

# A Goal Programming Model for Public Accounting Firms

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**Abstract:-** The purpose of this paper 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.

**Key Words:-** *Public accounting, Goal Programming*

## INTRODUCTION

Public accountants have, for years, encouraged clients to implement formal planning programs as an aid in the development of the business. However, until the past decade few accountants had implemented formal planning programs for their own practices. Because of this deficiency, witnessed the promulgation of written material in the area of planning for public accounting firms by the Institute of Certified Public Accountants and by individual accounting practitioners.[8].Even though most of these publications emphasize the necessity for formal planning by public accounting firms, many firms still have not seriously considered such programs. The professional firm simply cannot continue to ignore planning since it enables a firm to function more effectively and efficiently, to render better services to its clients, and to meet the challenge of a dynamic future [9].Once a firm accepts the concept of planning in future growth deliberations, the footnote-cited publications offer useful guidance to the practitioner concerned with development of an approach to the planning process. For example, Robert Ellyson[9] recommends the following four-step approach to the planning process:

- (i) Determine the tentative general goals
- (ii) Study the past and present situations and, based on these, project what the future will be, assuming the trend continues
- (iii) Define specific goals and tools for implementation and
- (iv) Design a reporting system and updating procedures

Although the need for formal planning is important to all accounting firms, it is critical in the larger firms. Planning in large accounting firms has become an extremely complex task, just as it has in industrial firms. Company management which public accountants serve

increasingly have turned to modern management techniques, especially management science tools, as aids in planning and efficiently administering their limited resources. The purpose of this paper 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 firm. Specifically, an attempt will be made to relate goal programming to a problem of a public accounting firm. With this goal in mind, a discussion of the goal programming technique was presented.

Goal programming, representing a special extension of linear programming, was discovered initially by A. Charnes and W. W. Cooper in their research of linear programming. These authors first introduced goal programming in their highly successful book, *Management Models and Industrial Applications of Linear Programming*, as a means of considering unsolvable linear programming problems.[4]. Ijiri Y. published a book on the goal programming technique in which he refined and reinforced the general notion of goal programming.[6] As a result of these efforts, goal programming has become an operational mathematical programming model.

As a practical technique, the goal programming approach first was applied by Charnes and others to advertising media planning.[6] This initial application was followed by those in the areas of manpower planning and aggregate production planning. More recently, others have explored the application of goal programming to the areas of portfolio management, municipal planning, and hospital administration[2]. Indeed goal programming is a relatively new technique, and its true potential has yet to be realized. The rather recent development of effective computer programs for the goal programming solution, the lack of which had hindered the technique's application in the past, has opened the avenues for possible application of this quantitative method to the more complicated management problems

## 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 1, 2, and 3 outline the information pertaining to the accounting firm needed for the model design.

TABLE-1  
AUDIT PERSONNEL, WORKING HOURS, BILLING RATES AND GROSS AUDIT FEES

Position	Number Employed	Working Hr per Individual Per Year	Total Hr/position year (50 weeks)	Chargeable Hrs per Individual Per Year	chargeable Hr/Position/Year	Nonchargeable Hr/Individual /year	Nonchargeable Hr/Position/Year	Billing Rates/Hr
Partner	3	2500	7,500	2000	6,000	500	1500	Rs40
Manager	6	2250	13,500	2000	12,000	250	1500	Rs30
Senior	12	2250	27,000	2100	25,000	150	1800	Rs20
Staff	30	2000	60,000	1900	57,000	100	3000	Rs15
Gross Audit Fees Earned for the Past Year:								
Partner: 6,000 hr @ Rs 40/hr = Rs 2,40,000								
Manager: 12,000 hr @ Rs 30/hr = Rs 3,60,000								
Senior: 25,000 hr @ Rs 20/hr = Rs 5,04,000								
Staff: 57,000 hr @ Rs 15/hr = Rs 8,55,000								
Total								
<u>Rs 19,59,000</u>								

TABLE-2  
PROJECTED INFORMATION FOR NEXT YEAR BASED ON THE GOALS SET BY THE FIRM

1. Chargeable Hours (an increase of 5%)			
Partner:	$6,000 \times 105\% = 6,300$		
Manager:	$12,000 \times 105\% = 12,600$		
Senior:	$25,200 \times 105\% = 26,460$		
Staff:	$57,000 \times 105\% = 59,850$		
	Total	1,05,210	
2. Total Hours by Position			
Partner	Chargeable	Nonchargeable	Total
Partner:	6,300	1,500	7,800
Manager:	12,600	1,500	14,100
Senior:	26,460	1,800	28,260
Staff:	59,850	3,000	62,850
	Total	<u>Rs1,13,010</u>	
3. Billing Rates/Hour (an increase of 5%)			
Partner:	$Rs 40 \times 105\% = Rs 42.00$		
Manager:	$30 \times 105\% = Rs 31.50$		
Senior:	$20 \times 105\% = Rs 21.00$		
Staff:	$10 \times 105\% = Rs 15.75$		

**TABLE-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	<u>Rs 21,59,798</u>	
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	

### 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

$Z_3$ = Chargeable-hours from clients in the over 5000 chargeable hour range

$Z_4$ = Average chargeable-hours from each type  $Z_3$  client.

#### 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 1 and 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 2) and  $d_i^+$  represents over-achievement of the projected billing rates, may be expressed as:

$$6300Y_1 + 12,600Y_2 + 26460Y_3 + 59,850Y_4 + d_9^- - d_9^+ = Rs 2,159,798$$

**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 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 1):

$$2000X_1 + 2,000X_2 + 2100X_3 + 1900X_4$$

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

$$6300Y_1 + 12,600Y_2 + 26460Y_3 + 59,850Y_4 - 30,000X_1 - 20,000X_2$$

$$- 15,000X_3 - 10,000X_4 + d_{16}^- - d_{16}^+ = 1,450,000(1,350,000 + 100,000)$$

## Priority Structure for Firm Goals

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

$$Y_1 + d_5^- - d_5^+ = Rs 42.00$$

$$Y_2 + d_6^- - d_6^+ = Rs 31.50$$

$$Y_3 + d_7^- - d_7^+ = Rs 21.00$$

$$Y_4 + d_8^- - d_8^+ = Rs 15.75$$

## 3. Gross Audit Fees

The goal of a 10% increase in gross audit fees, where  $d_i^-$  represents underachievement of this goal &  $d_i^+$  represents overachievement, may be expressed as (see Table 2 & Table 3):

$$6300Y_1 + 12,600Y_2 + 26460Y_3 + 59,850Y_4 + d_9^- - d_9^+ = Rs 2,159,798$$

$d_i^+$  = 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  $d_i^+$  and  $d_i^-$  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  $d_i^-$  represents the number of seniors and staff less than 42 and  $d_i^+$  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  $d_i^-$  represents under-achievement of the desired net income and  $d_i^+$  represents overachievement of the net income goal, may be expressed as:

$$6300Y_1 + 12,600Y_2 + 26460Y_3 + 59,850Y_4 - 30,000X_1 - 20,000X_2$$

$$- 15,000X_3 - 10,000X_4 + d_{16}^- - d_{16}^+ = 1,450,000(1,350,000 + 100,000)$$

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 Rs1,00,000 ( $P_7$ ).

#### 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:

$$\begin{aligned} \text{Min} = & P_1 d_9^- + P_2 (d_1^+ + d_2^+ + d_3^+ + d_4^+) + P_3 (d_5^+ + d_6^+ + d_7^+ + d_8^+) \\ & + 2P_4 d_{14}^+ + P_4 (d_{11}^+ + d_{12}^+ + d_{13}^+) + P_5 d_{10}^+ + P_6 d_{15}^+ + P_7 d_{16}^+ \end{aligned}$$

#### RESULTS AND DISCUSSION

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

#### THE FIRST RUN

A. Goal		
1. Gross audit fee increase	Achieved	
2. Chargeable hour increase	Not achieved	
3. Billing rate increase	Achieved	
4. (a) Client distribution	Achieved	
( b) Revenue distribution	Achieved	
5. Management/staff ratio	Achieved	
6. Senior and staff ceiling	Not achieved	
7. Net income	Not achieved	
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, 5897 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 ( $P_7$ ).

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

#### C. Goals

1. Net income	Achieved
2. Gross audit fee increase	Achieved
3. Chargeable hour increase	Not achieved
4. Billing rate increase	Not achieved
5.(a) Client distribution	Achieved
(b) Revenue distribution	Achieved
6. Management/staff ratio	Achieved
7. Senior and staff ceiling	Not achieved

#### D. Variables

$$\begin{array}{lll} X_1 = 3.12 & Y_1 = \text{Rs } 42.00 & Z_1 = 11,045.86 \\ X_2 = 6.27 & Y_2 = \text{Rs } 31.50 & Z_2 = 55,229.30 \\ X_3 = 6.27 & Y_3 = \text{Rs } 21.00 & Z_3 = 44,183.45 \\ X_4 = 34.37 & Y_4 = \text{Rs } 16.44 & Z_4 = 22,091.72 \end{array}$$

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.

#### CONCLUSIONS

An attempt has been made in this paper 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 paper, 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

#### B. Objective Function

The objective function for the second run then becomes:

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.

#### REFERENCES

1. Arisha, A. [2003]: *Intelligent Shop Scheduling for Semiconductor Manufacturing*. Doctorial dissertation, School of Mechanical and Manufacturing Engineering, Dublin City University, Dublin, Ireland.
2. Baker, R.L., et.al.,[2006]: A Pilot study to evaluate a computerized prototype used to generate hospital staff nurses a patient/shift assignment. Working paper.
3. Bard,J.F., and Purnono, H.W.[2005]: Hospital wide reactive scheduling of nurses with preference considerations. *IIE Transactions*, **35**,589-608.
4. Charnes A [1968]: Note on an application of a goal programming model for media planning. *Management Science*, **431-436**.
5. Charnes A and Copper WW [1961]: *Management models and industrial applications of linear programming*. John Wiley and sons, New York, USA.
6. Ijili Y [1965]: *Management goals and Accounting for control*. Amsterdam, North Holland.
7. Jaaskelainen V [1969]: A Goal Programming model for aggregate

- production planning. **Swedish Journal of Economics**, 14-29.
- 8. **Robert CE [1968]:** *Planning the future growth of an accounting practice – one approach.* **The Journal of Accountancy**, 46-56
  - 9. **Robert EH and Wharton D [1965]:** *A local CPA firm plans for the future.* **The journal of Accountancy**, 48-58
  - 10. **Sevebeck W et al. [1971]:** *An aggregate budget planning model for hospital administration.* **Management Science**, 104-119