A Goal Programming Approach to Funding Allocation in Library Management

Kirti Kumar Jain¹, Sanjay Choudhary²
¹Research Scholar, Barkat- Ullah University Bhopal
²Head, Department of Mathematics, Govt. NVM, Hoshangabad,(M.P.), India

Abstract-- This paper will allow librarians to find an optimal solution for allocating achievement funds while prioritizing funding objectives are developed by a mathematical goal programming technique. The use of this model thought about five goals and brought about a fruitful circulation of the financial plan.

Keywords-- Allocation formulas, Fund allocation, Goal Programming.

I. INTRODUCTION

With the cost increment of the expense of books, it turns out to be increasingly troublesome for librarians to keep up current dimensions of gathering, hence compelling libraries to decrease their buy of accumulation on logical materials and a few mathematical models in understanding an assortment of acquisitions subsidize portion were produced .Goal writing computer programs is a method for finding the ideal answer for a mathematical demonstrate that is made exclusively out of objectives by limiting the unwanted deviational factors. It has been utilized in numerous basic leadership issues in the field of farming and the board. A custodian may not be able to obtain the data on the expense or estimation of an objective however will have the capacity to set up an upper and lower limit for every objective and express this as a need that is wanted to be accomplished. A direct objective programming model is created to decide the allocation subsidize on books subject to five objective limitations and three needs.

It has been used in many decision-making problems in the field of agriculture and management. A custodian will most likely be unable to acquire the data on the expense or estimation of an objective however will have the capacity to set up an upper and lower limit for every objective and express this as a need that is wanted to be accomplished. A straight objective programming model is created to decide the designation subsidize on books subject to five-objective limitations and three needs.

A usually utilized summed up model for objective programming approach was first proposed by Charnes and Cooper as pursues:

\[
\text{Min } z = \sum_{i=1}^{n} b_i \left( u_i^+ + d_i^+ \right)
\]

subject to

\[
\sum_{i=1}^{n} a_{ij} x_i + u_i^+ + d_i^+ = b_i
\]

where \( u_i^+ \) and \( d_i^- \) are deviational variables.

In this model, there are \( m \) goals and \( m \) component.

\( b( b_1, b_2, ..., b_m ) \). Each \( a_{ij} \) speaks to the choice factors' coefficients communicating the relations between objectives, where \( b \) \( x_{ij} \) speaks to the choice

\( a_{ij} \) is the decision variable

\( x_{ij} \) is the decision variable concerned goal

Variables related with the destinations and the \( u_i^+ \) and \( d_i^- \) are \( m \)-fragment vectors for the components addressing deviations from the targets. \( P_i \) is the need level allocated to every primary target altogether ( \( P_1 > P_2 > ... > P_m \) ), and \( w_i \) are non-negative constants addressing the relative burdens doled out with a need level to the deviational factors, \( u_i^- \), and \( d_i^+ \). The decision factors \( x_i \) is the number of books to be acquired for subject \( i \). \( T \) is the total aggregate of resources for be assigned across over subject controls, \( q \) and \( r \) are the upper and lower purposes of constrainment of books required by the segment, \( C_i \) is the ordinary cost for books, while low \( i \) and up \( i \) are the minima and most extraordinary tasteful dimension of a book Titles to be assigned for subject \( i \). Coming up next are the objective requirements

Budget, Upper and Lower Limits:

\[
\sum_{i=1}^{n} a_{ij} x_i + d_i^- - u_i^+ = T
\]
The three factors which are to be addressed are the number of faculty (including research centres and areas), the cost of title of books and past record of a school library in spending allocated funds.

All these figures have been compiled from the School Library Annual Report, the total cost of the book can be taken by the quotient of the total allocation of each title (subject). Headings (subject).

The biggest and least breaking point for reserving each subject depends on the decision of accumulation reform officer and on the uncompromising recommendations by the workforce or organization. The requirement structure is with the final goal which is to ban the use of P1(priority 1) limit to expenditure budget in acquisition, P2(priority 2) is to achieve something like 900 titles and 800 headings, whereas P3 (priority 3) is to get title by topic within the prescribed limit points.

In any school library a lot of titles and books. We have some titles out of them in the table given below:

<table>
<thead>
<tr>
<th>BOOKS</th>
<th>PRICE MINIMUM</th>
<th>PRICE MAXIMUM</th>
<th>AVERAGE COST</th>
<th>MIN %</th>
<th>MAX %</th>
<th>NUMBER OF TITLES</th>
<th>%</th>
<th>BUDGE T</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATHEMATICS</td>
<td>180</td>
<td>245</td>
<td>212.5</td>
<td>0.705</td>
<td>0.96</td>
<td>120</td>
<td>14.72</td>
<td>25500</td>
<td>17.24</td>
</tr>
<tr>
<td>CHEMISTRY</td>
<td>260</td>
<td>285</td>
<td>272.5</td>
<td>0.87</td>
<td>0.90</td>
<td>110</td>
<td>13.49</td>
<td>29975</td>
<td>20.27</td>
</tr>
<tr>
<td>PHYSICS</td>
<td>245</td>
<td>310</td>
<td>277.5</td>
<td>0.88</td>
<td>1</td>
<td>100</td>
<td>12.26</td>
<td>27750</td>
<td>18.76</td>
</tr>
<tr>
<td>BIOLOGY</td>
<td>170</td>
<td>200</td>
<td>185</td>
<td>1.02</td>
<td>1.20</td>
<td>90</td>
<td>11.04</td>
<td>16650</td>
<td>11.26</td>
</tr>
<tr>
<td>PSYCHOLOGY</td>
<td>120</td>
<td>125</td>
<td>122.5</td>
<td>1.22</td>
<td>1.28</td>
<td>80</td>
<td>9.81</td>
<td>9800</td>
<td>6.63</td>
</tr>
<tr>
<td>COMPUTER</td>
<td>140</td>
<td>150</td>
<td>145</td>
<td>1.60</td>
<td>1.72</td>
<td>60</td>
<td>7.36</td>
<td>8700</td>
<td>5.88</td>
</tr>
<tr>
<td>SOCIOLOGY</td>
<td>45</td>
<td>105</td>
<td>75</td>
<td>1.2</td>
<td>2</td>
<td>50</td>
<td>6.13</td>
<td>3750</td>
<td>2.53</td>
</tr>
<tr>
<td>BUSINESS STUDIES</td>
<td>120</td>
<td>170</td>
<td>145</td>
<td>1.18</td>
<td>1.67</td>
<td>70</td>
<td>8.59</td>
<td>10150</td>
<td>6.86</td>
</tr>
<tr>
<td>ACCOUNTANCY</td>
<td>100</td>
<td>180</td>
<td>140</td>
<td>0.75</td>
<td>1.35</td>
<td>95</td>
<td>11.66</td>
<td>13300</td>
<td>8.99</td>
</tr>
<tr>
<td>SANSKRIT</td>
<td>55</td>
<td>60</td>
<td>57.5</td>
<td>2.39</td>
<td>2.6</td>
<td>40</td>
<td>4.90</td>
<td>2300</td>
<td>1.56</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>815</td>
<td>256.5</td>
<td>1.92</td>
<td></td>
<td></td>
<td>147875</td>
<td></td>
</tr>
</tbody>
</table>

336
Minimize
\[ Z = P_1 u_1 + P_2 (u_2 + d_3) + P_3 (u_3 + u_4 + u_5 + u_6 + u_7 + u_8 + u_9 + u_{10} + u_{11} + u_{12} + u_{13} + u_{14} + u_{15} + u_{16} + u_{17} + u_{18} + u_{19} + u_{20} + u_{21} + u_{22} + u_{23}) \]

**SUBJECT TO**

212.5 \( x_1 + 272.5 \ x_2 + 277.5 \ x_3 + 185 \ x_4 + 122.5 \ x_5 + 145 \ x_6 + 75 \ x_7 + 145 \ x_8 + 140 \ x_9 + 57.5 \ x_{10} + u_1 - d_1 = 148000 \)
\[ \begin{align*}
x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + u_2 - d_2 &= 900 \\
x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + u_3 - d_3 &= 800 \\
x_1 - 0.0070( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_4 - d_4 &= 0 \\
x_2 - 0.0087( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_5 - d_5 &= 0 \\
x_3 - 0.0088( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_6 - d_6 &= 0 \\
x_4 - 0.010( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_7 - d_7 &= 0 \\
x_5 - 0.012( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_8 - d_8 &= 0 \\
x_6 - 0.016( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_9 - d_9 &= 0 \\
x_7 - 0.012( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{10} - d_{10} &= 0 \\
x_8 - 0.0118( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{11} - d_{11} &= 0 \\
x_9 - 0.0075( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{12} - d_{12} &= 0 \\
x_{10} - 0.024( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{13} - d_{13} &= 0 \\
x_1 - 0.0096( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{14} - d_{14} &= 0 \\
x_2 - 0.0090( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{15} - d_{15} &= 0 \\
x_3 - 0.010( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{16} - d_{16} &= 0 \\
x_4 - 0.012( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{17} - d_{17} &= 0 \\
x_5 - 0.0128( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{18} - d_{18} &= 0 \\
x_6 - 0.0172( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{19} - d_{19} &= 0 \\
x_7 - 0.020( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{20} - d_{20} &= 0 \\
x_8 - 0.0167( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{21} - d_{21} &= 0 \\
x_9 - 0.0135( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{22} - d_{22} &= 0 \\
x_{10} - 0.026( x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10}) + u_{23} - d_{23} &= 0 \end{align*} \]

**V. RESULTS AND DISCUSSION**

This model is solved by LINGO SOFTWARE and the best solution of this model is:
- The least number of books 800
- The highest number of books 900.
- And calculated budget allotment of the books by Rs147834.

All three priorities are fully satisfied

**VI. CONCLUSION**

We have portrayed the utilization of straight target programming in designation.

Obtaining store dependent on clashing objectives in book gathering. The model can be Thinking about the necessities for managing a progressively mind boggling condition, it was altered.

Offering adaptability to confront obtaining authorities as a library.
A blend of obtaining objectives and change the need positioning of these objectives.

REFERENCES


