УО «Белорусский государственный технологический университет»

Кафедра Программной инженерии

**Курс “Математическое программирование”**

**Отчет по лабораторной работе №6**

**Транспортная задача**

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ФИТ 2 курс, 4 группа

Минск 2018

**ЦЕЛЬ РАБОТЫ:** Приобретение навыков решения открытой транспортной задачи.

**Задание для выполнения:**

Решить транспортную задачу. Имеется 5 поставщиков продукции и 6 потребителей. Величина запасов, потребностей и стоимость затрат на перевозку продукции взять в соответствии с вариантом (*3*).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| потребители  Поставщики | 1 | 2 | 3 | 4 | 5 | 6 | запасы |
| 1 | **15** | **5** | **9** | **6** | **14** | **4** | **171** |
| 2 | **13** | **3** | **11** | **8** | **10** | **16** | **116** |
| 3 | **4** | **8** | **14** | **11** | **5** | **14** | **153** |
| 4 | **7** | **13** | **13** | **6** | **16** | **5** | **162** |
| 5 | **6** | **14** | **12** | **3** | **13** | **7** | **103** |
| Потребности | **146** | **110** | **134** | **196** | **98** | **166** |  |

**ШАГ 1: Проверка на сбалансированность**

Общее кол-во запасов на складах: 705, а потребность общая: 850. Для приведения задачи к закрытому типу(сбалансированному), добавим 6(фиктивного) поставщика и обозначим его запасы как разницу – 145(850-705). А издержки доставки – 0.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| потребители  Поставщики | 1 | 2 | 3 | 4 | 5 | 6 | запасы |
| 1 | **15** | **5** | **9** | **6** | **14** | **4** | **171** |
| 2 | **13** | **3** | **11** | **8** | **10** | **16** | **116** |
| 3 | **4** | **8** | **14** | **11** | **5** | **14** | **153** |
| 4 | **7** | **13** | **13** | **6** | **16** | **5** | **162** |
| 5 | **6** | **14** | **12** | **3** | **13** | **7** | **103** |
| 6 | **0** | **0** | **0** | **0** | **0** | **0** |
| Потребности | **146** | **110** | **134** | **196** | **98** | **166** |

**ШАГ 2: Нахождение начального решения.**

Для этого запишем задачу в виде транспортной таблицы и добавим строку и столбец, в которых будут находится оставшиеся необходимые ресурсы для потребителя и оставшееся количество ресурсов на складе, соответственно.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |  |
| |  |  | | --- | --- | | a1= | 171 | |  |  |  |  |  |  | 171 |
| |  |  | | --- | --- | | a2= | 116 | |  |  |  |  |  |  | 116 |
| |  |  | | --- | --- | | a3= | 153 | |  |  |  |  |  |  | 153 |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  |  |  |  | 162 |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  |  |  | 103 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  |  | 145 |
|  | 146 | 110 | 134 | 196 | 98 | 166 |  |

Заполняем таблицу с помощью северо-западного угла. Первая ячейка – a1b1. Потребителю b1 необходимо 146 единицы товара. У поставщика a1 имеется 171 на складе. Вписываем 146 в ячейку. Т.к. потребность удовлетворена, то столбец окрашиваем в серый цвет и в ячейке потребности пишем 0. На складе остается 25 единиц товара:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |  |
| |  |  | | --- | --- | | a1= | 171 | | 146 |  |  |  |  |  | 25 |
| |  |  | | --- | --- | | a2= | 116 | |  |  |  |  |  |  | 116 |
| |  |  | | --- | --- | | a3= | 153 | |  |  |  |  |  |  | 153 |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  |  |  |  | 162 |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  |  |  | 103 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  |  | 145 |
|  | 0 | 110 | 134 | 196 | 98 | 166 |  |

Далее, заполняем соседнюю ячейку(a1b2). Потребителю b2 необходимо 110 единиц товара, а поставщик a1 может отдать 25. Вписываем это значение и помечаем строку серой, т.к. у поставщика более нет товара:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |  |
| |  |  | | --- | --- | | a1= | 171 | | 146 | 25 |  |  |  |  | 0 |
| |  |  | | --- | --- | | a2= | 116 | |  |  |  |  |  |  | 116 |
| |  |  | | --- | --- | | a3= | 153 | |  |  |  |  |  |  | 153 |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  |  |  |  | 162 |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  |  |  | 103 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  |  | 145 |
|  | 146 | 85 | 134 | 196 | 98 | 166 |  |

Таким образом заполняем всю таблицу и в конце получаем:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |  |
| |  |  | | --- | --- | | a1= | 171 | | 146 | 25 |  |  |  |  | 0 |
| |  |  | | --- | --- | | a2= | 116 | |  | 85 | 31 |  |  |  | 0 |
| |  |  | | --- | --- | | a3= | 153 | |  |  | 103 | 50 |  |  | 0 |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 146 | 16 |  | 0 |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  | 82 | 21 | 0 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 145 | 0 |
|  | 0 | 0 | 0 | 0 | 0 | 0 |  |

Мы получили опорный план, который к тому же является невырожденным.

**ШАГ 3:**

Посчитаем общие издержки на перевозку. Для этого в каждую ячейку со значением, впишем значение издержки на перевозку одной единицы продукции (исходная таблица). И получим следующую таблицу:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | 146  15 | 25  5 |  |  |  |  |
| |  |  | | --- | --- | | a2= | 116 | |  | 85  3 | 31  11 |  |  |  |
| |  |  | | --- | --- | | a3= | 153 | |  |  | 103  14 | 50  11 |  |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 146  6 | 16  16 |  |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  | 82  13 | 21  7 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 145  0 |

Умножив кол-во продукции на размер издержки и просуммировав все произведения найдем, что общие издержки составят:

P =2190+125+255+341+1442+550+876+256+1066+147+0=7248

**ШАГ 4: произведём оптимизацию решения с помощью метода потенциалов.**

Составляем матрицу затрат. Она строится из исходной матрицы переносом только тех ячеек, в которых есть значения в соответствующих ячейках транспортной матрицы. + справа и снизу добавлены строка и столбец для потенциалов:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |  |
| |  |  | | --- | --- | | a1= | 171 | | 15 | 5 |  |  |  |  | u1=14 |
| |  |  | | --- | --- | | a2= | 116 | |  | 3 | 11 |  |  |  | u2=12 |
| |  |  | | --- | --- | | a3= | 153 | |  |  | 14 | 11 |  |  | u3=15 |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 6 | 16 |  | u4=10 |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  | 13 | 7 | u5=7 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 0 | u6=0 |
|  | v1 =1 | v2 =-9 | v3=-1 | v4= -4 | v5=6 | v6=0 |  |

Выше представлена таблица с рассчитанными потенциалами по формуле: Pij = vij+uij. Обычно, u6 берется за 0 и благодаря этому рассчитываются остальные значения.

Теперь для всех пустых клеток находятся оценки по формуле: Sij = Pij-vij-uij, где P – соответствующее значение издержек доставки

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |  |
| |  |  | | --- | --- | | a1= | 171 | | 15 | 5 | -4 | -4 | -6 | -10 | u1=14 |
| |  |  | | --- | --- | | a2= | 116 | | 0 | 3 | 11 | 0 | -8 | 4 | u2=12 |
| |  |  | | --- | --- | | a3= | 153 | | -12 | 2 | 14 | 11 | -16 | 1 | u3=15 |
| |  |  | | --- | --- | | a4= | 162 | | -4 | 12 | 4 | 6 | 16 | -5 | u4=10 |
| |  |  | | --- | --- | | a5= | 103 | | -2 | 16 | 6 | 0 | 13 | 7 | u5=7 |
| |  |  | | --- | --- | | a6= | 145 | | -1 | 9 | 1 | 4 | -6 | 0 | u6=0 |
|  | v1 =1 | v2 =-9 | v3=-1 | v4= -4 | v5=6 | v6=0 |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | 146 | 25 |  |  |  |  |
| |  |  | | --- | --- | | a2= | 116 | |  | 85 | 31 |  |  |  |
| |  |  | | --- | --- | | a3= | 153 | |  |  | 103 | 50  - | + |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 146  + | 16  - |  |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  | 82 | 21 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 145 |

Самая большая отрицательная оценка (-16) говорит, что если мы доставим в эту ячейку товар, то общая сумма издержек на доставку сократится. Поэтому мы переходим к транспортной таблице

И помечаем соответствующую ячейку «+». Кроме этого, мы ставим плюсы и минусы в таких ячейках со значениями, чтобы в каждой строке и каждом столбце, количество плюсов и минусов было равным, таким образом, они образовывают цикл. Сделать это можно всегда лишь одним возможным способом.

Далее, мы находим минимальное значение из ячеек со знаком «-«(в нашем случае, это ячейка a4b5) и переносим его на ту самую ячейку с плюсом (a3b5). Ячейка a4b5 становится пустой. Кроме того, мы прибавляем либо отнимаем это минимальное значение от всех ячеек со знаками. В итоге, мы получаем следующую матрицу:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | 146 | 25 |  |  |  |  |
| |  |  | | --- | --- | | a2= | 116 | |  | 85 | 31 |  |  |  |
| |  |  | | --- | --- | | a3= | 153 | |  |  | 103 | 34 | 16 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  |  | 82 | 21 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 145 |

Далее, данный шаг повторяется до тех пор, пока все оценки не будут положительны. Как только мы дойдем до этого, то план считается оптимизированным.

**Итерация: 2**  
Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |  |
| |  |  | | --- | --- | | a1= | 171 | | 15 | 5 | -4 | -4 | -6 | -10 | u1=-2 |
| |  |  | | --- | --- | | a2= | 116 | | 0 | 3 | 11 | 0 | -8 | 4 | u2=-4 |
| |  |  | | --- | --- | | a3= | 153 | | -12 | 2 | 14 | 11 | 5 | 1 | u3=-1 |
| |  |  | | --- | --- | | a4= | 162 | | -4 | 12 | 4 | 6 | 16 | -5 | u4=-6 |
| |  |  | | --- | --- | | a5= | 103 | | -2 | 16 | 6 | 0 | 13 | 7 | u5=7 |
| |  |  | | --- | --- | | a6= | 145 | | -1 | 9 | 1 | 4 | -6 | 0 | u6=0 |
|  | v1 =17 | v2 =7 | v3=15 | v4= 12 | v5=6 | v6=0 |  |

Ячейка **а5,b1**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | | 146 |  | |  | - | | |  |  | | --- | --- | | 25 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 85 |  | |  | - | | |  |  | | --- | --- | | 31 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 103 |  | |  | - | | |  |  | | --- | --- | | 34 |  | |  |  | | |  |  | | --- | --- | | 16 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 82 |  | |  | - | | |  |  | | --- | --- | | 21 |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 145 |  | |  |  | |

Ячейка **а5,b5** становится свободной.

|  |  |
| --- | --- |
| **M =** | **82** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | 64 | 107 |  |  |  |  |
| |  |  | | --- | --- | | a2= | 116 | |  | 3 | 113 |  |  |  |
| |  |  | | --- | --- | | a3= | 153 | |  |  | 21 | 34 | 98 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 82 |  |  |  |  | 21 |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 145 |

**Итерация: 3**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 15 | 5 | -4 | -4 | 10 | -12 | |  |  | | --- | --- | | u1= | 16 | |
| |  | | --- | | a2 | | 0 | 3 | 11 | 0 | 8 | 2 | |  |  | | --- | --- | | u2= | 14 | |
| |  | | --- | | a3 | | -12 | 2 | 14 | 11 | 5 | -3 | |  |  | | --- | --- | | u3= | 17 | |
| |  | | --- | | a4 | | -4 | 12 | 4 | 6 | 16 | -7 | |  |  | | --- | --- | | u4= | 12 | |
| |  | | --- | | a5 | | 6 | 18 | 8 | 2 | 18 | 7 | |  |  | | --- | --- | | u5= | 7 | |
| |  | | --- | | a6 | | 1 | 11 | 3 | 6 | 12 | 0 | |  |  | | --- | --- | | u6= | 0 | |
|  | |  |  | | --- | --- | | v1= | -1 | | |  |  | | --- | --- | | v2= | -11 | | |  |  | | --- | --- | | v3= | -3 | | |  |  | | --- | --- | | v4= | -6 | | |  |  | | --- | --- | | v5= | -12 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка а1,b6, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | | 64 |  | |  | - | | |  |  | | --- | --- | | 107 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  | + | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 3 |  | |  |  | | |  |  | | --- | --- | | 113 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 21 |  | |  |  | | |  |  | | --- | --- | | 34 |  | |  |  | | |  |  | | --- | --- | | 98 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 82 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 21 |  | |  | - | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 145 |  | |  |  | |

Ячейка **а5,b6** становится свободной.

|  |  |
| --- | --- |
| **M =** | **21** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | 43 | 107 |  |  |  | 21 |
| |  |  | | --- | --- | | a2= | 116 | |  | 3 | 113 |  |  |  |
| |  |  | | --- | --- | | a3= | 153 | |  |  | 21 | 34 | 98 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 103 |  |  |  |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 143 |

**Итерация: 4**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 15 | 5 | -4 | -4 | 10 | 4 | |  |  | | --- | --- | | u1= | 16 | |
| |  | | --- | | a2 | | 0 | 3 | 11 | 0 | 8 | 2 | |  |  | | --- | --- | | u2= | 14 | |
| |  | | --- | | a3 | | -12 | 2 | 14 | 11 | 5 | -3 | |  |  | | --- | --- | | u3= | 17 | |
| |  | | --- | | a4 | | -4 | 12 | 4 | 6 | 16 | -7 | |  |  | | --- | --- | | u4= | 12 | |
| |  | | --- | | a5 | | 6 | 18 | 8 | 2 | 18 | 7 | |  |  | | --- | --- | | u5= | 7 | |
| |  | | --- | | a6 | | 1 | 11 | 3 | 6 | 12 | 0 | |  |  | | --- | --- | | u6= | 0 | |
|  | |  |  | | --- | --- | | v1= | -1 | | |  |  | | --- | --- | | v2= | -11 | | |  |  | | --- | --- | | v3= | -3 | | |  |  | | --- | --- | | v4= | -6 | | |  |  | | --- | --- | | v5= | -12 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а3,b1**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | | 43 |  | |  | - | | |  |  | | --- | --- | | 110 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 18 |  | |  |  | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 3 |  | |  | - | | |  |  | | --- | --- | | 113 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 21 |  | |  | - | | |  |  | | --- | --- | | 34 |  | |  |  | | |  |  | | --- | --- | | 98 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 103 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 148 |  | |  |  | |

Ячейка **а2,b2** становится свободной.

|  |  |
| --- | --- |
| **M =** | **3** |
|  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | 43 | 110 |  |  |  | 18 |
| |  |  | | --- | --- | | a2= | 116 | |  |  | 114 |  |  |  |
| |  |  | | --- | --- | | a3= | 153 | | 3 |  | 20 | 34 | 96 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 101 |  |  |  |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  |  |  |  | 148 |

**Итерация: 5**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 15 | 5 | -16 | -16 | -2 | 2 | |  |  | | --- | --- | | u1= | 2 | |
| |  | | --- | | a2 | | 12 | 12 | 11 | 0 | 8 | 26 | |  |  | | --- | --- | | u2= | -12 | |
| |  | | --- | | a3 | | 4 | 14 | 14 | 11 | 5 | 21 | |  |  | | --- | --- | | u3= | -9 | |
| |  | | --- | | a4 | | 8 | 24 | 4 | 6 | 16 | 17 | |  |  | | --- | --- | | u4= | -14 | |
| |  | | --- | | a5 | | 6 | 18 | -4 | -10 | 6 | 12 | |  |  | | --- | --- | | u5= | -7 | |
| |  | | --- | | a6 | | -13 | -3 | -23 | -20 | -14 | 0 | |  |  | | --- | --- | | u6= | 0 | |
|  | |  |  | | --- | --- | | v1= | 13 | | |  |  | | --- | --- | | v2= | 3 | | |  |  | | --- | --- | | v3= | 23 | | |  |  | | --- | --- | | v4= | 20 | | |  |  | | --- | --- | | v5= | 14 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а6,b3**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | | 43 |  | |  | - | | |  |  | | --- | --- | | 110 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 18 |  | |  | + | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 114 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 3 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 18 |  | |  | - | | |  |  | | --- | --- | | 34 |  | |  |  | | |  |  | | --- | --- | | 98 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 103 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 148 |  | |  | - | |

Ячейка **а3,b3** становится свободной.

|  |  |
| --- | --- |
| **M =** | **18** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | 22 | 108 |  |  |  | 39 |
| |  |  | | --- | --- | | a2= | 116 | |  |  | 114 |  |  |  |
| |  |  | | --- | --- | | a3= | 153 | | 21 |  |  | 34 | 96 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 160 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 101 |  |  |  |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 18 |  |  | 125 |

**Итерация: 6**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 15 | 5 | 5 | -16 | -2 | 2 | |  |  | | --- | --- | | u1= | 2 | |
| |  | | --- | | a2 | | -9 | -9 | 11 | -21 | -13 | 5 | |  |  | | --- | --- | | u2= | 11 | |
| |  | | --- | | a3 | | 2 | 14 | 21 | 11 | 5 | 21 | |  |  | | --- | --- | | u3= | -9 | |
| |  | | --- | | a4 | | 8 | 24 | 25 | 6 | 16 | 17 | |  |  | | --- | --- | | u4= | -14 | |
| |  | | --- | | a5 | | 6 | 18 | 17 | -10 | 6 | 12 | |  |  | | --- | --- | | u5= | -7 | |
| |  | | --- | | a6 | | -13 | -3 | 0 | -20 | -14 | 0 | |  |  | | --- | --- | | u6= | 0 | |
|  | |  |  | | --- | --- | | v1= | 13 | | |  |  | | --- | --- | | v2= | 3 | | |  |  | | --- | --- | | v3= | 0 | | |  |  | | --- | --- | | v4= | 20 | | |  |  | | --- | --- | | v5= | 14 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а2,b4**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | | 22 |  | |  | - | | |  |  | | --- | --- | | 110 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 39 |  | |  | + | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 114 |  | |  | - | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 21 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 34 |  | |  | - | | |  |  | | --- | --- | | 98 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 103 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 18 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 127 |  | |  | - | |

Ячейка **а1,b1** становится свободной.

|  |  |
| --- | --- |
| **M =** | **22** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  | 110 |  |  |  | 61 |
| |  |  | | --- | --- | | a2= | 116 | |  |  | 94 | 22 |  |  |
| |  |  | | --- | --- | | a3= | 153 | | 43 |  |  | 12 | 98 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 103 |  |  |  |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 40 |  |  | 105 |

**Итерация: 7**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 21 | 5 | 5 | 5 | 19 | 2 | |  |  | | --- | --- | | u1= | 2 | |
| |  | | --- | | a2 | | 12 | -9 | 11 | 8 | 8 | 5 | |  |  | | --- | --- | | u2= | 11 | |
| |  | | --- | | a3 | | 4 | -7 | 0 | 11 | 5 | 0 | |  |  | | --- | --- | | u3= | 12 | |
| |  | | --- | | a4 | | 8 | 3 | 4 | 6 | 16 | -4 | |  |  | | --- | --- | | u4= | 7 | |
| |  | | --- | | a5 | | 6 | -3 | -4 | -10 | 6 | -9 | |  |  | | --- | --- | | u5= | 14 | |
| |  | | --- | | a6 | | 8 | -3 | 0 | 1 | 7 | 0 | |  |  | | --- | --- | | u6= | 0 | |
|  | |  |  | | --- | --- | | v1= | -8 | | |  |  | | --- | --- | | v2= | 3 | | |  |  | | --- | --- | | v3= | 0 | | |  |  | | --- | --- | | v4= | -1 | | |  |  | | --- | --- | | v5= | -7 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а5,b4**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 110 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 61 |  | |  |  | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 94 |  | |  |  | | |  |  | | --- | --- | | 22 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 43 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 12 |  | |  | - | | |  |  | | --- | --- | | 98 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 103 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 40 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 105 |  | |  |  | |

Ячейка **а3,b4** становится свободной.

|  |  |
| --- | --- |
| **M =** | **12** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  | 110 |  |  |  | 61 |
| |  |  | | --- | --- | | a2= | 116 | |  |  | 94 | 22 |  |  |
| |  |  | | --- | --- | | a3= | 153 | | 55 |  |  |  | 98 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 91 |  |  | 12 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 40 |  |  | 105 |

**Итерация: 8**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 11 | 5 | 5 | 5 | 9 | 2 | |  |  | | --- | --- | | u1= | 2 | |
| |  | | --- | | a2 | | 2 | -9 | 11 | 8 | -2 | 5 | |  |  | | --- | --- | | u2= | 11 | |
| |  | | --- | | a3 | | 2 | 3 | 10 | 10 | 5 | 10 | |  |  | | --- | --- | | u3= | 2 | |
| |  | | --- | | a4 | | -2 | 3 | 4 | 6 | 6 | -4 | |  |  | | --- | --- | | u4= | 9 | |
| |  | | --- | | a5 | | 6 | 7 | 6 | 3 | 6 | 1 | |  |  | | --- | --- | | u5= | 6 | |
| |  | | --- | | a6 | | 0 | -1 | 0 | 3 | -1 | 0 | |  |  | | --- | --- | | u6= | 0 | |
|  | |  |  | | --- | --- | | v1= | 0 | | |  |  | | --- | --- | | v2= | 1 | | |  |  | | --- | --- | | v3= | 0 | | |  |  | | --- | --- | | v4= | -3 | | |  |  | | --- | --- | | v5= | 3 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а2,b2**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 110 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 61 |  | |  | + | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | | 94 |  | |  | - | | |  |  | | --- | --- | | 22 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 55 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 98 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 91 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 12 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 40 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 105 |  | |  | - | |

Ячейка **а2,b3** становится свободной.

|  |  |
| --- | --- |
| **M =** | **94** |
|  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  | 16 |  |  |  | 155 |
| |  |  | | --- | --- | | a2= | 116 | |  | 94 |  | 22 |  |  |
| |  |  | | --- | --- | | a3= | 153 | | 55 |  |  |  | 98 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 91 |  |  | 12 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 134 |  |  | 11 |

**Итерация: 9**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 2 | 5 | 5 | -4 | 0 | 4 | |  |  | | --- | --- | | u1= | 2 | |
| |  | | --- | | a2 | | 2 | 3 | 9 | 8 | -2 | 14 | |  |  | | --- | --- | | u2= | 0 | |
| |  | | --- | | a3 | | 4 | 12 | 19 | 10 | 5 | 19 | |  |  | | --- | --- | | u3= | -7 | |
| |  | | --- | | a4 | | -2 | 12 | 13 | 6 | 6 | 5 | |  |  | | --- | --- | | u4= | -2 | |
| |  | | --- | | a5 | | 6 | 16 | 15 | 3 | 6 | 10 | |  |  | | --- | --- | | u5= | -5 | |
| |  | | --- | | a6 | | -9 | -1 | 0 | -8 | -10 | 0 | |  |  | | --- | --- | | u6= | 0 | |
|  | |  |  | | --- | --- | | v1= | 11 | | |  |  | | --- | --- | | v2= | 3 | | |  |  | | --- | --- | | v3= | 0 | | |  |  | | --- | --- | | v4= | 8 | | |  |  | | --- | --- | | v5= | 12 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а6,b5**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 16 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 155 |  | |  | + | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 94 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 22 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 55 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 98 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 91 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 12 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 134 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | | 11 |  | |  | - | |

Ячейка **а6,b6** становится свободной.

|  |  |
| --- | --- |
| **M =** | **11** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  | 5 |  |  |  | 166 |
| |  |  | | --- | --- | | a2= | 116 | |  | 105 |  | 11 |  |  |
| |  |  | | --- | --- | | a3= | 153 | | 66 |  |  |  | 87 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 80 |  |  | 23 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 134 |  | 11 |  |

**Итерация: 10**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 2 | 5 | -5 | -4 | 0 | 4 | |  |  | | --- | --- | | u1= | 4 | |
| |  | | --- | | a2 | | 2 | 3 | -1 | 8 | -2 | 14 | |  |  | | --- | --- | | u2= | 2 | |
| |  | | --- | | a3 | | 4 | 12 | 9 | 10 | 5 | 19 | |  |  | | --- | --- | | u3= | -5 | |
| |  | | --- | | a4 | | -2 | 12 | 3 | 6 | 6 | 5 | |  |  | | --- | --- | | u4= | 0 | |
| |  | | --- | | a5 | | 6 | 16 | 5 | 3 | 6 | 10 | |  |  | | --- | --- | | u5= | -3 | |
| |  | | --- | | a6 | | 1 | 9 | 0 | 4 | 0 | 10 | |  |  | | --- | --- | | u6= | -10 | |
|  | |  |  | | --- | --- | | v1= | 9 | | |  |  | | --- | --- | | v2= | 1 | | |  |  | | --- | --- | | v3= | 10 | | |  |  | | --- | --- | | v4= | 6 | | |  |  | | --- | --- | | v5= | 10 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а1,b3**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 5 |  | |  | - | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 166 |  | |  |  | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 105 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 11 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 66 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 87 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 80 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 23 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 134 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 11 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | |

Ячейка **а1,b2** становится свободной.

|  |  |
| --- | --- |
| **M =** | **5** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  |  | 5 |  |  | 166 |
| |  |  | | --- | --- | | a2= | 116 | |  | 110 |  | 6 |  |  |
| |  |  | | --- | --- | | a3= | 153 | | 71 |  |  |  | 82 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 75 |  |  | 28 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 129 |  | 16 |  |

**Итерация: 11**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 7 | 5 | 9 | 1 | 5 | 4 | |  |  | | --- | --- | | u1= | 4 | |
| |  | | --- | | a2 | | 2 | 3 | -1 | 8 | -2 | 9 | |  |  | | --- | --- | | u2= | 7 | |
| |  | | --- | | a3 | | 4 | 12 | 9 | 10 | 5 | 14 | |  |  | | --- | --- | | u3= | 0 | |
| |  | | --- | | a4 | | -2 | 12 | 3 | 6 | 6 | 0 | |  |  | | --- | --- | | u4= | 5 | |
| |  | | --- | | a5 | | 6 | 16 | 5 | 3 | 6 | 5 | |  |  | | --- | --- | | u5= | 2 | |
| |  | | --- | | a6 | | 1 | 9 | 0 | 4 | 0 | 5 | |  |  | | --- | --- | | u6= | -5 | |
|  | |  |  | | --- | --- | | v1= | 4 | | |  |  | | --- | --- | | v2= | -4 | | |  |  | | --- | --- | | v3= | 5 | | |  |  | | --- | --- | | v4= | 1 | | |  |  | | --- | --- | | v5= | 5 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а2,b5**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 5 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 166 |  | |  |  | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 110 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 6 |  | |  | - | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 71 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 82 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 75 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 28 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 129 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 16 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |

Ячейка **а2,b4** становится свободной.

|  |  |
| --- | --- |
| **M =** | **6** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  |  | 5 |  |  | 166 |
| |  |  | | --- | --- | | a2= | 116 | |  | 110 |  |  | 6 |  |
| |  |  | | --- | --- | | a3= | 153 | | 77 |  |  |  | 76 |  |
| |  |  | | --- | --- | | a4= | 162 | |  |  |  | 162 |  |  |
| |  |  | | --- | --- | | a5= | 103 | | 69 |  |  | 34 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 129 |  | 16 |  |

**Итерация: 12**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 7 | 3 | 9 | 1 | 5 | 4 | |  |  | | --- | --- | | u1= | 2 | |
| |  | | --- | | a2 | | 4 | 3 | 1 | 2 | 10 | 11 | |  |  | | --- | --- | | u2= | 3 | |
| |  | | --- | | a3 | | 2 | 10 | 9 | 10 | 5 | 14 | |  |  | | --- | --- | | u3= | -2 | |
| |  | | --- | | a4 | | -2 | 10 | 3 | 6 | 6 | 0 | |  |  | | --- | --- | | u4= | 3 | |
| |  | | --- | | a5 | | 6 | 14 | 5 | 3 | 6 | 5 | |  |  | | --- | --- | | u5= | 0 | |
| |  | | --- | | a6 | | 1 | 7 | 0 | 4 | 0 | 5 | |  |  | | --- | --- | | u6= | -5 | |
|  | |  |  | | --- | --- | | v1= | 4 | | |  |  | | --- | --- | | v2= | -2 | | |  |  | | --- | --- | | v3= | 5 | | |  |  | | --- | --- | | v4= | 1 | | |  |  | | --- | --- | | v5= | 5 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а4,b1**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 5 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 166 |  | |  |  | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 110 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 6 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 77 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 76 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 162 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | | 69 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 34 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 129 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 16 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |

Ячейка **а5,b1** становится свободной.

|  |  |
| --- | --- |
| **M =** | **69** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  |  | 5 |  |  | 166 |
| |  |  | | --- | --- | | a2= | 116 | |  | 110 |  |  | 6 |  |
| |  |  | | --- | --- | | a3= | 153 | | 77 |  |  |  | 76 |  |
| |  |  | | --- | --- | | a4= | 162 | | 69 |  |  | 93 |  |  |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  | 103 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 129 |  | 16 |  |

**Итерация: 13**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 7 | 3 | 9 | -1 | 5 | 2 | |  |  | | --- | --- | | u1= | 4 | |
| |  | | --- | | a2 | | 4 | 3 | 1 | 0 | 10 | 11 | |  |  | | --- | --- | | u2=5 |  | |
| |  | | --- | | a3 | | 4 | 10 | 9 | 8 | 5 | 14 | |  |  | | --- | --- | | u3= | 0 | |
| |  | | --- | | a4 | | 7 | 12 | 5 | 6 | 8 | 2 | |  |  | | --- | --- | | u4= | 3 | |
| |  | | --- | | a5 | | 2 | 16 | 7 | 3 | 8 | 7 | |  |  | | --- | --- | | u5= | 0 | |
| |  | | --- | | a6 | | 1 | 7 | 0 | 2 | 0 | 5 | |  |  | | --- | --- | | u6= | -3 | |
|  | |  |  | | --- | --- | | v1= | 4 | | |  |  | | --- | --- | | v2= | -2 | | |  |  | | --- | --- | | v3= | 5 | | |  |  | | --- | --- | | v4= | 3 | | |  |  | | --- | --- | | v5= | 5 | | |  |  | | --- | --- | | v6= | 0 | |  |

Ячейка **а1,b4**, транспортной таблицы, должна загрузиться.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 5 |  | |  | - | | |  |  | | --- | --- | |  |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 166 |  | |  |  | |
| |  |  | | --- | --- | | a2= | 116 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 110 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 6 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a3= | 153 | | |  |  | | --- | --- | | 77 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 76 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a4= | 162 | | |  |  | | --- | --- | | 67 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 93 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a5= | 103 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 103 |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | |
| |  |  | | --- | --- | | a6= | 145 | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 129 |  | |  | + | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | --- | | 16 |  | |  | - | | |  |  | | --- | --- | |  |  | |  |  | |

Ячейка **а1,b3** становится свободной.

|  |  |
| --- | --- |
| **M =** | **5** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  |  |  | 5 |  | 166 |
| |  |  | | --- | --- | | a2= | 116 | |  | 110 |  |  | 6 |  |
| |  |  | | --- | --- | | a3= | 153 | | 72 |  |  |  | 81 |  |
| |  |  | | --- | --- | | a4= | 162 | | 74 |  |  | 88 |  |  |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  | 103 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 134 |  | 11 |  |

**Итерация: 14**

Рабочая матрица затрат с пересчитанными потенциалами и оценкам.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | --- | | b1 | | |  | | --- | | b2 | | |  | | --- | | b3 | | |  | | --- | | b4 | | |  | | --- | | b5 | | |  | | --- | | b6 | |  |
| |  | | --- | | a1 | | 8 | 4 | 1 | 6 | 6 | 4 | |  |  | | --- | --- | | u1= | 4 | |
| |  | | --- | | a2 | | 4 | 3 | 1 | 0 | 10 | 10 | |  |  | | --- | --- | | u2= | 6 | |
| |  | | --- | | a3 | | 4 | 10 | 9 | 8 | 5 | 13 | |  |  | | --- | --- | | u3= | 1 | |
| |  | | --- | | a4 | | 7 | 12 | 5 | 6 | 8 | 1 | |  |  | | --- | --- | | u4= | 4 | |
| |  | | --- | | a5 | | 2 | 16 | 7 | 3 | 8 | 6 | |  |  | | --- | --- | | u5= | 1 | |
| |  | | --- | | a6 | | 1 | 7 | 0 | 2 | 0 | 4 | |  |  | | --- | --- | | u6= | -2 | |
|  | |  |  | | --- | --- | | v1= | 3 | | |  |  | | --- | --- | | v2= | -3 | | |  |  | | --- | --- | | v3= | 4 | | |  |  | | --- | --- | | v4= | 2 | | |  |  | | --- | --- | | v5= | 4 | | |  | | --- | | v6=0 | |  |

В данной матрице нету отрицательных значений, значит, план является оптимизированным. Транспортная таблица выглядит так:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | b1= | 146 | | |  |  | | --- | --- | | b2= | 110 | | |  |  | | --- | --- | | b3= | 134 | | |  |  | | --- | --- | | b4= | 196 | | |  |  | | --- | --- | | b5= | 98 | | |  |  | | --- | --- | | b6= | 166 | |
| |  |  | | --- | --- | | a1= | 171 | |  |  |  | 5  6 |  | 166  4 |
| |  |  | | --- | --- | | a2= | 116 | |  | 110  3 |  |  | 6  10 |  |
| |  |  | | --- | --- | | a3= | 153 | | 72  4 |  |  |  | 81  5 |  |
| |  |  | | --- | --- | | a4= | 162 | | 74  7 |  |  | 88  6 |  |  |
| |  |  | | --- | --- | | a5= | 103 | |  |  |  | 103  3 |  |  |
| |  |  | | --- | --- | | a6= | 145 | |  |  | 134  0 |  | 11  0 |  |

Общие затраты для оптимального плана: P=6\*5 + 4\*166 + 3\*110 + 10\*6 + 4\*72 + 5\*81 + 7\*74 + 6\*88 + 3\*103 + 0\*134 + 0\*11 = 3132.

Задача решена.