www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 2 Issue 12 Dec,2013 Page No. 3455-3464

A Strategic Capacity Planning Model: A Genetic Algorithm Approach

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ABSTRACT: This paper presents an optimization based method to overcome the demands for multi-period production capacity planning by identifying the resources for the future months. Capacity planning plays an important role in all the manufacturing companies. The demand which has been forecasted by the company is totally delivered to the customers by the perfect production planning. Here we use Genetic Algorithm as the optimization tool for finding the optimal solution to minimize the production cost for six months to maximize the profit. The production cost must be minimized as much as possible and Inventories levels should be perfectly maintained, so the profit will be automatically increased. The inventory management also plays an important role in supply chain management. Inventory optimization is the real time works for the engineers those who are in the top administrative level. So here we concentrate on the main costs like Material cost, Inventory cost, Marginal cost of backlog, Hiring and Training cost, Lay-off cost, Regular time cost, Over time cost and cost of sub-contracting for allocating it by considering the demands of six months. Here we focus on generating an optimal schedule for the production for six months by fixing forty eight variables.

KEYWORDS: Supply chain Management, Production Planning, Capacity Planning, Genetic Algorithm, Inventory optimization.

INTRODUCTION

Notable changes in way of interest of customers often occur as a result of Global competition. The dynamic change in demand of the products and variety of products and standards of environment are the main components of the supply chain cycle. The manufacturing enterprise tries to deliver their best by optimizing the variables in order to reduce their total cost. Total cost is minimized by allocating the perfect resources for the next months by fixing those variables by an optimization tool. Here we use Genetic Algorithm to survive the fitness value among the several variables in supply chain activities by genetic operations like cross-over and mutation in certain probability. In this paper, we have developed an efficient and a new approach that works on Genetic Algorithm in order to allocate the optimal resources for an organization in Medium range prospective. The great potential for improvement in these objectives through effective supply chain management mechanisms has recently been realized [1].The minimization of total cost and maximization of profit has done while being subjected to a series of constraints in supply chain management. The competitions in today's industries are mainly depends heavily on the ability of the company to handle the different problems regards reducing lead-time and cost, satisfying customers in high level and increasing product quality. Main objective of this paper is to minimize the total cost to increase the profit. So here we have optimized the forty eight variables which will determine the total cost of the company using Genetic Algorithm.

1. LITERATURE REVIEW

1.1 CAPACITY PLANNING

Capacity planning involves analysis and decisions to balance capacity at a production or service point with demand from customers. Once capital expenditure has been made, it cannot be recovered entirely since salvage values are well below the original costs [2]. Therefore, the company has to maintain their capacity in order to increase their profit. Sometimes under-capacity and over-capacity may give cost benefits in some production period. Extensive research has been done on developing tools to make effective capacity planning decisions [3].Focusing on the problem of a firm that must satisfy monotone increasing demand overtime [4]. A general model that considers replacement of capacity as well as expansion and disposal, together with scale economy effects assuming deterministic technological changes is developed in [5]. The competitiveness of a company in the modern-day market place is determined by more than one vital feature such as the decrease in lead times and expenses, enhancement of customer service levels and upgrading the product quality [6]. So without capacity planning the company can't meet the demand and result of that it may reduce customer satisfaction.

1.2 GENETIC ALGORITHM

Genetic Algorithm is invented by John Holland in 1970s at United Stales at University of Michigan. Generally, Optimization algorithms can be divided into two basic classes: deterministic and probabilistic algorithms [7]. GA is a subclass of evolutionary algorithms that comes under the class of probabilistic algorithms. It employs a random yet direct search inspired by the process of natural evolution and the principles of "survival of the fittest" for locating the globally optimal solution [8]. GA can be efficiently used for operation control, design, scheduling, robotics trajectory planning, and machine learning like designing neural networks, improving classifier systems, signal processing and traveling salesman problems. It is a highly effective tool for an organization to use when it tries to maximize profits while being subjected to a series of constraints. An optimized crossover genetic algorithm is used to minimize total weighted completion time for a single machine scheduling problem [9]. The algorithm starts with the selection of random population has attached to the objective function that shows the individual performance based on series of constraints. The starting population is repeated to calculate the fittest solution as explained in following steps. Flowchart for GA operations is clearly shown in Chart. 1.

Step 1: [Start] Randomly generate population of n chromosomes as per population size.

Step 2: [Fitness] Evaluate the fitness f(x) of each chromosome x in the population

Step 3: [New population] Create new population by repeating following steps until the new population is complete.

a. [Selection] Select two parent chromosomes from a population.

b. [Crossover] With a crossover probability, crossover the parents to form a new offspring. If no crossover was performed, offspring is the exact copy of parents.

c. [Mutation] With a mutation probability, mutate new offspring at each locus.

d. [Accepting] place new offspring in the new population.

Step 4: [Replace] Use new generated population for a future run of the algorithm.

Step 5: [Test] if the end condition is satisfied, stop, and return the best solution in current population.

Step 6: [Loop] Go to step 2

Step 7: [Stop] Stop when the fittest value is obtained.

We are using those basic steps for finding the optimal resources for an organization in Medium range prospective using MATLAB software package

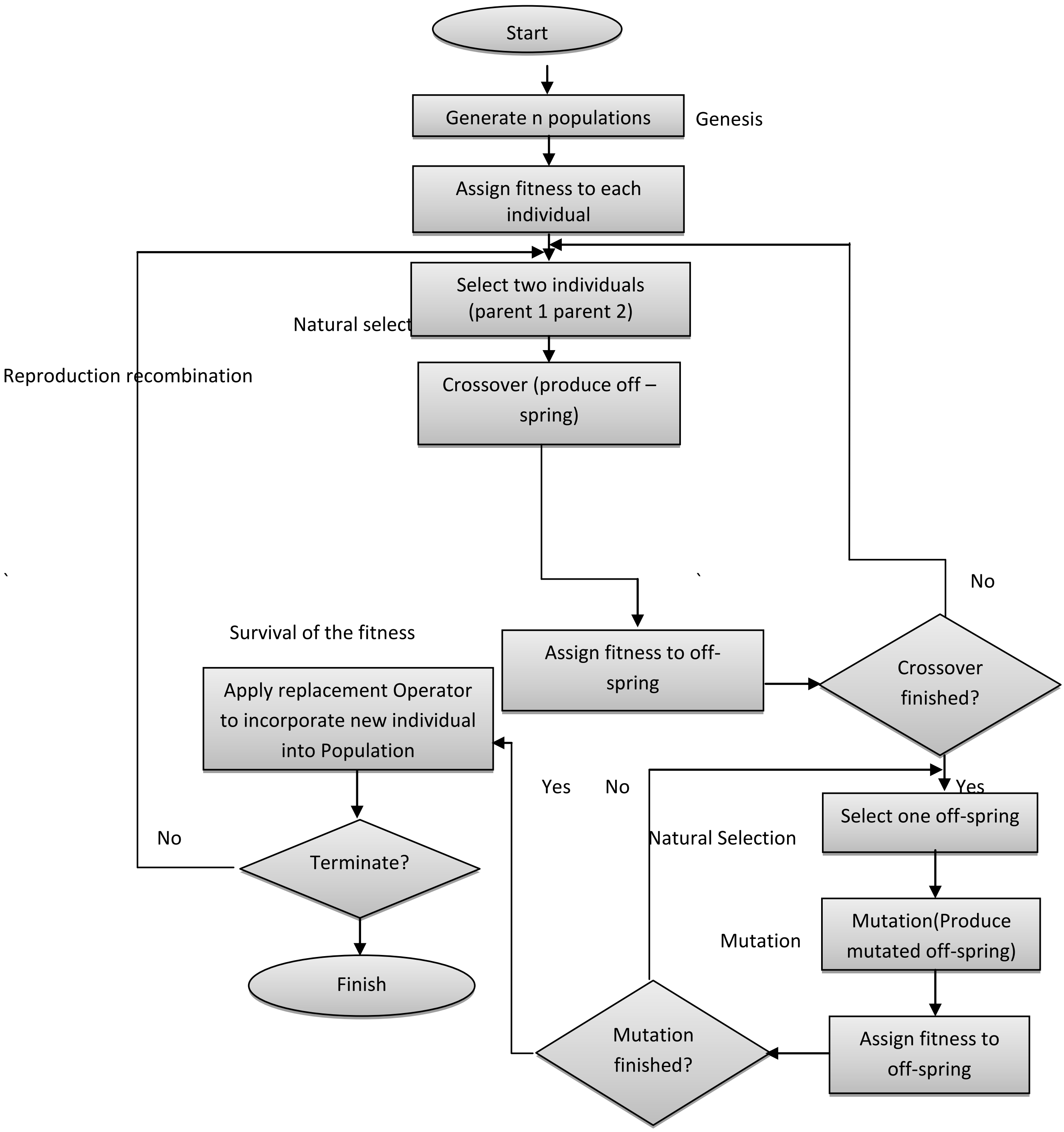


Chart. 1 GA Operations

2. DESCRIPTION OF THE PROBLEM

The demand for red tomato gardening tools from customers is highly seasonal, peaking in the spring as people plant their gardens. This seasonal demand ripples up the supply chain from the retailer to red tomato, the manufacture. Red tomato has decided to use aggregate planning to overcome the obstacle of seasonal demand and maximize profits. The options red tomato has for handling the seasonality are adding works during the peak season, subcontracting out some of the work, building up inventory during the slow months, are building up a back log of orders that will be delivered late to customers. To determine how to best use these options through an aggregate plan, red tomato wise president of supply chain starts with the first task-building a demand forecast. All through red tomato could attempt to forecast this demand itself, a much more accurate forecast comes from a collaborative process used by both red tomato and its retailers to produce the forecast shown in Table.1

Table.1 Forecasted demands

Month	Demand
January	1,600
February	3,000
March	3,200
April	3,800
May	2,200
June	2,200

Red tomato sells each tool to the retailers for $40. The company has a starting inventory in January of 1000 tools. At the beginning of January the company has a workforce of 80 employees. The plant has a total of 20 working days in each month, and each employee earns $4 per hour regular time, each employee works 8 hours per day on straight time and the rest on overtime. As discussed previously, the capacity of the production operation is determined primarily by the total labor hours worked. Therefore, machine capacity does not limit the capacity of the production operation. Because of labor rules, no employee works more than 10 hours of overtime per month. The various costs are shown in Table. 2

Table.2 Cost of products

Item	Cost
Material cost	$10/unit
Inventory cost	$2/unit
Marginal cost of backlog	$5/unit
Hiring and Training cost	$300/unit
Layoff cost	$500/unit
Labor hours required	4/unit
Regular time cost	$4/unit
Overtime cost	$6/unit
Cost of sub-contracting	$3/unit

Currently, red tomato has no limits on subcontracting, inventories and stock outs/backlog. All stock outs are backlogged and supplied from the following month's production. Inventory costs are incurred on the ending inventory in the month. The supply chain manager's goal is to obtain the optimal aggregate plan that allows red tomato to end June with at least 500 units (i.e., no stock outs at the end of June and at least 500 units in inventories). The optimal aggregate plan is one that results in the highest profit over the six month planning horizon. For now, given red tomato's desire for a very high level customer service, assume all demand is to be met, although it can be met late. Therefore, the revenues earned over the planning are fixed. As a result, minimize cost over the planning horizon is the same as maximizing profit. In many instances, a company has the option of not meeting certain demand, or prize itself may be a variable that a company has to determine based on the aggregate plan. In such a scenario, minimizing cost is not equivalent to maximizing profits.

3. OBJECTIVE OF THE WORK

The work is specifically deals with the planning for minimizing the total cost. The main parameters are going to be optimized id work force, over-time, Hiring workers, lay-offing workers, Inventory management, Production per month and sub-contracting limits.

- To form total cost model
- To formulate constraints
- Minimizing the total cost using Genetic Algorithm with MATLAB R2012a
- Comparing Genetic Algorithm results with LINGO.13

Here the demands for the next six months are forecasted by the company. To complete the demands which have been forecasted by the company without loss, it requires some optimization techniques to overcome the demand. So here we use the Genetic Algorithm for optimization of the resources of the production. The planning is done by Genetic Algorithm using MATLAB software as optimization tool for eight variables having capacity planning to maximize the profit.

Techniques used: Genetic Algorithm, Software used: MATLAB R2011a, Genetic Algorithm Parameters: Population size: 20, Generations: 100, Creation function: constraint dependent, Crossover type: scattered, Crossover function: 0.8 and Mutation function: constraint dependent

4. PROBLEM FORMULATION

Equations of the Objective Function and constraints:

The equations of the objective function is given in equation (1) and the constraints are given in equation (2) to (5)

4.1 FITNESS FUNCTION

The cost incurred as following components:

- Regular-time labor cost
- Overtime labor cost
- Cost of hiring and layoffs
- Cost of holding inventory
- Cost of stocking out
- Cost of subcontracting
- Material cost

TC=RT+OT+H+L+I+S+P+C

Where,

TC- Total cost

RT- Regular Time Labor cost

$$\sum_{t=1}^{6} 640W_t$$

OT- Over-time Labor cost

$$\sum_{t=1}^{6} 6O_t$$

H and L- Hiring and Lay-off cost

$$\sum_{t=1}^{6} 300H_t + \sum_{t=1}^{6} 500L_t$$

I and S- Inventory and stock-out cost

$$\sum_{t=1}^{6} 2I_t + \sum_{t=1}^{6} 5S_t$$

P and C- Material cost and Sub-contracting cost

$$\sum_{t=1}^{6} 10P_t + \sum_{t=1}^{6} 30C_t$$

Total Cost is

$$\sum_{t=1}^{6} 640W_t + \sum_{t=1}^{6} 6O_t + \sum_{t=1}^{6} 300H_t + \sum_{t=1}^{6} 500L_t + \sum_{t=1}^{6} 2I_t + \sum_{t=1}^{6} 5S_t + \sum_{t=1}^{6} 10P_t + \sum_{t=1}^{6} 30C_t$$

(Equation. 1)

Where decision variables are,

W_t- Work force size per month

O_t- Number of Over-time hours worked in the month

H_t- Number of employees hired at the beginning of the month

L_t- Number of employees laid off at the beginning of the month

P_t- Number of unit production in month

I_t- Inventory at the end of month

S_t- Number of units stocked at end of the month

C_t- Number of products sub-contracted for the month

4.2 CONSTRAINT FUNCTION

There are four constraints in this problem

Work force, Hiring and lay-off constraints:

$$W_t = W_{t-1} + H_t - L_t$$

(Equation. 2)

Capacity constraints:

$$P_t \leq 40W_t + {}^{O_t}/_{2}$$

(Equation. 3)

Inventory balance constraints

$$I_{t-1} + P_t + C_t = D_t + S_{t-1} + I_t + S_t$$

(Equation. 4)

Over-time limit constraints

$$O_t \leq 10W_t$$

(Equation. 5)

5.3 PROBLEM VARIABLES

The assumptions which are made for programming in MATLAB software is tabulated below

Table. 3 Decision variable for January to June

Variables	Jan	Feb	Mar	Apr	May	Jun
W_t	$x(1)$	$x(9)$	$x(17)$	$x(25)$	$x(33)$	$x(41)$
O_t	$x(2)$	$x(10)$	$x(18)$	$x(26)$	$x(34)$	$x(42)$
H_t	$x(3)$	$x(11)$	$x(19)$	$x(27)$	$x(35)$	$x(43)$
L_t	$x(4)$	$x(12)$	$x(20)$	$x(28)$	$x(36)$	$x(44)$
I_t	$x(5)$	$x(13)$	$x(21)$	$x(29)$	$x(37)$	$x(45)$
S_t	$x(6)$	$x(14)$	$x(22)$	$x(30)$	$x(38)$	$x(46)$
P_t	$x(7)$	$x(15)$	$x(23)$	$x(31)$	$x(39)$	$x(47)$
C_t	$x(8)$	$x(16)$	$x(24)$	$x(32)$	$x(40)$	$x(48)$

We made programming using the variables which are in above Table. 3. Those 48 variables are defined clearly to perform minimization of total cost.

Problem assumptions:

Work force at December is 80

(i.e. $W_0 = 80$)

Inventory at the end of June is greater than or equal to 500

(i.e. $I_6 \geq 500$)

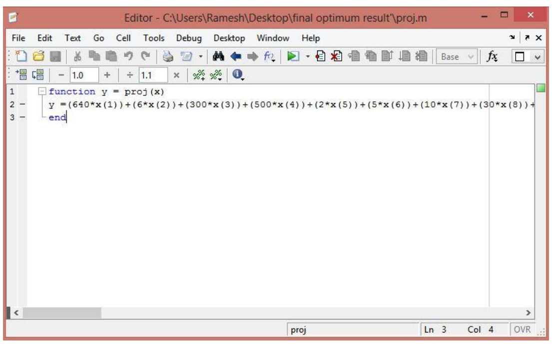
Stock-out in January and June is zero

(i.e. S_1 and $S_6 = 0$)

5. METHODOLOGY

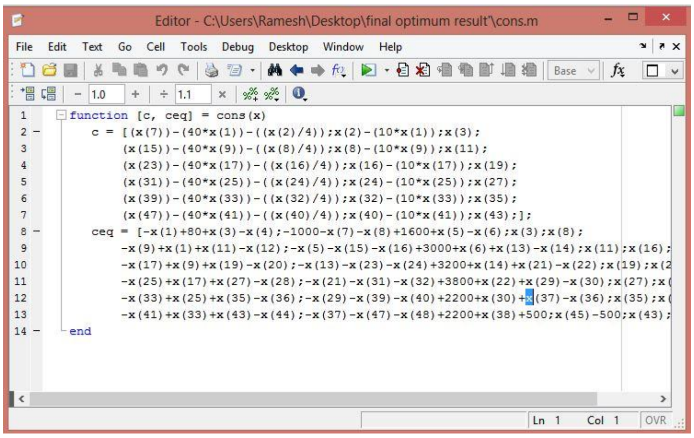
The MATLAB software is and Genetic Algorithm technique is used in this optimization. The Objective function coding was done using MATLAB editor and a figure of MATLAB window (Objective function was saved as m file in the name of 'proj') is in the Figure. 1

Figure. 1 Objective function window



The constraint function coding was done using MATLAB editor and a figure of MATLAB window (Constraint function was stored as m file in the name of 'cons') is given in Figure. 2

Figure. 2 Constraint function window



6. GENETIC ALGORITHM CODING

In MATLAB the objective function and constraint function was saved as m file for to use in GA optimization tool because optimization tool requires the objective function and the constraint function in m file.

6.1 CODING OBJECTIVE FUNCTION

The coding of Objective function in MATLAB editor is given below. It was saved in the name of 'proj'

function y = proj(x)

*y=(640*x(1))+(6*x(2))+(300*x(3))+(500*x(4))+(2*x(5))+(5*x(6))+(10*x(7))+(30*x(8))+(640*x(9))+(6*x(10))+(300*x(11))+(500*x(12))+(2*x(13))+(5*x(14))+(10*x(15))+(30*x(16))+(640*x(17))+(6*x(18))+(300*x(19))+(500*x(20))+(2*x(21))+(5*x(22))+(10*x(23))+(30*x(24))+(640*x(25))+(6*x(26))+(300*x(27))+(500*x(28))+(2*x(29))+(5*x(30))+(10*x(31))+(30*x(32))+(640*x(33))+(6*x(34))+(300*x(35))+(500*x(36))+(2*x(37))+(5*x(38))+(10*x(39))+(30*x(40))+(640*x(41))+(6*x(42))+(300*x(43))+(500*x(44))+(2*x(45))+(5*x(46))+(10*x(47))+(30*x(48));*

end

Similarly, the constraint function also coded in editor.

6.2 CODING CONSTRAINT FUNCTION

Constraint function for the problem is coded as below and it is named as 'cons'.

function [c, ceq] = cons(x)

*c = [(x(7))-(40*x(1))-((x(2)/4));x(2)-(10*x(1));x(3);*

*(x(15))-(40*x(9))-((x(8)/4));x(8)-(10*x(9));x(11);*

*(x(23))-(40*x(17))-((x(16)/4));x(16)-(10*x(17));x(19);*

*(x(31))-(40*x(25))-((x(24)/4));x(24)-(10*x(25));x(27);*

*(x(39))-(40*x(33))-((x(32)/4));x(32)-(10*x(33));x(35);*

*(x(47))-(40*x(41))-((x(40)/4));x(40)-(10*x(41));x(43);];*

ceq = [-x(1)+80+x(3)-x(4);-1000-x(7)-x(8)+1600+x(5)-x(6);x(3);x(8);

-x(9)+x(1)+x(11)-x(12);-x(5)-x(15)-x(16)+3000+x(6)+x(13)-x(14);x(11);x(16);

-x(17)+x(9)+x(19)-x(20);-x(13)-x(23)-x(24)+3200+x(14)+x(21)-x(22);x(19);x(24);

-x(25)+x(17)+x(27)-x(28);-x(21)-x(31)-x(32)+3800+x(22)+x(29)-x(30);x(27);x(32);

-x(33)+x(25)+x(35)-x(36);-x(29)-x(39)-x(40)+2200+x(30)+x(37)-x(36);x(35);x(40);

-x(41)+x(33)+x(43)-x(44);-x(37)-x(47)-x(48)+2200+x(38)+500;x(45)-500;x(43);x(48)];

end

This constraint function was coded as the converted form of the functions. Here equality constraints are in 'c' and inequality constraints are in 'ceq'. The total constraints are defined in the vector like [c, ceq].

7. RESULT AND DISCUSSIONS

Result was obtained by the MATLAB optimization tool. In that GA single objective tool is used to minimize the total cost of the problem. The window of optimization tool is given in Figure. 3. The various costs that are involved in this company's production were optimized. The 48 variables for six month are tabulated in Table. 4. The total cost is minimized and the profit for six month is maximized.The final answer after optimization is shown by GA optimization tool is given in Figure.4.

Fig. 3 GA optimization tool running

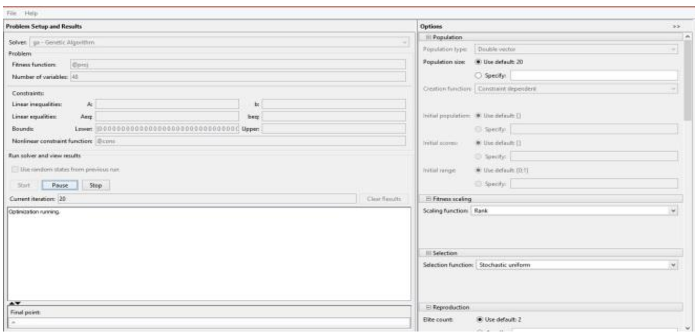
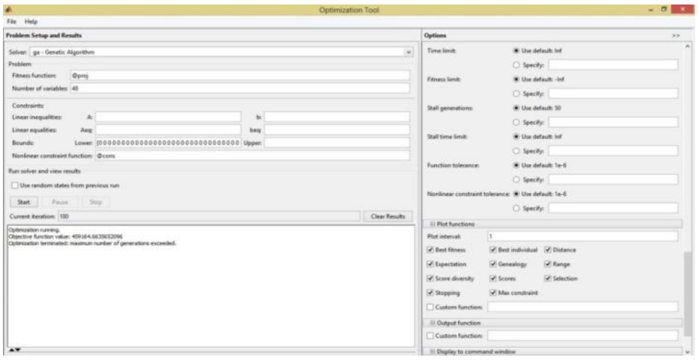


Fig.4 Optimization tool (after completing 100th iteration it shows the result value)



The optimum limits of work force, over-time, Hiring limit, Lay-offing limit, Inventory limit, production per month, stock-out limit and sub-contracting limit are tabulated in Table. 4

Table. 4 Optimum result for 48 variables

S. No	Work force	Over time	Hiring	Lay-off	Inventory	Stock-out	Production per month	Sub-contracting
January	80	3	0	0	953	2	1551	0
February	80	8	0	0	452	1	2499	0
March	80	2	0	0	204	2	2951	0
April	80	4	0	0	2	453	3145	0
May	68	4	0	12	32	3	2672	0
June	67	2	0	1	500	2	2671	0

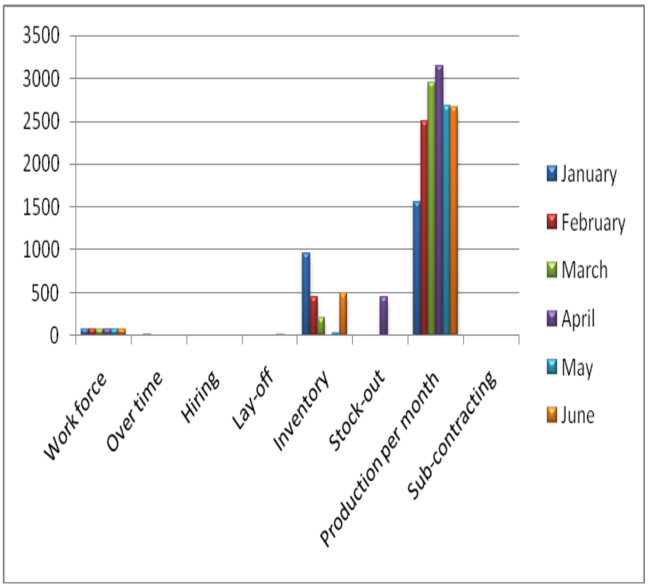


Figure. 1 Optimal values for six months

By optimizing the total cost using Genetic Algorithm the constraints of the total resource cost i.e. Regular labor cost, Over-time labor cost, Hiring cost, Lay-off cost, Inventory keeping cost, Stock of the month, Production of the month and Sub-contracting cost are reduced which results in reduction of the total cost (objective function) and increase in profit of the organization. The optimized results were also obtained Figureically for several iterations are given in following figures.

Work force for January to June: 80, 80, 80, 80, 69 and 69.

Over-time hours for January to June: 1, 3, 1, 0, 2 and 2.

Hiring for January to June: 0

Lay-off for January to June: 0, 0, 0, 0, 11, 0.

Inventory keeping from January to June: 950, 499, 198, 1, 29 and 500.

Stock-out from January to June: 0, 0, 0, 445, 0 and 1.

Production per month: 1551, 2499, 2951, 3145, 2672 and 2671.

Sub-contracting: 0

The Figureical representation of optimal schedule is shown in Figure. 1

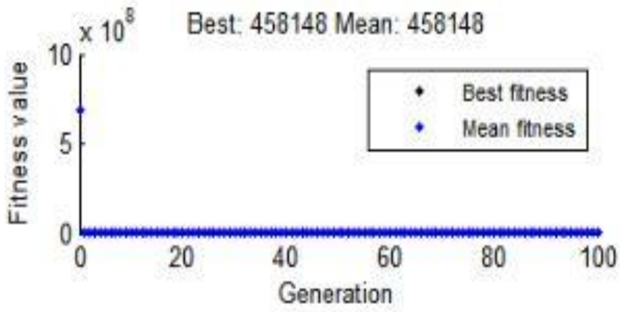


Figure. 2 Best and Mean values

In each generation the best and mean values are ploted between fitness value and Generations in Figure. 2. The best minimized value of total cost of our problem is \$458148 and mean value of our problem is \$458148 as shown in Figure. 2.

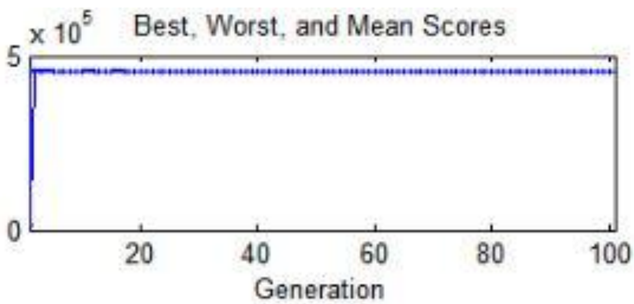


Figure. 3 Best,Worst, and Mean Scores

In each generation the scores of best, worst and mean values are ploted in Figure. 3. It is to represent the best, worst and mean scores of all the generations.

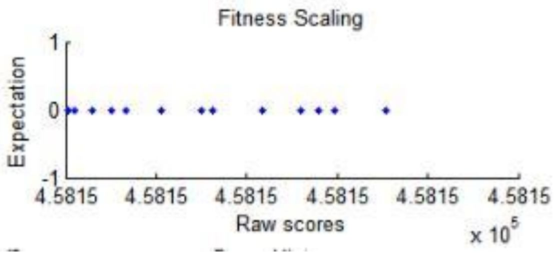


Figure. 4 Fitness Scaling

The convertion of the raw fitness scores that are returned by the fitness function to values in a range that is suitable for the selection function is represented in Figure. 4.

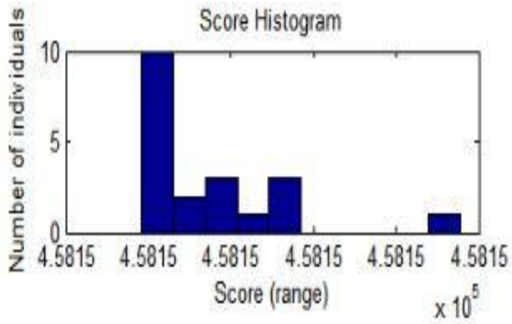


Figure. 5 Score Histogram

The score at each generation is ploted as histogram by GA-optimization tool. The histogram of 100th iteration is ploted between number of individuals and scre value as shown in Figure. 5.

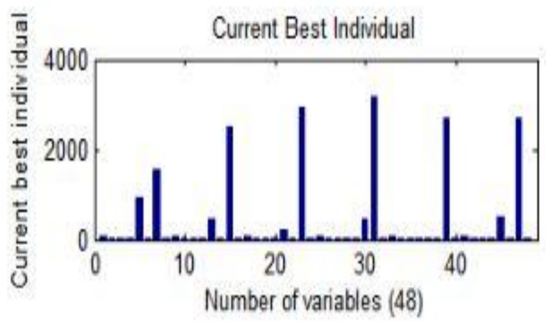


Figure. 6 Current Best Individuals

The best individual Figure represents the value of best fitness value of the generation. Here the vector of the individual with the best fitness function value in final generation is ploted in Figure. 6.

8. VALIDATION USING LINGO VERSION 13

Here we done validation by using LINGO optimization software and the result and discussions are following

8.1 LINGO FORMULATION

Min=640*x1+6*x2+300*x3+500*x4+2*x5+5*x6+10*x7+30*x8+640*x9+6*x10+300*x11+500*x12+2*x13+5*x14+10*x15+30*x16+640*x17+6*x18+300*x19+500*x20+2*x21+5*x22+10*x23+30*x24+640*x25+6*x26+300*x27+500*x28+2*x29+5*x30+10*x31+30*x32+640*x33+6*x34+300*x35+500*x36+2*x37+5*x38+10*x39+30*x40+640*x41+6*x42+300*x43+500*x44+2*x45+5*x46+10*x47+ 30*x48;

-x7+40*x1+x2/4>=0;-x15+40*x9+x8/4>=0; -x2+10*x1>=0; -x8+10*x9>=0; -x23+40*x17+x16/4>=0;-x16+10*x17>=0; -x31+40*x25+x24/4>=0;-x24+10*x25>=0; -x39+40*x33+x32/4>=0; -x32+10*x33>=0;x24=0; x32=0; x40=0;

-x47+40*x41+x40/4>=0; -x40+10*x41>=0;1000=-x7-x8+1600+x5-x6; x1=80+x3-x4; -x9+x1+x11-x12=0;x45=500; x48=0;

-x5-x15-x16+3000+x6+x13-x14=0;-x13-x23-x24+3200+x14+x21-x22=0; -x17+x9+x19-x20=0; 500>=X13; -x25+x17+x27-x28=0;

-x21-x31-x32+3800+x22+x29-x30=0; -x33+x25+x35-x36=0; x3=0; x1=80; x5=1000; x19=0; x27=0; x35=0; x43=0; x8=0; x16=0

-x41+x33+x43-x44=0; -x37-x47-x48+2200+x38+500=0;

Here we used LINGO.13 for validation purpose. And we concluded the result got in mat lab is optimum.here we given the result obtained from lingo shown in Table. 5

Table. 5 LINGO.13 optimal shedule

S. No	Work force	Over time	Hiring	Lay-off	Inventory	Stock-out	Production per month	Sub-contracting
January	80	0	0	0	1000	0	1600	0
February	72	0	0	8	500	0	2500	0
March	72	0	0	0	200	0	2900	0
April	72	0	0	0	0	700	2900	0
May	72	0	0	0	0	0	2900	0
June	67	0	0	5	500	0	2700	0

Work force for January to June: 80, 72, 72, 72, 72 and 67.

Over-time hours for January to June: 0

Hiring for January to June: 0

Lay-off for January to June: 0, 8, 0, 0, 0, 5

Inventory keeping from January to June: 1000, 500, 200, 0, 0 and 500.

Stock-out from January to June: 0, 0, 0, 700, 0 and 0.

Production per month: 1600, 2500, 2900, 2900, 2900 and 2700.

Sub-contracting: 0

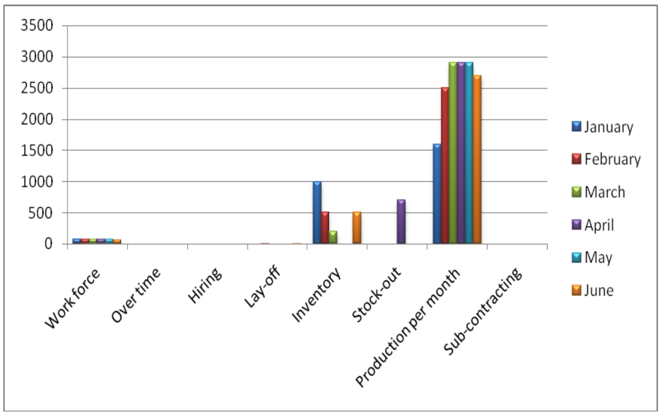


Figure. 7 LINGO optimal results

Total Cost: $436850

Total solved iterations: 20

8.2 COMPARISON

The comparison Table 6 describes the deviation from the MATLAB R2012a to LINGO.13

Table. 6 Comparision with GA and Lingo

S. No	January		February		March		April		May		June	
	Mat lab	Lingo	Mat lab	Lingo	Mat lab	Lingo	Mat lab	Lingo	Mat lab	Lingo	Mat lab	Lingo
Work force	80	80	80	72	80	72	80	72	68	72	67	67
Percentage of deviation	0		10		10		10		5		0	
Over time	3	0	8	0	2	0	4	0	4	0	2	0
Percentage of deviation	100		100		100		100		100		100	
Hiring	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of deviation	0		0		0		0		0		0	
Layoff	0	0	0	8	0	0	0	0	12	0	1	5
Percentage of deviation	0		100		0		0		100		8	
Inventory	953	1000	452	500	204	200	2	0	32	0	500	500
Percentage of deviation	0.7		1.6		2		100		100		0	
Stock out	2	0	1	0	2	0	453	700	3	0	2	0
Percentage of deviation	100		100		100		35		100		100	
Production per month	1551	1600	2499	2500	2951	2900	3145	2900	2672	2900	2671	2700
Percentage of deviation	3		0.04		1.7		7.7		7.8		1	
Sub-contracting	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of deviation	0		0		0		0		0		0	

9. Conclusions

The project is completed successfully. Here by we analyzed optimization techniques. Genetic algorithm is used for optimization. In a coactive planning genetic algorithm is used for optimization. Here we analyzed a capacitive planning problem and are studied, after that we maid constraints and then we set up boundary condition for that. The problem is converted to mathematical equations from the words. And then the equations are modified to work in mat lab version. The function is called objective function is analyzed according to the boundary conditions given. Mat lab software is used for the GA analysis of the problem. Then the formulated equations are applied in mat lab. And the constraints are listed as equality and inequality basis. After that boundary conditions are applied. The result is obtained by using run the program. And the charts are studied for analyze answer and the answer is tabulated for easier understanding. he obtained answer is validated by using validation software. Here we used LINGO.13 for the purpose of validation. The equations maid as per the problem is typed in the lingo. And the answer is collected by solving the function according to constrains. The answer is tabulated as the order of tabulation done in mat lab. Finally the tabulations got from GA analysis from mat lab and by using lingo are compared for analyzing the percentage of deviation. Tabulation is maid for comparing the result and to find out percentage of deviation. After comparing the both result we found that validation software will give better answer than the mat lab coding. Even though the mat lab coding is used for GA analyses since it is able handle more no of constraints and variables. It has been shown that the genetic algorithm perform better in finding areas of interest even in a complex, real-world scene. Genetic Algorithms are adaptive to their environments, and as such this type of method is appealing to the vision community who must often work in a changing environment. However, several improvements must be made in order that GAs could be more generally applicable. Grey coding the field would greatly improve the mutation operation while combing segmentation with recognition so that the interested object could be evaluated at once. Finally, timing improvement could be done by utilizing the implicit parallelization of multiple independent generations evolving at the same time. GA analysis is used in varying field in all companies. It is used for optimization process in almost all companies. In many companies GA used for vehicle suspension.In multi dynamic body design of a vehicle is done by optimization technique by using GA.

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