OPTIMIZATION OF SALES ALLOCATION THROUGH GOAL PROGRAMMING

V. Subbaiah, G. Ravindra Babu & S. D. Sahrma

ABSTRACT: One of the most decision problems in marketing is determination of optimum sales allocation as a part among sales of report. This paper is to develop a goal programming model for the determination of sales policy which covers all exclusive product line sold in numerous sales territory.

Keywords: Goal programming model, Sales allocation

1. INTRODUCTION

One of the most different decision problem in marketing is the determination of the optimum allocation of sales effort among the various market elements. Because of the multiplicity of factors used the complex relationship among these factors is often beyond the ability of the sales manager to identify the optimum allocation alternative. Thus it has become important for the retail manager to understand the capabilities and applications of the various quantitative or management science techniques so that he can thoroughly evaluate its alternative allocation opportunities. Wages, generally represent more than half the total expenses in retailing. This along with single and effective man power scheduling is one of the most important jobs for the retail manager. The development has pointed out the need for some efficient manpower scheduling as a means to the optimum sales effort allocation. The objective of this paper is directed to the determination of a sales policy which covers all exclusive product line sold in numerous sales territories. Benayoun et al., [1] have developed the Linear programming with multiple objective functions. Buchanan [2] has developed with naïve approach solving problem. Caballero et al., [3] have developed efficient solution in convex multi objective programming. Caballero et al., [4] have divided interactive multiple objective methods to determine the budget assignment to the hospitals of a sanitary system. Caballero et al., [5] have discussed interactive system for multi objective programming. Korhonen et al., [6] have proposed interactive method for solving the multiple criteria problem. Miettinen [7] has described non linear multi objective optimization. Miettinen et al., [8] have developed Interactive bundle-based method for non-differentiable multi-objective optimization. Miettinen et al., [9] have developed On scalarizing functions in multiobjective optimization. Miettinen et al., [10] have organized synchronous approach in interactive multiobjective optimization. Miettinen et al., [11] have discussed experiments with classification based on scalarizing functions and interactive multiobjective optimization. Sawaragi et al., [12] have proposed theory of multiobjective Optimization. Steuer [13] has proposed an interactive multiple objective linear programming procedure. Steuer et al., [14] have developed multiple Criteria Optimization in theory of computation and application. Wierzbicki [15] has described basic properties of scalarizing functional for multiobjective optimization.

2. DATA OF THE PROBLEM

The Hyderabad Jewellery Company markets its product through 30 salesmen, is as follows: The bulk of the firm’s annual sales, however, is made by only seven salesman operating in seven separate sales territories. The firm sells nine product lines of merchandise. The required information is given in Table 1, where each column shows how a rupee in sales in each of the seven territories is distributed among the various product lines in 2008. For example 0.04 Co-efficient for the first product (belt) indicates that on the average of centres of every rupee of firms merchandise sold in territory No. 1 is spent on their items.
Table 1

<table>
<thead>
<tr>
<th>Product lines</th>
<th>No.1</th>
<th>No.2</th>
<th>No.3</th>
<th>No.4</th>
<th>No.5</th>
<th>No.6</th>
<th>No.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belts</td>
<td>0.04</td>
<td>0.03</td>
<td>0.02</td>
<td>0.17</td>
<td>0.19</td>
<td>0.15</td>
<td>0.001</td>
</tr>
<tr>
<td>Buckles</td>
<td>0.06</td>
<td>0.02</td>
<td>0.02</td>
<td>0.14</td>
<td>0.15</td>
<td>0.09</td>
<td>0.00</td>
</tr>
<tr>
<td>Package Goods</td>
<td>0.22</td>
<td>0.37</td>
<td>0.31</td>
<td>0.25</td>
<td>0.26</td>
<td>0.26</td>
<td>0.50</td>
</tr>
<tr>
<td>Necklaces</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.11</td>
<td>0.17</td>
<td>0.10</td>
<td>0.04</td>
</tr>
<tr>
<td>Ear Rings</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>Bracelets</td>
<td>0.14</td>
<td>0.24</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Gold Store</td>
<td>0.16</td>
<td>0.14</td>
<td>0.19</td>
<td>0.11</td>
<td>0.07</td>
<td>0.07</td>
<td>0.16</td>
</tr>
<tr>
<td>Hematite</td>
<td>0.19</td>
<td>0.09</td>
<td>0.19</td>
<td>0.03</td>
<td>0.03</td>
<td>0.14</td>
<td>0.12</td>
</tr>
<tr>
<td>Job Turquite</td>
<td>0.03</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

The market potential for each sales territory for the planning period is given in Table 2:

Table 2
Marketing Potential in Each of Seven Selling Areas (2008)

<table>
<thead>
<tr>
<th>Territory No.</th>
<th>Market Potential (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,50,000.00</td>
</tr>
<tr>
<td>2</td>
<td>1,50,000.00</td>
</tr>
<tr>
<td>3</td>
<td>1,25,000.00</td>
</tr>
<tr>
<td>4</td>
<td>2,25,000.00</td>
</tr>
<tr>
<td>5</td>
<td>1,00,000.00</td>
</tr>
<tr>
<td>6</td>
<td>1,35,000.00</td>
</tr>
<tr>
<td>7</td>
<td>1,20,000.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11,05,000.00</strong></td>
</tr>
</tbody>
</table>

Table 3 represents the maximum amount of product line capacity that is available to the firm at the given price structure of nine products lines. We assume that the firm can acquire sufficient working capital to handle Rs. 1,20,000 in sales for the 2008 planning period.

Table 3
Maximum Amount of Product Line Capacity (2008)

<table>
<thead>
<tr>
<th>Lines</th>
<th>Product Line Capacity (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80,000.00</td>
</tr>
<tr>
<td>2</td>
<td>30,000.00</td>
</tr>
<tr>
<td>3</td>
<td>2,20,000.00</td>
</tr>
<tr>
<td>4</td>
<td>80,000.00</td>
</tr>
<tr>
<td>5</td>
<td>1,75,000.00</td>
</tr>
<tr>
<td>6</td>
<td>1,25,000.00</td>
</tr>
<tr>
<td>7</td>
<td>1,50,000.00</td>
</tr>
<tr>
<td>8</td>
<td>1,50,000.00</td>
</tr>
<tr>
<td>9</td>
<td>50,000.00</td>
</tr>
</tbody>
</table>
3. **THE MODEL**

3.1 **Goal Programming Model**

The general GP model can be defined as follows.

Minimize \( \sum W_j P_j (d^-_j + d^+_j) \)

Subject to \( \sum [A_{ij} X_{ij}] + I - I = B_i \)

Where \( W_j \) is the preemptive weight of each priority \( J \), \( P_j \) is the preemptive priority of goal \( J \) or constraint \( J \), \( A_{ij} \) is the technological coefficient between decision variable \( I \) and constraint \( J \), \( X_{ij} \) is the decision variable \( I \) on constraint \( J \), \( d^-_j \) is positive deviation variable, \( d^+_j \) is negative deviation variable, and \( B_i \) is the right-hand-side value of constraint \( I \).

3.2 **Goal Constraints**

**Belt Capacity:**

\[
0.08x_1 + 0.03x_2 + 0.02x_3 + 0.17x_4 + 0.19x_5 + 0.001x_7 + d^-_1 - d^+_1 = 80,000
\]

**Bulk Capacity:**

\[
0.06x_1 + 0.02x_2 + 0.02x_3 + 0.14x_4 + 0.15x_5 + 0.09x_6 + d^-_2 - d^+_2 = 30,000
\]

**Package Goods:**

\[
0.22x_1 + 0.37x_2 + 0.31x_3 + 0.25x_4 + 0.26x_5 + 0.26x_6 + d^-_3 - d^+_3 = 2,20,000
\]

**Necklaces:**

\[
0.05x_1 + 0.05x_2 + 0.05x_3 + 0.11x_4 + 0.17x_5 + 0.17x_6 + d^-_4 - d^+_4 = 50,000
\]

**Ear Rings:**

\[
0.17x_1 + 0.17x_2 + 0.17x_3 + 0.17x_4 + 0.17x_5 + 0.17x_6 + d^-_5 - d^+_5 = 1,75,000
\]

**Bracelets:**

\[
0.08x_1 + 0.03x_2 + 0.02x_3 + 0.17x_4 + 0.19x_5 + 0.18x_6 + 0.001x_7 + d^-_6 - d^+_6 = 80,000
\]

**Gold Stone:**

\[
0.16x_1 + 0.14x_2 + 0.19x_3 + 0.11x_4 + 0.07x_5 + 0.07x_6 + 0.16x_7 + d^-_8 - d^+_8 = 1,50,000
\]

**Hematite:**

\[
0.19x_1 + 0.09x_2 + 0.19x_3 + 0.03x_4 + 0.03x_5 + 0.12x_6 + 0.12x_7 + d^-_8 - d^+_8 = 1,50,000
\]

**Job turquite:**

\[
0.03x_1 + 0.2x_2 + 0.2x_3 + 0.2x_4 + 0.2x_5 + 0.2x_6 + 0.2x_7 + d^-_8 - d^+_8 = 50,000
\]

Market Potential Goals for Territory 1-7 are as follows:

\[
X_1 + d^-_{10} - d^+_{10} = 2,50,000
\]
\[
X_2 + d^-_{11} - d^+_{11} = 1,50,000
\]
\[
X_3 + d^-_{12} - d^+_{12} = 1,25,000
\]
\[
X_4 + d^-_{13} - d^+_{13} = 2,25,000
\]
\[
X_5 + d^-_{14} - d^+_{14} = 1,00,000
\]
\[
X_6 + d^-_{15} - d^+_{15} = 1,35,000
\]
\[
X_7 + d^-_{16} - d^+_{16} = 1,20,000
\]
3.3 Objective Function
Mathematically the G.P. model can be developed as follows:

\[
Z = \sum_{i=1}^{9} p_i d_i^+ + \sum_{i=10}^{16} p_i d_i^- .
\]

4. RESULT AND DISCUSSION
The solution obtained by using the QSB + computer software may be interpreted as follows:

<table>
<thead>
<tr>
<th>Table 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result Analysis</td>
</tr>
<tr>
<td>---------------------------------------</td>
</tr>
<tr>
<td>( x_1 = x_2 = x_3 = 0; ) ( x_4 = 0; ) ( x_5 = 1,25,000; ) ( x_6 = 90,000; ) ( x_7 = 1,13,000 )</td>
</tr>
<tr>
<td>( d_1^+ = 29,000; ) ( d_1^- = 0; ) ( d_2^+ = d_2^- = 0; ) ( d_3^+ = d_3^- = 0; ) ( d_4^+ = 15,000; ) ( d_4^- = 0; )</td>
</tr>
<tr>
<td>( d_5^+ = 51,000; ) ( d_5^- = 0; ) ( d_6^+ = 15,000; ) ( d_6^- = 0; ) ( d_7^+ = 50,000; ) ( d_7^- = 0; )</td>
</tr>
<tr>
<td>( d_8^+ = 55,000; ) ( d_8^- = 0; ) ( d_9^+ = d_9^- = d_{10}^+ = d_{10}^- = 0; ) ( d_{11}^+ = 90,000; ) ( d_{11}^- = 0; )</td>
</tr>
<tr>
<td>( d_{12}^+ = 60,000, ) ( d_{12}^- = 0; ) ( d_{13}^+ = 0; ) ( d_{14}^+ = 500,000; ) ( d_{14}^- = 0; )</td>
</tr>
<tr>
<td>( d_{15}^- = d_{15}^- = d_{16}^- = d_{16}^- = 0 )</td>
</tr>
</tbody>
</table>

5. CONCLUSION
We notice that the optimal solution excludes the sales territories No. 5 and 4 and unless management has some reason for including these sales areas. It would be more beneficial to drop them. Selling in territory 1 and 4 will only result in a decline in net revenue.

REFERENCES


V. Subbaiah
Department of Mathematics,
Meerut College, Meerut, U.P., India.

G. Ravindra Babu
Department of Computer Science and Engineering,
Sri Chaitanya College of Engineering and Technology,
Shariguda (village), Ibrahim Patnam (Mandal),
RR (dist), Hyderabad, AP, India.

S. D. Sharma
Department of Mathematics,
Meerut College, Meerut, U.P., India.