CHAPTER-3
A GOAL PROGRAMMING MODEL FOR PUBLIC ACCOUNTING FIRMS

3.1 Objective
The purpose of this chapter is to indicate the usefulness of a management science tool to the problem of planning in public accounting firms. Specifically, an attempt will be made to relate goal programming to a planning problem of a public accounting firms.

3.2 DATA OF THE PROBLEM
This study was carried out to designing a goal programming planning model for a public accounting firm in Hyderabad. The model to be designed is limited to the planning horizon of one year, although once a model for one year is developed, it could subsequently be expanded for a longer planning horizon. In addition to the limited planning horizon, certain other simplifications have been made. For example, the model is concerned only with the firm's audit function, although tax and management services functions could be added; the goals of the firm are not necessarily indicative of the goals any specific public accounting firm might have (and are not necessarily in the most desirable order for every firm); and possibly other factors which do not lend themselves easily to quantification, but which must be considered by firms in their planning processes, are absent from the model. Despite these obvious limitations, the model presented here should illustrate how the general goal programming approach may be applied to assist public accounting firms in their planning. Tables 3.1, 3.2 & 3.3 outline the information pertaining to the accounting firm needed for the model design.
### TABLE-3.1
**AUDIT PERSONNEL, WORKING HOURS, BILLING RATES AND GROSS AUDIT FEES**

<table>
<thead>
<tr>
<th>Position</th>
<th>Number Employed</th>
<th>Working Hr per Year</th>
<th>Total Hr/position (50 weeks)</th>
<th>Chargeable Hrs per Individual Per Year</th>
<th>Nonchargeable Hr/Position/year</th>
<th>Billing Rates/Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner</td>
<td>3</td>
<td>2500</td>
<td>7,500</td>
<td>2000</td>
<td>6,000</td>
<td>Rs40</td>
</tr>
<tr>
<td>Manager</td>
<td>6</td>
<td>2250</td>
<td>13,500</td>
<td>2000</td>
<td>12,000</td>
<td>Rs30</td>
</tr>
<tr>
<td>Senior</td>
<td>12</td>
<td>2250</td>
<td>27,000</td>
<td>2100</td>
<td>25,000</td>
<td>Rs20</td>
</tr>
<tr>
<td>Staff</td>
<td>30</td>
<td>2000</td>
<td>60,000</td>
<td>1900</td>
<td>57,000</td>
<td>Rs15</td>
</tr>
</tbody>
</table>

Gross Audit Fees Earned for the Past Year:
- Partner: 6,000 hr @ Rs 40/hr = Rs 240,000
- Manager: 12,000 hr @ Rs 30/hr = Rs 360,000
- Senior: 25,000 hr @ Rs 20/hr = Rs 504,000
- Staff: 57,000 hr @ Rs 15/hr = Rs 8,55,000

Total: Rs 19,59,000

### TABLE-3.2
**PROJECTED INFORMATION FOR NEXT YEAR BASED ON THE GOALS SET BY THE FIRM**

1. **Chargeable Hours (an increase of 5%)**
   - Partner: 6,000 × 105% = 6,300
   - Manager: 12,000 × 105% = 12,600
   - Senior: 25,200 × 105% = 26,460
   - Staff: 57,000 × 105% = 59,850

Total: 1,05,210

2. **Total Hours by Position**

<table>
<thead>
<tr>
<th>Position</th>
<th>Chargeable Hrs</th>
<th>Nonchargeable Hrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner</td>
<td>6,300</td>
<td>1,500</td>
<td>7,800</td>
</tr>
<tr>
<td>Manager</td>
<td>12,600</td>
<td>1,500</td>
<td>14,100</td>
</tr>
<tr>
<td>Senior</td>
<td>26,460</td>
<td>1,800</td>
<td>28,260</td>
</tr>
<tr>
<td>Staff</td>
<td>59,850</td>
<td>3,000</td>
<td>62,850</td>
</tr>
</tbody>
</table>

Total: Rs 1,13,010

3. **Billing Rates/Hour (an increase of 5%)**
   - Partner: Rs 40 × 105% = Rs 42.00
   - Manager: 30 × 105% = Rs 31.50
   - Senior: 20 × 105% = Rs 21.00
   - Staff: 10 × 105% = Rs 15.75

69
TABLE-3.3
PROJECTED REVENUES AND EXPENSES

1. Gross Audit Fees
   Partner: 6,300 hr @ Rs 40.00/hr = Rs 2,64,600
   Manager: 12,600 hr @ Rs 31.50/hr = Rs 3,96,900
   Senior: 26,460 hr @ Rs 21.00/hr = Rs 5,55,660
   Staff: 59,850 hr @ Rs 15.75/hr = Rs 9,42,638
   Total = Rs 21,59,798

2. Expenses
   Salaries
   Partners (Rs 30,000. \( X_1 \))
   Managers (Rs 20,000. \( X_2 \))
   Seniors (Rs 15,000. \( X_3 \))
   Staff (Rs 10,000. \( X_4 \))

3. Other Expenses
   Estimated amount for rent, depreciation,
   dues insurance, secretarial salaries,
   supplies and other expenses = Rs 1,350,000

3.3 GOAL PROGRAMMING MODEL

Variables:

Let,

\( X_1 \) = Number of audit partners required
\( X_2 \) = Number of audit managers required
\( X_3 \) = Number of audit seniors required
\( X_4 \) = Number of audit staff required
\( Y_1 \) = New hourly billing rate for partners
\( Y_2 \) = New hourly billing rate for managers
\( Y_3 \) = New hourly billing rate for seniors
\( Y_4 \) = New hourly billing rate for staff
\( Z_1 \) = Chargeable-hours from clients in the 0-1000 chargeable hour range
\( Z_2 \) = Chargeable-hours from clients in the 1001-5000 chargeable hour range
$Z_3 = \text{Chargeable-hours from clients in the over 5000 chargeable hour range}$

$Z_4 = \text{Average chargeable-hours from each type } Z_3 \text{ client.}$

### 3.3.1 The Goal constraints are developed as follows

#### A. Gross Audit Fees and Related goals. A goal set by the firm is to increase gross audit fees by approximately 10% over the past year. The achievement of this goal is dependent on three interrelated subgoals: (1) to increase chargeable hours by 5%; (2) to maintain the present level of total nonchargeable hours per personnel classification; and (3) to increase the hourly billing rates per classification by 5%.

The partners in charge of the firm's planning function have decided that in order to achieve the subgoal of increasing chargeable hours by 5%, the firm must obtain new clients. A few of the means by which new clients may be obtained are referrals from present clients, speaking engagements by partners and other qualified people in the firm, and the publication of articles in accounting and business journals. All of these approaches require non-chargeable time to be spent by the firm's personnel.

To achieve the subgoal of increasing the hourly billing rates per classification by 5% over the past year, the firm's planning group believes that it is necessary to upgrade their auditing services. The primary means of upgrading services are to conduct professional development courses for the audit personnel and to engage in research aimed toward advancing the firm's auditing techniques. Quality services are also a prerequisite for obtaining new clients.

The planning group has determined that the present level of nonchargeable hours per position is adequate to provide the time necessary for obtaining the new clients, the upgrading of services, and the administrative work required to realize the projected increase in chargeable hours and billing rates. By maintaining total nonchargeable hours at the present level, the firm's efficiency will be increased. The increase in audit personnel necessitated by the increase in chargeable hours will reduce nonchargeable hours per employee.
1. Personnel Requirement

The constraints for the number of audit personnel required (see Tables 3.1 & 3.2), where $d_i^-$ represents working hours under the projected requirement and $d_i^+$ represents working hours in excess of the projected requirement, may be expressed as:

$$2500X_1 + d_1^- - d_1^+ = 7800$$
$$2250X_2 + d_2^- - d_2^+ = 14,100$$
$$2250X_3 + d_3^- - d_3^+ = 28,260$$
$$2000X_4 + d_4^- - d_4^+ = 62,850$$

2. Billing Rates

The constraints for the new hourly billing rates, where $d_i^-$ represents under-achievement of the projected billing rates (see Table 3.2) and $d_i^+$ represents over-achievement of the projected billing rates, may be expressed as:

$$Y_1 + d_5^- - d_5^+ = Rs42.00$$
$$Y_2 + d_6^- - d_6^+ = Rs31.50$$
$$Y_3 + d_7^- - d_7^+ = Rs21.00$$
$$Y_4 + d_8^- - d_8^+ = Rs15.75$$

3. Gross Audit Fees

The goal of a 10% increase in gross audit fees, where $d_i^-$ represents underachievement of this goal and $d_i^+$ represents overachievement, may be expressed as (see Table 3.2 & Table 3.3):

$$6300Y_1 + 12,600Y_2 + 26460Y_3 + 59,850Y_4 + d_9^- - d_9^+ = Rs2,159,798$$

B. Management/Staff Ratio. The planning group believes that it is desirable to maintain a ratio of at least one management personnel (partners and managers) to every five staff
men (seniors and staff). This constraint, where $d_i^-$ represents over achievement of the desired ratio and $d_i^+$ represents underachievement, becomes:

$$X_3 + X_4 - 5X_1 - 5X_2 + d_{10}^- - d_{10}^+ = 0$$

C. Distribution of Clients. Another firm goal set by the planning group is the attainment of a desirable distribution of clients with respect to size expressed in chargeable hours. The firm would like to be in a position where:

1. 10% of their total chargeable hours comes from clients in the 0-1000 chargeable-hour range
2. 50% of their total chargeable hours comes from clients in the 1000-5000 chargeable-hour range and
3. 40% of their total chargeable hours comes from clients in the over-5000 chargeable-hour range.

These constraints then become:

$$Z_1 - 0.01T + d_{11}^- - d_{11}^+ = 0$$

$$Z_2 - 0.50T + d_{12}^- - d_{12}^+ = 0$$

$$Z_3 - 0.40T + d_{13}^- - d_{13}^+ = 0$$

where $T$ = total chargeable hours expressed as (see Table 3.1):

$$2000X_1 + 2000X_2 + 2100X_3 + 1900X_4$$

$d_i^-$ = chargeable hours from each classification of clients less than the desirable distribution

$d_i^+$ = chargeable hours from each classification of clients in excess of the desirable distribution

In addition to these constraints, it is desired that no one client account for more than 20% of the firm's total revenue, which may be expressed in terms of chargeable hours if it is assumed, for purposes of simplification, that each job requires a constant proportion of hours from each personnel classification. This constraint, which is relevant only for
chargeable hours from clients in the over-5000 chargeable-hour range, may be expressed as:

\[ 2Z_4 - Z_3 + d_{14}^- - d_{14}^+ = 0 \]

where \( d_{14}^+ \) and \( d_{14}^- \) indicate non achievement and achievement of the goal respectively. \( Z_3 \) is the number of chargeable hours to 5000+ clients which ideally (per earlier constraint) would be 40% of total chargeable hours. \( Z_4 \), the hours chargeable to the largest desirable client, can be no more than 20% of total. Consequently, \( 2Z_4 - Z_3 \) should be less than or equal to zero.

**D. Constraint on Seniors and Staff.** It is desired that the number of senior and staff accountants not exceed 42 personnel. This constraint, where \( d_{15}^- \) represents the number of seniors and staff less than 42 and \( d_{15}^+ \) represents the number in excess of 42 becomes:

\[ X_3 + X_4 + d_{15}^- - d_{15}^+ = 42 \]

**E. Net Income.** It is desirable to provide a minimum net income of Rs 1,00,000 in the upcoming year for the growth and enhancement of the firm’s partners. This constraint, where \( d_{16}^- \) represents under-achievement of the desired net income and \( d_{16}^+ \) represents overachievement of the net income goal, may be expressed as:

\[ 6300Y_1 + 12,600Y_2 + 26460Y_3 + 59,850Y_4 - 30,000X_1 - 20,000X_2 - 15,000X_3 - 10,000X_4 + d_{16}^- - d_{16}^+ = 1,450,000(1,350,000 + 100,000) \]

**Priority Structure for Firm Goals**

The partners in charge of the firm's planning function have set the following priority structure for firm goals:

1. Increase gross audit fees by 10% \((P_1)\)
2. Increase chargeable hours by 5% \((P_2)\)
3. Increase billing rates by 5% \((P_3)\).
4. (a) Attain a desirable distribution of clients with respect to size expressed in chargeable hours ($P_4$).

(b) Allow no one client to account for more than 20% of the firm's total revenue. This goal is considered to be twice as important as Goal 4(a) $2(P_4)$.

5. Maintain a ratio of at least one management personnel to every five staff men ($P_5$).

6. Hold the number of senior and staff accountants to 42 ($P_6$).

7. Provide a minimum net income of Rs1,000,000 ($P_7$).

**Objective Function**

The objective function in this model is to minimize the deviations from the firm goals established within the preceding ordinal priority structure. The objective function is formulated as follows:

$$Min = P_1 d_{0}^- + P_2 (d_{1}^+ + d_{2}^+ + d_{3}^+ + d_{4}^+) + P_3 (d_{5}^+ + d_{6}^+ + d_{7}^+ + d_{8}^+)$$

$$+ 2P_4 d_{14}^+ + P_4 (d_{11}^+ + d_{12}^+ + d_{13}^+) + P_5 d_{10}^+ + P_6 d_{15}^+ + P_7 d_{16}^+$$
3.4 RESULT AND DISCUSSION

The solution will be obtained by using QM for WINDOWS package, which discussed as follows:

**Table-3.4**

<table>
<thead>
<tr>
<th>THE FIRST RUN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Goal</strong></td>
</tr>
<tr>
<td>1. Gross audit fee increase</td>
</tr>
<tr>
<td>2. Chargeable hour increase</td>
</tr>
<tr>
<td>3. Billing rate increase</td>
</tr>
<tr>
<td>4. (a) Client distribution</td>
</tr>
<tr>
<td>( b) Revenue distribution</td>
</tr>
<tr>
<td>5. Management/staff ratio</td>
</tr>
<tr>
<td>6. Senior and staff ceiling</td>
</tr>
<tr>
<td>7. Net income</td>
</tr>
</tbody>
</table>

**B. Variables**

- \(X_1 = 3.12\)
- \(Y_1 = \text{Rs} 42.00\)
- \(Z_1 = 11,045.86\)
- \(X_2 = 6.27\)
- \(Y_2 = \text{Rs} 31.50\)
- \(Z_2 = 55,229.30\)
- \(X_3 = 12.56\)
- \(Y_3 = \text{Rs} 21.00\)
- \(Z_3 = 44,183.45\)
- \(X_4 = 34.37\)
- \(Y_4 = \text{Rs} 15.75\)
- \(Z_4 = 22,091.72\)

The solution for the first run indicates that the following three goals were not achieved: (1) the chargeable hour increase, (2) the senior and staff ceiling, and (3) the desired net income. In order to achieve the optimum solution for all goals, 5,897 staff hours in excess of the projected chargeable hour increase were required. A total of 46.93 senior and staff accountants were required in order to achieve the higher order goals. This figure represents an excess of 4.93 over the desired ceiling of 42. Net income of Rs 58,734 was attained, resulting in a Rs 41,266 underachievement of the net income goal of 1 lakh.
The goal of a 10% increase in gross audit fees was over-achieved, but only the underachievement of this goal was considered critical. The client and revenue distributions were achieved in this model, but this probably will not happen very often. For example, if 51%, rather than 50%, of the firm's total chargeable hours came from clients in the 1001-5000 chargeable-hour range, the optimum solution would not be achieved. Nonachievement of this goal would also be the case if one client accounted for 21%, rather than 20%, of the firm's total revenue. Since in neither case would it be rational for the firm to let a client go, the only solution to such a problem would be to change the applicable constraints in the model.

One of the more desirable features of goal programming as an aid in the planning process is that it allows management to review critically their priority structure for goals after an initial solution has been obtained from the planning model. After analyzing the results of the first run, the planning team has decided to modify their hierarchy of goals. This analysis and modification are reflected in the second run.

The Second Run

A. Modified Priority Structure for Goals

The firm's planning team has decided to give the net income goal the highest priority. All of the other goals remain in the same order except that this modification lowers each goal one priority level. The firm's modified priority structure for goals is:

1. Provide a minimum net income of Rs 1,00,000 ($P_1$).
2. Increase gross audit fees by 10% ($P_2$).
3. Increase chargeable hours by 5% ($P_3$).
4. Increase billing rates by 5% ($P_4$).
5. (a) Attain a desirable distribution of clients with respect to size expressed in chargeable hours ($P_5$).
   (b) Allow no one client to account for more than 20% of the firm's total revenue.

This goal is considered to be twice as important as goal 5(a) ($2P_5$).
6. Maintain a ratio of at least one management personnel to every five staff men \(P_6\).
7. Hold the number of senior and staff accountants to 42 \(P_7\).

**B. Objective Function**

The objective function for the second run then becomes:

\[
\text{Minimize } P_1 d_{16}^- + P_2 d_9^- + P_3 (d_1^+ + d_2^+ + d_3^+ + d_4^+) + P_4 (d_5^+ + d_6^+ + d_7^+ + d_8^+)
+ 2P_5 d_{14}^+ + P_6 (d_{11}^+ + d_{12}^+ + d_{13}^+) + P_7 d_{10}^+ + P_8 d_{15}^+
\]

<table>
<thead>
<tr>
<th><strong>Table-3.5</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C. Goals</strong></td>
</tr>
<tr>
<td>1. Net income</td>
</tr>
<tr>
<td>2. Gross audit fee increase</td>
</tr>
<tr>
<td>3. Chargeable hour increase</td>
</tr>
<tr>
<td>4. Billing rate increase</td>
</tr>
<tr>
<td>5. (a) Client distribution</td>
</tr>
<tr>
<td>(b) Revenue distribution</td>
</tr>
<tr>
<td>6. Management/staff ratio</td>
</tr>
<tr>
<td>7. Senior and staff ceiling</td>
</tr>
<tr>
<td><strong>D. Variables</strong></td>
</tr>
<tr>
<td>(X_1 = 3.12)</td>
</tr>
<tr>
<td>(X_2 = 6.27)</td>
</tr>
<tr>
<td>(X_3 = 6.27)</td>
</tr>
<tr>
<td>(X_4 = 34.37)</td>
</tr>
</tbody>
</table>

The solution for the second run indicates that once again the firm failed to achieve three of its seven goals, but a trade-off of scarce resources has been effected in order to achieve a more desirable goal. Two of the goals not achieved in the first run, the chargeable hour increase and the senior and staff ceiling, were also not achieved by identical amounts in this run. The third goal not achieved in the second run was the billing rate increase. In order to achieve the highest goal, a minimum net income of Rs1,00,000, it was necessary
to raise the hourly billing rate for staff accountants from the desired rate of Rs15.75/hour to Rs16.44/hour, which resulted in a deviation of Rs0.69/hour from this goal. Hence, a trade-off of scarce resources has resulted in the achievement of a more desirable goal.

3.5 CONCLUSIONS

An attempt has been made in this chapter to relate the goal programming technique to the planning function in public accounting firms. Although it is recognized that this approach has both desirable features and limitations, its advantages seem to outweigh its limitations. Goal programming, as demonstrated by the planning model presented in this chapter, can be effectively utilized where the firm has multiple, incompatible, and incommensurable goals. Goal programming does not impose on management a requirement that their goals be compressed into a uni-dimensional decision criterion. Another advantage of goal programming is that it helps to identify the conflicting nature of firm goals and where trade-offs must occur in order to achieve the most desirable goals under the given constraints. The most desirable feature of goal programming is the opportunity it gives to the planning team to review critically its hierarchy of goals after an initial solution has been obtained from the planning model. Both the priority structure for goals and constraints can be modified to attain the most desirable set of objectives.

The most apparent limitation of utilizing the goal programming model in the planning process is that it requires the planning team to define, quantify, and establish an ordinal priority structure for the firm's goals. The goal programming model will provide the optimum solution only if there has been correct definition quantification, and ordering of goals. The effect of this limitation is mitigated somewhat when one considers that the efficacy of any type of formal planning model depends on the organized setting of objectives and the evaluation of alternatives. Although the model presented in this paper is not conclusive evidence that goal programming can be applied effectively to the planning process in public accounting firms, it does indicate that potential exists for such an application.