*

 *x1+2x2+x3 ≤ 30*

 *2 x1+x2+3x3 ≤ 48*

 *x1+x2+2x3 ≤ 32*

 *x1 ≥ 0, x2 ≥ 0, x3 ≥ 0*

**المطلوب:**

**1-** تطبيق طريقة السمبلكس يسمح لنا بالحصول على الجدول التالي:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Ri*** | ***B rayon*** | 0 | 0 | 0 | 06 | 03 | 05 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 07 | -5/2 | 3/2 | 1/2 | 0 | 0 | 1 | ***x1*** | 05 |
|  | 09 | 3/2 | -1/2 | -1/2 | 1 | 0 | 0 | ***x3*** | 06 |
|  | 07 | 1/2 | -1/2 | 1/2 | 0 | 1 | 0 | ***x2*** | 03 |
| Z = 110 | -2 | 3 | 1 | 6 | 3 | 5 | ***Zj***  |
| 2 | -3 | -1 | 0 | 0 | 0 | ***Cj – Zj*** |

هل جدول السمبلكس أعلاه يمثل الحل الأمثل؟ اشرح.

**2-** أوجد جدول الحل الأمثل؛

**3-** شكِّل نموذج البرمجة الخطية الثنائي للنموذج الأولي أعلاه؛

**4-** انطلاقا من جدول سمبلكس الحل الأمثل المتوصل إليه، قم بقراءة الحل الأمثل للنموذج الثنائي الموافق للنموذج الأصلي.

**حل التمرين الثاني:**

**1-** **لا**، جدول السمبلكس أعلاه **لا** يمثل الحل الأمثل، لأن قيم (***Cj – Zj***) لا تحقق شرط الأمثلية.

1. **إيجاد جدول الحل الأمثل:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | 06 | 03 | 05 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
| / | 07 | -5/2 | 3/2 | 1/2 | 0 | 0 | 1 | ***x1*** | 05 |
| 06 | 09 | 3/2 | -1/2 | -1/2 | 1 | 0 | 0 | ***x3*** | 06 |
| 14 | 07 | 1/2 | -1/2 | 1/2 | 0 | 1 | 0 | ***x2*** | 03 |
| Z = 110 | -2 | 3 | 1 | 6 | 3 | 5 | ***Zj***  |
| 2 | -3 | -1 | 0 | 0 | 0 | ***Cj – Zj*** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $$\frac{b\_{i}}{a\_{ij}}$$ | $$b\_{i}$$ | 0 | 0 | 0 | 06 | 03 | 05 | *Cj* |
| ***S3*** | ***S2*** | ***S1*** | ***x3*** | ***x2*** | ***x1*** |
|  | 22 | 0 | 2/3 | -1/3 | 5/3 | 0 | 1 | ***x1*** | 05 |
|  | 06 | 1 | -1/3 | -1/3 | 2/3 | 0 | 0 | ***S3*** | 00 |
|  | 04 | 0 | -1/3 | 2/3 | -1/3 | 1 | 0 | ***x2*** | 03 |
| Z = 122 | 0 | 7/3 | 1/3 | 22/3 | 3 | 5 | ***Zj***  |
| 0 | -7/3 | -1/3 | -4/3 | 0 | 0 | ***Cj – Zj*** |

**الحل الأمثل للنموذج الأولي هو:** *S2=0, S3=06**x1=22, x2=04, S1=0,*

1. **تشكيل نموذج البرمجة الخطية الثنائي للنموذج الأولي:**

*Min W=30 y1+48 y2 +32 y3*

*Soumise aux contraintes*

 *y1 + 2y2 +y3 ≥ 5*

 *2y1 + y2 +y3 ≥ 3*

*y1 + 3y2 +2y3 ≥ 6*

*y1≥0, y2≥0, y3≥0*

1. **قراءة الحل الأمثل للنموذج الثنائي الموافق للنموذج الأصلي انطلاقا من جدول السمبلكس**:

***yi = - Zj*** ⇒ *y1 = - 1/3, y2 = - 7/3, y3 = 0*

***ki* *= -(C j – Z j)***⇒ *x1 = 0, y2 = 0, y3 = 4/3*

**التمرين الثالث:** ليكن نموذج البرمجة الخطية التالي:

*Max Z = 600 x1 + 800 x2 + 500 x3*

*Soumise aux contraintes*

 *4x1+2x2+4x3 ≤ 500*

 *2x1+2x2+x3 ≤ 400*

 *x1+3x2+2x3 ≤ 200*

 *x1 ≥ 0, x2 ≥ 0, x3 ≥ 0*

أثناء عملية تطبيق طريقة السمبلكس تم التوصل إلى الجدول أدناه:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *B* | 00 | 00 | 00 | 500 | 800 | 600 | *Cj*  |
| *S3* | *S2* | *S1* | *x3* | *x2* | *x1* |
| 110 | -1/5 | 0 | 3/10 | 4/5 | 0 | 1 | *x1* | 600 |
| 120 | -2/5 | 1 | -2/5 | -7/5 | 0 | 0 | *S2* | 00 |
| 30 | 2/5 | 0 | -1/10 | 2/5 | 1 | 0 | *x2* | 800 |
| *Z* = 90000 | 200 | 0 | 100 | 800 | 800 | 600 | *Zj* |
| -200 | 0 | -100 | -300 | 00 | 00 | *Z = Cj - Zj* |

**المطلوب:1-** هل الحل المتوصل إليه هو حل أمثل؟ و لماذا؟ قدم الحل الأمثل للنموذج أعلاه؛

 **2-** بافتراض أن الربح الوحدوي للمنتج الثاني قد تغير بمقدار *ΔC2* ، حدد مجال تغيره لكي يبقى الحل أمثلا. و في حال انخفاض هذا الربح بمقدار (- 420) هل يبقى الحل أمثلا؟

 **3-** بافتراض أن هذه المؤسسة قررت إضافة مورد جديد يستخدم كالتالي: ***4 x1 + 2 x2 + 4 x3 ≤ 300***

هل يبقى الحل أمثلا في هذه الحالة؟ قدم الحل الأمثل.

**حل التمرين الثالث:**

**1-** **نعم** الحل المتوصل إليه هو **حل أمثل**، حيث:

*x1 =110, x2 =30, x3 =0*

*S1 =0, S2 =120, S3=0*

**2-** **بافتراض أن الربح الوحدوي للمنتج الثاني قد تغير بمقدار *ΔC2* :**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *B* | 00 | 00 | 00 | 500 | 800+*ΔC2* | 600 | *Cj*  |
| *S3* | *S2* | *S1* | *x3* | *x2* | *x1* |
| 110 | -1/5 | 00 | 3/10 | 4/5 | 00 | 01 | *x1* | 600 |
| 120 | -2/5 | 01 | -2/5 | -7/5 | 00 | 00 | *S2* | 00 |
| 30 | 2/5 | 00 | -1/10 | 2/5 | 01 | 00 | *x2* | 800+*ΔC2* |
| *Z* = 90000 | 200+2/5*ΔC2* | 00 | 100-1/10*ΔC2* | 800+2/5*ΔC2* | 800+*ΔC2* | 600 | *Zj* |
| -200-2/5*ΔC2* | 00 | -100+1/10*ΔC2* | -300-2/5*ΔC2* | 00 | 00 | *Z = Cj - Zj* |

**تحديد مجال تغير *ΔC2* لكي يبقى الحل أمثلا:**

 لكي يبقى الحل أمثلا يجب تحقق معيار الأمثلية لنموذج التعظيم: 0≥ *Cj - Zj* و عليه:*:*

-300-2/5*ΔC2 ≤ 0*⇒-2/5*ΔC2 ≤ 300* ⇒2/5*ΔC2 ≥ - 300* ⇒ *ΔC2 ≥ - 750*

-100+1/10*ΔC2 ≤ 0*⇒1/10*ΔC2 ≤ 100* ⇒ *ΔC2 ≤ 1000*

-200-2/5*ΔC2 ≤ 0*⇒ -2/5*ΔC2 ≤ 200* ⇒2/5*ΔC2 ≥ - 200* ⇒ *ΔC2 ≥ - 500*

 **-500 ≥ *ΔC2 ≤ 1000***إذن:

**في حال انخفاض هذا الربح بمقدار (- 420) نعم يبقى الحل أمثلا (تنخفض قيمته):**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *B* | 00 | 00 | 00 | 500 | 380 | 600 | *Cj*  |
| *S3* | *S2* | *S1* | *x3* | *x2* | *x1* |
| 110 | -1/5 | 00 | 3/10 | 4/5 | 00 | 01 | *x1* | 600 |
| 120 | -2/5 | 01 | -2/5 | -7/5 | 00 | 00 | *S2* | 00 |
| 30 | 2/5 | 00 | -1/10 | 2/5 | 01 | 00 | *x2* | 380 |
| ***Z* = 77400** | **32** | **00** | **142** | **632** | **380** | **600** | *Zj* |
| **-32** | **00** | **-142** | **-132** | **00** | **00** | *Z = Cj - Zj* |

**3-** **بافتراض أن هذه المؤسسة قررت إضافة مورد جديد يستخدم كالتالي: *4 x1 + 2 x2 + 4 x3 ≤ 300***

*Max Z = 600 x1 + 800 x2 + 500 x3*

*Soumise aux contraintes*

 *4x1+2x2+4x3 ≤ 500*

*2x1+2x2+x3 ≤ 400*

*x1+3x2+2x3 ≤ 200*

*4 x1 + 2 x2 + 4 x3 ≤ 300*

 *x1 ≥ 0, x2 ≥ 0, x3 ≥ 0*

عند تعويض قيم الحل الأمثل المتوصل إليه في الجدول أعلاه نحصل على:

*4(110)+2 (30)+4(0)+S4= 300* ⇒ *S4= -200*

* تُضرب قيم السطر الأول في القيمة (-4)، فنحصل على:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| -440 | 0 | 4/5 | 0 | -6/5 | -16/5 | 0 | -4 | ***x1*** |

* تُضرب قيم السطر الثالث في القيمة (-2)، فنحصل على:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| -60 | 0 | -4/5 | 0 | 1/5 | -4/5 | -2 | 0 | ***x2*** |

* أما بالنسبة للقيم الجديدة لسطر متغيرة الأساس ***S4*** يتم الحصول عليها عن طريق جمع قيم الأسطر الجديدة لمتغيرتي القرار الأولى و الثانية (السطر الأول و الثالث)، مع القيم القديمة لـــ  ***S4*** فنحصل على:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| -440 | 0 | 4/5 | 0 | -6/5 | -16/5 | 0 | -4 | ***x1*** |
| -60 | 0 | -4/5 | 0 | 1/5 | -4/5 | -2 | 0 | ***x2*** |
| 300 | 1 | 0 | 0 | 0 | 4 | 2 | 4 | ***S4*** |
| **-200** | **1** | **0** | **0** | **-1** | **0** | **0** | **0** | ***S4*** |

و بتعويض القيم الجديدة **فقط** لمتغيرة الأساس  ***S4***في جدول الحل الأمثل نحصل على:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *B* | **00** | 00 | 00 | 00 | 500 | 800 | 600 | *Cj*  |
| ***S4*** | *S3* | *S2* | *S1* | *x3* | *x2* | *x1* |
| 110 | **00** | -1/5 | 00 | 3/10 | 4/5 | 00 | 01 | *x1* | 600 |
| 120 | **00** | -2/5 | 01 | -2/5 | -7/5 | 00 | 00 | *S2* | 00 |
| 30 | **00** | 2/5 | 00 | -1/10 | 2/5 | 01 | 00 | *x2* | 800 |
| **-200** | **01** | **0** | **00** | **-01** | **0** | **00** | **00** | ***S4*** | **00** |
| *Z* = 90000 | 00 | 200 | 00 | 100 | 920 | 800 | 600 | *Zj* |
| 00 | -200 | 00 | -100 | -420 | 00 | 00 | *Z = Cj - Zj* |

 معيار الأمثلية في الجدول أعلاه غير محقق، لذا فالحل المتوصل إليه ليس أمثلا، مما يتطلب تشكيل جدول سمبلكس آخر بالاعتماد على الخوارزمية الثنائية للسمبلكس:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *B* | 00 | 00 | 00 | 00 | 500 | 800 | 600 | *Cj*  |
| *S4* | *S3* | *S2* | *S1* | *x3* | *x2* | *x1* |
| 50 | 3/10 | -1/5 | 00 | 00 | 4/5 | 00 | 01 | *x1* | 600 |
| 200 | -2/5 | -2/5 | 01 | 00 | -7/5 | 00 | 00 | *S2* | 00 |
| 50 | -1/10 | 2/5 | 00 | 00 | 2/5 | 01 | 00 | *x2* | 800 |
| 200 | -1 | 0 | 00 | 01 | 0 | 00 | 00 | *S1* | 00 |
| *Z* = 70000 | 100 | 440 | 00 | 00 | 800 | 800 | 600 | *Zj* |
| -100 | 00 | 00 | 00 | -300 | 00 | 00 | *Z = Cj - Zj* |