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GOAL PROGRAMMING WITH UTILITY FUNCTION FOR ACADEMIC RESOURCE ALLOCATION IN SCHOOL FOR PURPOSE OF COURSE AFFILIATION USEFUL IN GETTING AFFILIATION

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ABSTRACT

Course affiliation of Schools imparting elementary education by Central or State board is vital issue for school Managers. As any School have both non academic and academic resources .For purpose of course affiliation with board .School authorities has to meet out both academic and non academic needs defined by rule given by affiliating boards in India. Academic resource allocation is the vital part which has to be well taken in the rules structured by boards. To meet out academic resource allocation in any school the most important academic resources is library. To make investment to upgrade library is very serious concern for school managers, for which a proper budget is required or in other words a proper funding is required for library resource allocation. Here we are focusing on the same The funding of library is optimally utilized to achieve the need of not only users but also fulfils major requirement for course affiliation of schools by designated boards. We build a goal programming model with utility functions to maximize the number of reading materials bought and the utility for each field's user for bought materials. The model is then applied to a school library. The goal programming model illustrated an optimum solution for funding allocation with utility of each field's user of the library.

Keywords: *Goal programming, Utility function, Course affiliation.*

1. INTRODUCTION

In our country there are more than one billion educational institutions which are working with purpose of providing best education .biased when allocating funds for academic areas. Thus, this gave rise to a mathematic model that can give optimum and balanced solution for the allocation. Due to limited funding but unlimited demand from library users, the library has to properly apportioned its allocation. The total funding for the library has been decreased from RM10905000 in 2011 to RM8395000 in 2012 (UKM 2011). Thus, The importance of fair and unbiased allocation of funding for materials of different academic fields is more obvious as resources are low. The library may face multiple objectives. Goal programming is one technique that can be used in such situations (Winston 2007) for solving multi criteria decision making and multi objectives decision making problems by finding a set of satisfying solutions (Chang *et al.* 2011). Hassan *et al.* (2010a, 2010b) and Hassan and Tabar (2011) dealt with decision making of multi objective resource allocation problems. Hassan and Mohammad Basir (2009) and Hassan and Ayop (2012) used goal programming for decision making in various applications. Under some further mathematical assumptions, the preferences of the decision maker can be modeled by the value or utility functions (Podinovski 2010). The choice of a utility in portfolio selection in a given asset market is based on the preferred degree of risk aversion, which is by nature subjective. In the financial literature, except portfolio selection, a problem often includes consumption choice as well (Yu *et al.* 2009). A multi-choice goal programming model with utility functions is proposed so that the library not only can optimize the deviations of variables from the goals, but also the utility of the decision being made.

2. MODEL BUILDING

The two objectives of funding allocation are to:

i. maximize the use of funding to each field of knowledge.

ii. balance the purchase of materials with respect to the priority of the field of knowledge.

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The variables, constant, and constraints are listed below:

2.1. Decision variables

x_i = number of reading materials that should be bought for subject *i*
d_i^- = under achievement of the *i*th goal
d_i^+ = over achievement of the *i*th goal
e^- = under achievement of fund used from the total fund
e^+ = over achievement of fund used from the total fund
λ_i = utility for the *i*th goal
f_i^- = dissatisfactory for *i*th goal
y_i = objective value of *i*th goal

2.2 Coefficients and constants

C_i = average cost for reading materials of subject *i*
T = total funding available
g_{maxi} = upper demand limit for subject *i*
g_{mini} = lower demand limit for subject *i*

2.3 Constraints

i. Funding:

Product of average cost for each reading material and its number purchased must not exceed the total funding available. Also assume that the amount of funding used, *fund*, should be at least half of the total funding available, where $dfund^+$ and $dfund^-$ are positive and negative deviations of the product of average cost for each reading material and its number purchased.

$$\sum_{i=1}^{m} c_i x_i - dfund^+ + dfund^- = fund$$

$1/2\ T \le fund \le T\ fund - e^+ + e^- = T$

ii. Utility: Assume that if the number of reading materials purchased equal to the greater of the amount purchased in the past two years, then utility is maximized. Else utility is minimized. Thus g_{mini} equals to the lesser number purchased in that period for subject *i* while g_{maxi} equals to the greater number.

$$g\max_n - d^+ + d^- = y_n, g\min_n \le g\max_n$$

$$\lambda_n \le \frac{y_n - g\min_n}{g\max_n - g\min_n}, \lambda_n + f_n^- = 1$$

2.4 Objective function

The objective function is to minimize *z*, defined as the summation of all the deviations from every goal.

$$\text{Min z} = \sum_{i=1}^{m} \left(d_i^+ + d_i^- + f_i^-\right) + dfund^+ + dfund^- + e^+ + e^-$$

APPLICATION

Above model is applied on Govt. Multi purpose Girls Higher Secondary School, Bhopal. School is having its own library containing almost 20,000 books. Based on the library's annual report of 2008, the total collection of books in is 5123 with budget of Rs.75000 available for purchase of new materials. Nonetheless School library was over-budgeted in the year 2008. Library has divided its collection of books into 16 areas. These include various subjects, languages , and other groupings as listed in columns 1 and 2 of Table 1.

Number of reading materials

S. No.	Subjects/Languages/Area	Average Cost	No. of Books in year 2008	No. of Books in year 2007	Optimum numbers x_i
1.	English	Rs.10.00	80	85	80
2.	Hindi	Rs.8.00	70	75	70
3.	Environ Sc	Rs.12.00	60	65	60
4.	Information Tech	Rs.15.00	50	65	50
5.	Hindi	Rs.7.00	80	85	80
6.	Mathematics	Rs.9.00	70	80	70
7.	Physics	Rs.12.00	60	75	60

8.	History	Rs.11.00	75	85	75
9.	Sociology	Rs.9.00	70	80	70
10.	Education	Rs.10.00	63	69	63
11.	Economics	Rs.09.00	90	85	85
12.	Political science	Rs.10.00	65	85	65
13.	Chemistry	Rs.11.00	80	85	80
14.	Biology	Rs.16.00	73	85	73
15.	Zoology	Rs.10.00	80	75	75
16	Botany	Rs.14.00	43	55	43

Our mathematical model is

subject to min z = $\sum_{i=1}^{16}\left(d_i^+ + d_i^- + f_i^-\right) + dfund^+ + dfund^- + e^+ + e^-$

$\sum_{i=1}^{16} c_i x_i - dfund^+ + dfund^- = fund \quad 110000 \le fund \le 222000$, fund = $e^+ + e^+ = 222000$

$g\max_n - d^+ + d^- = y_n, g\min_n \le g\max_n$

$\lambda_n \le \frac{y_n - g\min_n}{g\max_n - g\min_n}, \lambda_n + f_n^- = 1$

where n = 1,2,3,4,5,6,…16

RESULT AND DISCUSSION

QSB+ is used to solve this model. The optimal number of reading materials to be bought is displayed in the last column of Table 1. Table 2 lists the values of utility function, overachievement and underachievement variables

S. No.	Subjects/Languages/Area	d^+	d^-	Utility
1.	English	7	0	0
2.	Hindi	15	0	0
3.	Environ Sc	16	0	0
4.	Information Tech	12	0	0
5.	Hindi	8	0	0
6.	Mathematics	10	0	0
7.	Physics	8	0	0
8.	History	9	0	0
9.	Sociology	6	0	0
10.	Education	11	0	0
11.	Economics	10	0	0
12.	Political science	13	0	0
13.	Chemistry	9	0	0
14.	Biology	15	0	0
15.	Zoology	10	0	0
16	Botany	14	0	0

It is found that *fund* = Rs 220000, implying that the funding has been fully utilized. The $dfund^-$ small value of 0.576 shows that there is only Rs 0.576 left. Values of 0 for e^+ and e^- mean that the total of funding used equals to the total funding available. d^+ is the reduction of the number of reading materials bought from the greater number of the past two years, and vice versa for d^-. These might probably be due to the big difference
between the number of reading materials bought in the past two years. If too many books were bought last year, the need for new books will be lower for the present year.

5. CONCLUSION

Goal programming with utility functions to overcome the funding allocation problem in purchasing reading materials has been successfully applied to a school library. The utility value approach will help libraries make better decisions in optimizing funding allocation in order to maximize utility with limited resources such as this library funding allocation problem.

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Conflict of interest:
Useful for school management to adopt the given method while purchasing books and other study materials for the school library. School management after analyzing the requirement of books in library, can utilize this method to minimize the error rate of purchasing undesired books in the school library.

