International Journal of Research in Advent Technology (IJRAT) Special Issue, January 2019
E-ISSN: 2321-9637
Available online at www.ijrat.org

International Conference on Applied Mathematics and Bio-Inspired Computations

10th & 11th January 2019

An Approach for Production Planning using Fuzzy Goal Programming Technique

Dr. K. Kalaiarasi[1], R. Gayatri[2]
Assistant professor, Department of Mathematics
PG Student, Department of Mathematics, Cauvery College for Women, Trichirapalli, India.
kalaishruthi12@gmail.com[1], gayuravi0304@gmail.com[2]

Abstract-Production planning of supply chain is one of the long-time goal in the industrial world. Production planning is efficient process in almost all companies to meet the market demand. In this paper we present how to increase the production of Furniture Company. Fuzzy Goal Programming is a technique applied for production planning to maximize the profit and to minimize the cost of raw materials. By using Fuzzy Goal Programming we can able to take decisions regarding the production. The main objective is to solve the Decision making problem to meet the market demand.
KEY WORDS: production planning; Fuzzy goal programming; decision making.

1. INTRODUCTION

Nowadays, Production Planning is the major problem in some of the companies. To overcome this disadvantage we make use of Fuzzy Goal Programming. Production planning includes cost we spent in buying raw materials, and gain benefits of profit and goodwill of the company. Both quality and cost must satisfy the customer. And most importantly we must also able to take decisions when the cost of raw materials is moved up and down. Fuzzy goal programming has two methods to solve the multiobjective goal programming problem.one is multi objective plus fractional programming problem. To meet this requirements Fuzzy Goal Programming is used in efficient manner to perform on amount of production in order to meet the target of the company.

2. FUZZY GOAL PROGRAMMING (FGP):

FGP is formulated as

1) To find a^* and maximize λ
2) To satisfy the condition

$\mu_{fi}(x) \geq \lambda$ ….. (1)

$A_x \leq b, x \geq 0$ …. (2)

The objective functions are

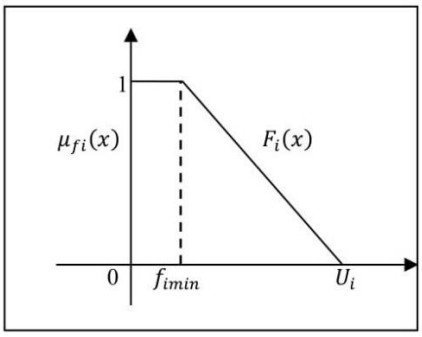
If $F_i \leq f_i$ then

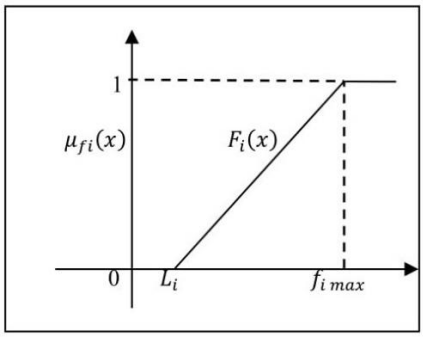
$$\mu_{fi}(x) = \begin{cases} 1 & ,F_i \leq f_{i\,min} \\ \frac{U_i - F_i(x)}{U_i - f_{i\,min}} & ,f_{i\,min} < F_I(x) \leq U_i \\ 0 & ,F_i \geq U_i \end{cases} \quad \ldots (3)$$

If $F_i \geq f_i$ then,

$$\mu_{fi}(x) = \begin{cases} & ,F_i \geq f_{i\,min} \\ \frac{F_i(x) - L_i}{f_{i\,max} - L_i} & ,L_i < F_i(x) \leq f_{i\,max} \\ 0 & ,F_i \leq L_i \end{cases} \ldots (4)$$

The membership functions of equations (3) and (4)





3. STEPS INVOLVED IN FGP:

a) Optimization of products.
b) Enter input values like cost and selling price and maximum and minimum input of raw materials and production of products.
c) Achieve three level input values of goal programming.
d) Obtain optimal solution of input values like profit, cost of materials and cost of production. If there is no optimal solution go to step b
e) Compare three level and find optimum goal factors. If the condition

satisfies then formulate fuzzy goal programming if not then go to step c

f) FGP model has to be calculated

g) FGP calculation will give a solution .If it satisfies then find optimal value λ If not then go to step f .The result follows optimal value with input values then stop the process

4. DISSCUSSION:

The company need to produce bed, wardrobe, dressing table, writing table and teapot. Let us see the input table as given

Input Table: 1

No	Product name	Selling price	Production cost	Minimum production	Maximum production
1	Bed	4250	350	0	5
2	Wardrobe	5000	400	5	12
3	Dressing table	2500	300	0	5
4	Writing table	4000	375	2	5
5	Teapot	18000	1000	3	4

Suppose the minimum target of the company is 35000 and maximum cost of raw materials is 75000 and the cost for maximum production target is 15000

GOAL FUNCTION: To find a^*

1) Profit maximization:

$$4250a_1 + 5000a_2 + 2500a_3 + 4000a_4 + 18000a_5$$
$$1950a_1 + 2675a_2 + 1050a_3 + 1590a_4 + 6865a_5$$
$$350a_1 + 400a_2 + 300a_3 + 375a_4 + 1000a_5 + 25000 \quad (-)$$
$$1950a_1 + 1925a_2 + 1150a_3 + 2035a_4 + 10135a_5 - 25000$$

2) Material cost maximization:

$$325a_1$$
$$510a_1 + 640a_2 + 385a_3 + 510a_4 + 1530a_5 + 585a_5$$
$$390a_1 + 235a_2 + 65a_3 + 390a_4 + 190a_4 + 500a_5$$
$$600a_1 + 250a_4 + 1750a_5$$
$$125a_1 + 250a_4 + 2500a_5$$
$$1800a_2 + 600a_3 1950a_1 + 2675a_2 + 1050a_3 + 1590a_4 + 6865a_5$$

3) Production cost minimization:

$$1000a_1 + 800a_2 + 250a_3 + 300a_4 + 150a_5$$

CONSTRAINT FUNCTION:

1) Production time: $12 \leq 0.25a_1 + 0.25a_2 + 0.5a_3 + a_4 + 0.125a_5 \leq 13$
2) Inventory: $0.5a_1 + 1.5a_2 + 1.2a_3 + a_4 + 1.5a_5 \leq 125$
3) Materials:
   Glass: $a_1 \leq 50$
   Wood: 9mm: $2a_4 + a_5 \leq 150$
   12mm: $3a_1 + 2a_2 + a_3 + 3a_4 \leq 300$
   15mm: $3a_5 \leq 150$
   18mm: $2a_1 + 3a_2 + a_3 + 2a_4 + 6a_5 \leq 300$
   Paint: $a_1 + a_4 + a_5 \leq 150$
4) Max & Min quantity of bed: $0 \leq a_2 \leq 5$
5) Max & Min quantity of wardrobe: $5 \leq a_2 \leq 12$
6) Max & Min quantity of dressing table: $0 \leq a_2 \leq 5$
7) Max & Min quantity of writing table: $2 \leq a_2 \leq 5$
8) Max & Min quantity of teapot: $3 \leq a_2 \leq 4$

Using linear programming optimum profit: Z^*=55832.

Using linear programming cost of material: M^*=53933

Using linear programming cost of production P^* = 8990

Profit value: $Z^* \geq Z$

$55832 \geq 35000$

Cost of material: $M^* \leq M$

$53933 \leq 75{,}000$

Cost of production: $P^* \leq$P

$8990 \leq 15{,}000$

Goal function: max λ

CONSTRAINT FUNCTION:

$$1950a_1 + 1925a_2 + 1150a_3 + 2035a_4 + 10135a_5 - 25000 - (55832.4 - 35000) \geq 350001950a_1 + 2675a_2 + 1050a_3 + 1590a_4 + 6805a_5 + (75000 - 37115)\lambda \leq 75000$$
$$350a_1 + 400a_2 + 300a_3 + 375a_4 + 1000a_5 + (15000 - 5750)\lambda \leq 15000$$

1) Production time:
   $14 \leq 0.5a_1 + 0.25a_2 + 0.5a_3 + a_4 + 0.125a_5 \leq 15$
2) Inventory:

$0.5a_1 + 1.5a_2 + 1.2a_3 + a_4 + 1.5a_5 \leq 100$

3) Materials:

Glass: $a_1 \leq 50$

Wood: 9mm: $2a_4 + a_5 \leq 150$

12mm: $3a_1 + 2a_2 + a_3 + 3a_4 \leq 300$

15mm: $3a_5 \leq 150$

18mm: $2a_1 + 3a_2 + a_3 + 2a_4 + 6a_5 \leq 300$

Paint: $a_1 + a_4 + a_5 \leq 150$

4) Max & Min quantity of bed:

$0 \leq a_2 \leq 5$

5) Max & Min quantity of wardrobe:

$5 \leq a_2 \leq 12$

6) Max & Min quantity of dressing table:

$0 \leq a_2 \leq 5$

7) Max & Min quantity of writing table:

$2 \leq a_2 \leq 5$

8) Max & Min quantity of teapot:

$3 \leq a_2 \leq 4$

The result using fuzzy goal programming is:

Bed=a_1=0

Wardrobe=a_2=5

Dressing table=a_3=3

Writing table=a_4=0

Teapot=a_5=6

The objective of the company is to produce 5 wardrobes, 3 dressing table and 6 teapot with profit gain is

$=1950a_1 + 1925a_2 + 1150a_3 + 2035a_4 + 10135a_5$ -25,000

=1950*0 + 1925*5 + 1150*3 + 2035*0 + 10135*6 - 25000

=73885 Rs

Cost of .material:

$= 1950a_1 + 2675a_2 + 1050a_3 + 1590a_4 + 6865a_5$

=1950*0 + 2675*5 + 1050*3 + 1590*0 + 6865*6

=57715

Cost of production:

$=350a_1 + 400a_2 + 300a_3 + 375a_4 + 1000a_5$

=350*0 + 400*5 + 300*3 + 375*0 +1000*6

=8900

Profit of the company is

$73885 \geq 35000$

Cost of the material is

$57715 \leq 75000$

Cost of production is

$8900 \leq 15000$

Since there are variety of factors in production planning there is a defective product. Because of these defective products the company lose its gain and we can't achieve its target of profit.

The total production of 2wardrobe process cost and cost of raw materials is

2*(2670) + 2*(400) = 6140

The total profit becomes

73885 – 6140 = 67745

5. CONCLUSION:

As a result of our discussion fuzzy goal programming is applied to many companies to maximize the profit and to minimize the cost of raw materials. In accordance with company preferences in production planning using fuzzy goal programming we determine the cost or amount. Fuzzy goal programming is an extension of conventional goal programming to solve multi objective problems precisely in a decision making environment.

REFERENCES

[1] Gupta.M and Bhattacharjee.D.(2012). "Two weighted fuzzy goal programming methods to solve multiobjective goal programming problem". Journal of applied Mathematics (2012)

[2] Li S., Y.Yang, C.Teng. (2004). "Fuzzy Goal Programming With Multiple Priorities via Generalized Varying-Domain Optimization Method. IEEE Transactions on Fuzzy System". Journal Mathematics **12:** 597 – 605

[3] Reddy, B. C. M., Reddy, K. H., and Reddy, C. N. M. (2012), " Production Centres Selection Problem for A Manufacturing Firm of Supply Chain Under Production Centers' Uncertainty and Demand Uncertainty by using Fuzzy Goal Programming Approaches ". International Journal of Research in Mechanical Engineering & Technology **2**

[4] Singh P., Kumar, S. T., Singh, R. K. (2011). "Fuzzy Goal Programming Approach to Multiobjective Linear plus Linear Fractional Programming Problem". Journal of Applied Mathematics

[5] Bhargava, A.K, Singh, S.R, and Divya Bansal. (2015). "Fuzzy Goal Programming Techniques for Production Planning in Industry". International Journal of Computer Applications Technology and Research 4 (2): 92-96

[6] [6] Tampinongkol, F. F., Rindengan, A. J., Latumakulita, L. A. (2015) "Aplikasi Fuzzy Goal Programming (StudiKasus: UD. SinarSakti Manado)". JurnalMatematika**4** (2)