GE Shipping Problem

General Electric wishes to determine a shipping plan to deliver 3,000 refrigerators from two plants to three regional warehouses. Plant 1 can supply 1,200 of the refrigerators, while Plant 2 can supply 1,800 refrigerators. The shipping costs vary by plant and warehouse:

<table>
<thead>
<tr>
<th></th>
<th>To Warehouse 1</th>
<th>To Warehouse 2</th>
<th>To Warehouse 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Plant 1</td>
<td>$10</td>
<td>$15</td>
<td>$13</td>
</tr>
<tr>
<td>From Plant 2</td>
<td>$8</td>
<td>$20</td>
<td>$11</td>
</tr>
</tbody>
</table>

If each of the three warehouses requires 1,000 refrigerators, then what is the optimal shipping plan?

(a) Write down letters to represent the decision variables in the problem.

Let $P_{1W_1}$ = The number of refrigerators shipped from Plant 1 to Warehouse 1.
Let $P_{1W_2}$ = The number of refrigerators shipped from Plant 1 to Warehouse 2.
Let $P_{1W_3}$ = The number of refrigerators shipped from Plant 1 to Warehouse 3.
Let $P_{2W_1}$ = The number of refrigerators shipped from Plant 2 to Warehouse 1.
Let $P_{2W_2}$ = The number of refrigerators shipped from Plant 2 to Warehouse 2.
Let $P_{2W_3}$ = The number of refrigerators shipped from Plant 2 to Warehouse 3.

(b) Write one sentence describing what the decision maker wants to do (the objective).

General Electric wants to determine the least expensive way to ship 1000 refrigerators to each plant, taking into consideration that Plant 1 can supply 1200 refrigerators and Plant 2 can supply 1800 refrigerators.

(c) Now, write out the objective function.

Cost = $10 \times P_{1W_1} + $15 \times P_{1W_2} + $13 \times P_{1W_3} + $8 \times P_{2W_1} + $20 \times P_{2W_2} + $11 \times P_{2W_3}$

(d) Write one sentence describing each constraint.

1. Plant 1 must ship 1200 refrigerators.
2. Plant 2 must ship 1800 refrigerators.
3. Warehouse 1 must receive 1000 refrigerators.
4. Warehouse 2 must receive 1000 refrigerators.
5. Warehouse 3 must receive 1000 refrigerators.
(e) Now, write out equations that represent each constraint.

1. Plant 1 must ship 1200 refrigerators.
   \[ P_1W_1 + P_1W_2 + P_1W_3 = 1200 \]

2. Plant 2 must ship 1800 refrigerators.
   \[ P_2W_1 + P_2W_2 + P_2W_3 = 1800 \]

3. Warehouse 1 must receive 1000 refrigerators.
   \[ P_1W_1 + P_2W_1 = 1000 \]

4. Warehouse 2 must receive 1000 refrigerators.
   \[ P_1W_2 + P_2W_2 = 1000 \]

5. Warehouse 3 must receive 1000 refrigerators.
   \[ P_1W_3 + P_2W_3 = 1000 \]

(f) Use Solver to find the optimal solution.

The optimal solution is found by minimizing the cost function in (c) subject to the constraints in (e).

The optimal solution requires Plant 1 to ship 200 refrigerators to Warehouse 1, 1000 refrigerators to Warehouse 2, and no refrigerators to Warehouse 3. Plant 2 should ship 800 refrigerators to Warehouse 1, no refrigerators to Warehouse 2, and 1000 refrigerators to Warehouse 3. The total shipping costs are $34,400.

### GENERAL ELECTRIC SHIPPING PROBLEM

<table>
<thead>
<tr>
<th>SHIPPING COSTS</th>
<th>To Warehouse 1</th>
<th>To Warehouse 2</th>
<th>To Warehouse 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Plant 1</td>
<td>$10</td>
<td>$15</td>
<td>$13</td>
</tr>
<tr>
<td>From Plant 2</td>
<td>$8</td>
<td>$20</td>
<td>$11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NUMBER SHIPPED</th>
<th>To Warehouse 1</th>
<th>To Warehouse 2</th>
<th>To Warehouse 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Plant 1</td>
<td>200</td>
<td>1000</td>
<td>0</td>
<td>1200</td>
</tr>
<tr>
<td>From Plant 2</td>
<td>800</td>
<td>0</td>
<td>1000</td>
<td>1800</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

TOTAL COST

$34,400