**Задание 2. Решение транспортной задачи**

Найти оптимальный план транспортной задачи:

Требуется решить две задачи: *сбалансированную* и *несбалансированную*. Если в таблице даны две строки – *bj* (два столбца - *ai*) для количества груза, то *первая* строка (первый столбец) относится к *сбалансированной* задаче, *вторая* строка / второй столбец к *несбалансированной*.

Постановка задачи:

Пусть имеется *n* пунктов отправления, в которых сосредоточены запасы некоторого груза и *m* пунктов назначения, куда необходимо перевезти груз. Стоимость перевозки единицы продукции из *i*-го пункта отправления в *j*-ый пункт назначения *cij* приведена в таблице. В *i*-ой строке таблицы указано количество груза в пункте отправления, а в *j*-ом столбце – количество груза, который должен быть перевезен в пункт назначения. Необходимо составить план перевозок по доставке продукции в пункты назначения, минимизирующий суммарные транспортные расходы.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 2 | 5 | 7 | 6 | 3 | 26 | 28 |
| *A*2 | 3 | 8 | 1 | 2 | 5 | 50 | 50 |
| *A*3 | 5 | 5 | 3 | 2 | 7 | 10 | 10 |
| *A*4 | 2 | 1 | 2 | 10 | 8 | 20 | 20 |
| *A*5 | 3 | 7 | 1 | 4 | 5 | 57 | 60 |
| *bj* | 42 | 30 | 24 | 25 | 42 |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *ai* |
| *A*1 | 1 | 8 | 2 | 3 | 35 |
| *A*2 | 4 | 7 | 5 | 1 | 50 |
| *A*3 | 5 | 3 | 4 | 4 | 15 |
| *bj* | 15 | 15 | 40 | 30 |  |
| 25 | 20 | 35 | 30 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 2 | 6 | 3 | 4 | 8 | 60 | 50 |
| *A*2 | 1 | 5 | 6 | 9 | 7 | 30 | 30 |
| *A*3 | 3 | 4 | 1 | 6 | 10 | 15 | 15 |
| *bj* | 20 | 34 | 16 | 10 | 25 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 2 | 4 | 1 | 3 | 2 | 30 |
| *A*2 | 5 | 6 | 5 | 4 | 3 | 20 |
| *A*3 | 3 | 7 | 9 | 5 | 5 | 40 |
| *A*4 | 1 | 2 | 2 | 7 | 8 | 50 |
| *A*5 | 3 | 5 | 8 | 2 | 4 | 30 |
| *bj* | 35 | 20 | 55 | 30 | 30 |  |
| 40 | 25 | 55 | 30 | 30 |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 2 | 4 | 5 | 1 | 7 | 60 |
| *A*2 | 2 | 3 | 9 | 4 | 5 | 70 |
| *A*3 | 3 | 4 | 2 | 5 | 6 | 20 |
| *A*4 | 4 | 3 | 2 | 3 | 5 | 30 |
| *A*5 | 1 | 6 | 8 | 7 | 3 | 40 |
| *bj* | 40 | 30 | 30 | 50 | 70 |  |
| 35 | 25 | 30 | 45 | 65 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | |  | | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *ai* | |  |
| *A*1 | 4 | 5 | 5 | 7 | 100 | 120 |  |
| *A*2 | 8 | 7 | 5 | 4 | 120 | 100 |  |
| *A*3 | 9 | 6 | 4 | 5 | 150 | 160 |  |
| *A*4 | 3 | 2 | 9 | 3 | 130 | 140 |  |
| *bj* | 140 | 130 | 90 | 140 |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 10 | 5 | 7 | 4 | 7 | 90 |
| *A*2 | 7 | 4 | 9 | 10 | 3 | 25 |
| *A*3 | 6 | 14 | 8 | 7 | 6 | 35 |
| *A*4 | 8 | 5 | 6 | 8 | 5 | 50 |
| *bj* | 40 | 30 | 30 | 50 | 50 |  |
| 50 | 35 | 30 | 50 | 55 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 3 | 2 | 4 | 1 | 5 | 60 | 75 |
| *A*2 | 2 | 3 | 1 | 5 | 4 | 40 | 40 |
| *A*3 | 3 | 2 | 4 | 4 | 7 | 10 | 20 |
| *A*4 | 4 | 5 | 2 | 3 | 6 | 20 | 20 |
| *A*5 | 7 | 2 | 3 | 5 | 9 | 30 | 30 |
| *bj* | 30 | 25 | 35 | 20 | 50 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 1 | 3 | 3 | 4 | 5 | 50 |
| *A*2 | 5 | 2 | 7 | 5 | 3 | 30 |
| *A*3 | 6 | 4 | 8 | 2 | 4 | 30 |
| *A*4 | 7 | 1 | 5 | 7 | 6 | 10 |
| *bj* | 40 | 30 | 25 | 10 | 15 |  |
| 40 | 30 | 35 | 20 | 10 |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 2 | 4 | 3 | 2 | 6 | 60 |
| *A*2 | 3 | 1 | 2 | 3 | 5 | 65 |
| *A*3 | 5 | 4 | 1 | 5 | 7 | 70 |
| *A*4 | 6 | 4 | 4 | 5 | 4 | 20 |
| *A*5 | 8 | 3 | 4 | 2 | 3 | 30 |
| *bj* | 40 | 60 | 70 | 25 | 50 |  |
| 55 | 60 | 75 | 30 | 50 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 7 | 4 | 3 | 2 | 6 | 60 | 70 |
| *A*2 | 3 | 5 | 2 | 3 | 5 | 75 | 65 |
| *A*3 | 5 | 4 | 1 | 5 | 7 | 70 | 70 |
| *A*4 | 6 | 8 | 4 | 5 | 4 | 20 | 30 |
| *A*5 | 8 | 3 | 3 | 2 | 3 | 30 | 50 |
| *bj* | 50 | 60 | 70 | 25 | 50 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 10 | 4 | 3 | 2 | 6 | 25 |
| *A*2 | 4 | 5 | 2 | 3 | 4 | 60 |
| *A*3 | 7 | 5 | 3 | 9 | 11 | 75 |
| *A*4 | 3 | 8 | 4 | 5 | 3 | 20 |
| *bj* | 30 | 45 | 40 | 45 | 20 |  |
| 55 | 45 | 35 | 50 | 15 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 6 | 4 | 3 | 2 | 6 | 60 | 70 |
| *A*2 | 3 | 5 | 2 | 3 | 5 | 75 | 90 |
| *A*3 | 8 | 4 | 4 | 5 | 7 | 90 | 70 |
| *A*4 | 6 | 8 | 4 | 5 | 4 | 20 | 30 |
| *A*5 | 8 | 3 | 3 | 3 | 3 | 30 | 50 |
| *bj* | 50 | 60 | 70 | 45 | 50 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 7 | 4 | 3 | 2 | 6 | 30 |
| *A*2 | 3 | 7 | 2 | 3 | 5 | 35 |
| *A*3 | 10 | 4 | 4 | 5 | 7 | 90 |
| *A*4 | 7 | 8 | 4 | 5 | 4 | 20 |
| *A*5 | 8 | 3 | 3 | 3 | 3 | 30 |
| *bj* | 10 | 60 | 40 | 45 | 50 |  |
| 20 | 65 | 20 | 55 | 60 |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 4 | 4 | 3 | 2 | 6 | 40 |
| *A*2 | 3 | 6 | 2 | 3 | 5 | 35 |
| *A*3 | 8 | 4 | 3 | 5 | 7 | 90 |
| *A*4 | 5 | 8 | 4 | 5 | 4 | 20 |
| *A*5 | 8 | 3 | 3 | 3 | 3 | 30 |
| *bj* | 20 | 60 | 40 | 45 | 50 |  |
| 30 | 40 | 40 | 45 | 50 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 9 | 4 | 3 | 2 | 6 | 30 | 40 |
| *A*2 | 3 | 10 | 2 | 3 | 5 | 75 | 80 |
| *A*3 | 8 | 4 | 4 | 5 | 7 | 90 | 70 |
| *A*4 | 7 | 8 | 4 | 5 | 4 | 20 | 55 |
| *A*5 | 8 | 3 | 3 | 3 | 3 | 30 | 40 |
| *bj* | 50 | 60 | 40 | 45 | 50 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 10 | 4 | 3 | 2 | 6 | 40 |
| *A*2 | 7 | 6 | 2 | 3 | 5 | 50 |
| *A*3 | 8 | 4 | 3 | 6 | 7 | 90 |
| *A*4 | 5 | 7 | 6 | 5 | 4 | 20 |
| *A*5 | 4 | 3 | 2 | 3 | 3 | 30 |
| *bj* | 20 | 50 | 50 | 60 | 50 |  |
| 30 | 50 | 50 | 60 | 60 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 2 | 4 | 3 | 2 | 6 | 30 | 40 |
| *A*2 | 3 | 7 | 2 | 3 | 5 | 50 | 40 |
| *A*3 | 11 | 5 | 4 | 6 | 9 | 90 | 70 |
| *A*4 | 3 | 8 | 4 | 5 | 4 | 20 | 55 |
| *A*5 | 8 | 3 | 1 | 3 | 2 | 30 | 40 |
| *bj* | 30 | 55 | 40 | 45 | 50 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 10 | 4 | 3 | 2 | 6 | 25 |
| *A*2 | 4 | 6 | 2 | 3 | 4 | 60 |
| *A*3 | 6 | 5 | 3 | 9 | 11 | 70 |
| *A*4 | 3 | 7 | 4 | 5 | 3 | 20 |
| *bj* | 30 | 40 | 40 | 45 | 20 |  |
| 30 | 40 | 50 | 25 | 10 |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 7 | 4 | 3 | 2 | 6 | 20 |
| *A*2 | 4 | 6 | 2 | 3 | 5 | 30 |
| *A*3 | 10 | 5 | 7 | 5 | 6 | 70 |
| *A*4 | 3 | 8 | 4 | 5 | 4 | 20 |
| *bj* | 10 | 55 | 30 | 25 | 20 |  |
| 15 | 50 | 35 | 30 | 20 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 9 | 4 | 3 | 2 | 6 | 20 | 40 |
| *A*2 | 4 | 7 | 2 | 3 | 5 | 50 | 40 |
| *A*3 | 11 | 5 | 4 | 6 | 9 | 90 | 70 |
| *A*4 | 3 | 8 | 4 | 5 | 4 | 20 | 55 |
| *bj* | 30 | 55 | 30 | 45 | 20 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 8 | 4 | 3 | 2 | 6 | 30 |
| *A*2 | 7 | 5 | 1 | 2 | 4 | 50 |
| *A*3 | 5 | 4 | 2 | 6 | 7 | 90 |
| *A*4 | 6 | 6 | 6 | 3 | 4 | 20 |
| *A*5 | 4 | 3 | 2 | 3 | 3 | 30 |
| *bj* | 20 | 50 | 40 | 60 | 50 |  |
| 10 | 40 | 40 | 60 | 50 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 5 | 4 | 3 | 2 | 6 | 25 | 40 |
| *A*2 | 4 | 6 | 2 | 3 | 7 | 55 | 40 |
| *A*3 | 1 | 5 | 3 | 6 | 9 | 90 | 50 |
| *A*4 | 3 | 8 | 4 | 5 | 4 | 20 | 55 |
| *bj* | 30 | 55 | 40 | 45 | 20 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 1 | 4 | 3 | 2 | 6 | 25 |
| *A*2 | 4 | 5 | 2 | 3 | 4 | 55 |
| *A*3 | 6 | 5 | 3 | 9 | 11 | 75 |
| *A*4 | 3 | 8 | 4 | 5 | 3 | 20 |
| *bj* | 25 | 45 | 40 | 45 | 20 |  |
| 30 | 50 | 40 | 50 | 15 |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *ai* |
| *A*1 | 5 | 1 | 2 | 4 | 50 |
| *A*2 | 4 | 2 | 6 | 7 | 90 |
| *A*3 | 6 | 6 | 3 | 4 | 30 |
| *A*4 | 3 | 2 | 3 | 3 | 30 |
| *bj* | 50 | 40 | 60 | 50 |  |
| 45 | 45 | 40 | 35 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 7 | 4 | 3 | 2 | 6 | 20 | 30 |
| *A*2 | 4 | 6 | 2 | 3 | 5 | 30 | 20 |
| *A*3 | 10 | 5 | 7 | 5 | 6 | 70 | 50 |
| *A*4 | 3 | 8 | 4 | 5 | 4 | 20 | 20 |
| *bj* | 10 | 55 | 30 | 25 | 20 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 7 | 2 | 1 | 2 | 5 | 20 |
| *A*2 | 4 | 5 | 2 | 3 | 4 | 60 |
| *A*3 | 5 | 2 | 1 | 4 | 6 | 75 |
| *A*4 | 3 | 8 | 4 | 5 | 3 | 10 |
| *A*5 | 7 | 5 | 3 | 9 | 11 | 10 |
| *bj* | 30 | 40 | 40 | 45 | 20 |  |
| 30 | 30 | 30 | 50 | 20 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  | |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* | |
| *A*1 | 7 | 9 | 3 | 2 | 6 | 40 | 30 |
| *A*2 | 3 | 5 | 2 | 3 | 5 | 25 | 25 |
| *A*3 | 8 | 4 | 5 | 6 | 7 | 90 | 85 |
| *A*4 | 5 | 8 | 4 | 5 | 4 | 20 | 20 |
| *A*5 | 8 | 3 | 3 | 3 | 3 | 30 | 30 |
| *bj* | 20 | 70 | 40 | 25 | 50 |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 1 | 7 | 3 | 2 | 6 | 20 |
| *A*2 | 2 | 5 | 2 | 3 | 5 | 35 |
| *A*3 | 6 | 4 | 5 | 6 | 7 | 90 |
| *A*4 | 3 | 5 | 4 | 5 | 4 | 20 |
| *A*5 | 8 | 3 | 3 | 3 | 3 | 30 |
| *bj* | 30 | 50 | 40 | 25 | 50 |  |
| 55 | 50 | 50 | 15 | 50 |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Стоимость перевозки единицы груза | | | | |  |
|  | *B*1 | *B*2 | *B*3 | *B*4 | *B*5 | *ai* |
| *A*1 | 7 | 4 | 3 | 2 | 6 | 40 |
| *A*2 | 3 | 8 | 1 | 3 | 5 | 35 |
| *A*3 | 2 | 4 | 6 | 5 | 7 | 70 |
| *A*4 | 5 | 3 | 4 | 5 | 4 | 20 |
| *A*5 | 8 | 3 | 3 | 3 | 3 | 30 |
| *bj* | 20 | 40 | 40 | 45 | 50 |  |
| 30 | 50 | 40 | 40 | 50 |  |