Australian Journal of Basic and Applied Sciences, 4(9): 4390-4399, 2010
ISSN 1991-8178

Designing a Production Programming Model with Multiple Objectives in Textile Industry

[1,2]Abdollah Hadi-Vencheh, [2]Mojtaba Aghajani

[1]Department of Mathematics, Mobarakeh Branch, Islamic Azad Uiversity, Isfahan, Iran
[2]Department of Management, Mobarakeh Branch, Islamic Azad Uiversity, Isfahan, Iran.

Abstract: This paper presents a production programming model in textile industry by using a goal programming method. The production programming presented here is a new modeling method which uses a single objective model and the shadow price of restrictions and management priorities to cover all various goals of the organization without overlooking some. A weight is also given to the goals based on the management opinion. Applying this model, more compatibility with management ideas and more precise and effective results are obtained. Design method and development of the model was implemented using ACCESS Software. After entering the data, various goals and management decisions can be determined and useful guides are provided to select proper goals. The produced model is then solved by LINDO software and the required reports are expressed in a clear manner. A case study was performed in Isfahan Kanaf textile factory. The obtained results show that using the proposed model, the factory management ideals in determining the production amount of the desired strings while maximizing the profit and complete usage from the capacity of production parts and consuming the raw material at requested level are well achieved.

Key words: Production Programming; Goal Programming; Linear Programming; Textile Industry; Access; Lindo.

INTRODUCTION

Programming plays a crucial role in the world today, knowing the great importance of time and resources. Programming involves the proper use of money, time, human resource and equipment which gains the highest value when such resources are limited. Production programming is in fact the process of planning and controlling different aspects of the entire production line so that customer's demand are fully met. The management should make decision about production rate in a medium-term planning by having the demand factors, machines capacity, human resource status and side contrast. In a classical programming model, maximizing the profit is viewed as the objective and the available budget, raw material and other factors are considered as constraints. In the highly competitive word today, the management can have different goals at the same time and try to achieve them all together. Textile industry attains a special importance in Iran. The industry, however, suffers severe problems currently so that keeping workforce and survival in the market are high priorities for some textile factories in Iran. Therefore the importance of programming , especially production programming can be easily understand.

Goal programming (GP)is a branch of multiple objective programming, which in turn is a branch of multi-criteria decision analysis (MCDA), also known as multiple-criteria decision making (MCDM). It can be thought of as an extension or generalization of linear programming to handle multiple, normally conflicting objective measures. Each of these measures is given a goal or target value to be achieved. Unwanted deviations from this set of target values are then minimized in an achievement function. This can be a vector or a weighted sum dependent on the goal programming variant used. As satisfaction of the target is deemed to satisfy the decision maker(s), an underlying sat-isficing philosophy is assumed.

GP was first used by Charnes, Cooper and Ferguson in 1955, although the actual name first appear in a text by Charnes and Cooper (1961). Seminal works by Lee (1972), Ignizio (1976), Ignizio and Cavalier (1994) and Romero (1991) followed. Scniederjans (1995) gives in a bibliography of a large number of pre 1995 articles relating to goal programming and Jones and Tamiz give an annotated bibliography of the period (Jones

Corresponding Author: Abdollah Hadi-Vencheh, Department of Mathematics, Mobarakeh Branch, Islamic Azad Uiversity, Isfahan, Iran.
E-mail: ahadi@khuisf.ac.ir

and Tamiz, 1990-2000).

The first engineering application of GP, due to Ignizio in 1962, was the design and placement of the antennas employed on the second stage of the Saturn V. This was used to launch the Apollo space capsule which landed the first men on the moon. The study of the applications of techniques of operations research for textile industry , until now, is very few. Therefore results obtained in this paper are completely new and very valuable. Araz *et al.* (2007). propose an outsourcer and management system for a textile company by use of fuzzy goal programming (FGP). At first phase of the methodology, evaluation criteria for the outsourcers and the objectives of the company are determined. The existing outsourcers of the company are evaluated by PROMETHEE. At the second phase, the FGP model developed selects the most appropriate outsourcers suitable to be strategic partners with the company and simultaneously allocates the quantities to be ordered to them. In the end, the results achieved are compared with the current situation of the company. Leung and Ng (2007) apply GP for production planning of perishable products with postponement. In their work the production process for perishable products is proposed to be divided into two phases by applying the concept of postponement. Consequently, three production activities - direct production, master production and final assembly - will be considered. A preemptive goal programming model to solve aggregate production planning for perishable products is developed, in which three objectives are optimized hierarchically. Blake and carter, (2002) describe a methodology for allocating resources in hospitals. The methodology uses two linear goal-programming models. One model sets case mix and volume for physicians, while holding service costs fixed; the other translates case mix decisions into a commensurate set of practice changes for physicians. The models allow decision makers to set case mix and case costs in such a way that the institution is able to break even, while preserving physician income and minimizing disturbance to practice. Li *et al.* (2006) deal with the master production planning problem for a mass manufacturing system in the just-in-time environment, an earliness-tardiness production planning (ETPP) problem. The objective is to determine the optimum production rate for each product so that the total penalties imposed on the early and tardy production for all production periods be minimized. A GP approach is proposed to formulate the ETPP problem in a more generalized form, which includes several existing models in one unifying model. Oliveira *et al.* (2003) GP in a brazilian forest problem, in a case study accomplished in the Santa Candida Farm. The areas of this farm can be managed for timber (pine and native species), harvesting of erva-mate leaves, pasture, and tourism. There is also a concern of the farm managers with increasing the diversity of flora and fauna, increasing environmental protection conditions and maintaining employees in the farm. Goal programming was used to develop a project of land allocation, in which all the goals would be reached as closest as possible of the ideal, in a way to attend all the operational restrictions considered.

However, we see that the GP models for the textile industry up to now is still not studied. The rest of this paper is as follows. In section 2 Goal Programming (GP), its purpose and the general model of weighting goal programming are expressed. In section 3, the single objective model and then design model for multiple objective model are presented. In section 4, a production programming model is designed for weaving factories and applied for Isfahan Kanaf weaving factory. This model is made by Multiple Objective Decision Making (MCDM) methods pointing out goals such as maximizing profit, market demand predictions, maximum use of machines and workforce, minimizing the consuming material and the importance of an objective as viewed by the management. solving the proposed model and the obtained results are presented in section 5. Section 6 concludes.

Goal Programming:

MCDM is one of the suitable models developed in decision making sciences. In these models, the decision maker does not define and optimize a single objective function but tries to provide compatability among some overlapping goals. GP is a kind of MCDM model. GP aims at achieving and approaching various goals related to the decision making problem at the same time. The first step toward formulating a GP model is to make a set of goals relevant to the problem. After defining the above set, objective values *(bi)* should be determined. The objective value *bi* are actually the success levels for each goal which are to be reached. Although the values of these objectives have already been determined, but it should become clarified whether decreasing the value of objective makes the objective levels higher or lower. Briefly explaining, the first stage toward formulating a GP model is to define a set of objectives as a combination of indexes and expected value. Deviation variables are then introduced in a GP model. Deviation variables may be negative (n_i) or positive (p_i) (Hwang and Masud, 1979). The negative deviation variables, n_i, represent the amount of failure in reaching the objective *i* and p_i reflect the reverse. It should be taken in to account for each objective, at least either the positive or negative deviation is zero. It may be also plausible that a certain objective is equal to its desired value, meaning n_i = p_i = 0. If the estimated value of an objective is more than its value, the negative deviation variable will be zero, $n_i = 0$, and if it less the positive deviation variable will equal zero, $p_i = 0$, (Romero, 1991). The algebraic expression of the i-th objective is as follow

$$f_i(x) + n_i - p_i = b_i \tag{2.1}$$

where X is vector of decision variables. If the desired direction of the i-th objective is equal or greater than the assumed access level *(fi(X) > bi),* then the negative variable *rii* should necessary gain the least possible value (in this case *rii* should be minimized). If the desired direction of the i-th objective is equal or less than the assumed access level *(fi(X) < bi),* then the positive deviation variable *pi* should have the least possible value. Furthermore, if it is desired that for the i-th objective, *fi(X) = bi* then not only the negative deviation variable but also positive deviation variable should get the least possible value (Romero, 1991) (in this case the sum $n_i + Pi$ is to be minimized).

The general aim in GP is to minimize the deviations between reaching the objectives and their aspiration levels. A Weighted Goal Programming (WGP) based model is introduced in the current paper. In this kind of programming, all the objectives are set into a compound objective function. The objective function aims to minimizing the sum of all deviations between goals and their expected values. These deviations are considered based on the relative importance of each objective for the decision maker. The algebraic structure of a conventional WGP model is as follows

$$\min \sum_{i}^{k} w_i \, (n_i \, , \, p_i) \tag{2.2}$$

st.

$$f_i(x) + n_i - p_i = b_i$$
$$x \in F$$
$$x \geq 0, \; n \geq 0, \; p \geq 0$$

in which n_i and p_i are the negative and positive deviations from the goals, *Wi* is the weight coefficient and *F* is the set of all feasible solutions (Romero, 1991).

Modelling:

The design method of a production programming model with multiple objectives is studied in this section. The introduced method is a new production programming modelling method which helps the management or the decision maker in identification selection of goals and making the model.

Structure of a Single Objective Model:

A single objective linear programming problem with three constraints is examined here. Having studied the constrains and the problem framework, the process of making the multiple objective model will be explained. Consider the following linear programming problem with three set of constraints

MAX CX

s.t.

$$A_1X \geq B_1 \tag{3.1}$$
$$A_2X \leq B_2 \tag{3.2}$$
$$A_3X = B_3 \tag{3.3}$$
$$X \geq 0$$

Where X is a no-negative vector of decision variables, C is the vector of objective function coefficients, A is the vector of constraints coefficients and B is the vector of right-hand side numbers. The first set of constraints, (3.1), are the ones which have negative or zero shadow prices after the linear programming problem is solved. In other words, we can write this set of constraints as follows

$$A_1X \geq B_1 \Rightarrow \begin{cases} A_1^{'}X \geq B_1^{'} & (3.4) \\ A_1^{''}X \geq B_1^{''} & (35) \end{cases}$$

The (3.4) constraints have negative shadow price. Any increment (decrement) in the right-hand value of objective function, hence we can change the right-hand values so that the objective function improves.

Of course not every right-hand value of the aforementioned constraints is changeable, partly due to the limitation of the current system resources. So the constraints (3.4) may be expressed as follows

$$A_1^{'}X \geq B_1^{'} \Rightarrow \begin{cases} A_{11}^{'}X \geq B_{11}^{'} - \alpha B_{11}^{'} = (1-\alpha)B_{11}^{'} & (3.6) \\ A_{12}^{'}X \geq B_{12}^{'} & (3.7) \end{cases}$$

The right hand values of constraints (3.6) are to extent changable while for constraint (3.7) they can not vary. The number *a* in (3.6) is a vectorial constant to be determined by decision maker. The shadow price of constraints (3.5) is zero. According to the definition of shadow price, changing the right hand values will have no effect on the important of the objective function. It should be notified, however, that any change in the right hand value of these constraints may effect the structure of the original problem. With consideration of the above relations, the set of constraints (1.3) can be written as follows

$$A_1 X \geq B_1 \Rightarrow \begin{cases} A_{11}^{'}X \geq B_{11}^{'} - \alpha B_{11}^{'} = (1-\alpha)B_{11}^{'} & (3.8) \\ A_{12}^{'}X \geq B_{12}^{'} & (3.9) \\ A_1^{''}X \geq B_1^{''} & (3.10) \end{cases}$$

The second set of constraints (2.3) are expressed as less or equal in the problem. These constraints represent resource limitations in an organization. These constraints have positive or zero shadow price after solving the problem, s a result, the right hand values can be increased in order to improve the objective function. In other words, the manager can increase the right hand side numbers based on the available resources in a way that it makes profit.

In some cases, increment the right hand numbers leads to profit, however, the available resources will bar any such change. For example, in a typical industry we may not be able to increase the capacity of a section or machine or the row material is limited, so these constraints enter the model without any change. As a result, the set of constraints (2.3) may be classified as follows

$$A_2 X \geq B_2 \Rightarrow \begin{cases} A_{21}^{'}X \leq (1+\alpha)B_{21}^{'} & (3.11) \\ A_{22}^{'}X \leq B_{22}^{'} & (3.12) \\ A_2^{''}X \leq B_2^{''} & (3.13) \end{cases}$$

The third set of constraint (3.3) are expressed as equal forms which have a constant on the right hand side. If these constraints are involved in a problem, the corresponding shadow prices will be negative, positive or zero after solving. Then we have

$$A_3 X = B_3 \Rightarrow \begin{cases} A_{31}^{'}X = (1-\alpha)B_{31}^{'} & (3.14) \\ A_{33}^{'}X = B_{33}^{'} & (3.15) \\ A_{31}^{''}X = (1+\alpha)B_{31}^{''} & (3.16) \\ A_{32}^{''}X = B_{32}^{''} & (3.17) \\ A_3^{'''}X = B_3^{'''} & (3.18) \end{cases}$$

The single objective model can then be expressed as

MAX CX

s.t

$$A'_{11}X \geq (1-\alpha'_1)B'_{11} \tag{3.19}$$
$$A'_{12}X \geq B'_{12}$$
$$A''_1X \geq B''_1$$
$$A'_{21}X \leq (1+\alpha'_2)B'_{21}$$
$$A'_{22}X \leq B'_{22}$$
$$A''_2X \leq B''_2$$
$$A'_{31}X = (1-\alpha'_3)B'_{31}$$
$$A'_{32}X = B'_{32}$$
$$A''_{31}X = (1+\alpha''_3)B''_{31}$$
$$A''_{32}X = B''_{32}$$
$$A'''_{32}X = B'''_3$$

In general we have a linear programming problem with one objective, the aforementioned relations work and the objective function can be improved by applying the above changes.

3.2 Designing a Multiple Objective Model:

The following should be considered to develop a multiple objective model. Considering the set of constraints (3.1), if the constraints with negative shadow price are involved in the multiple objective model, the following cases should be examined:

a) At least one of the constraints is expressed as $A'_{l2}X < B'_{l2}$ in the multiple objective model, because no change can be made in the right hand side numbers. In other words, these constraints enter the multiple objective model without any change in comparison with the single objective model. These constraints have been expressed in (3.7).
b) The right hand value of at least one of these constraints remains unchanged but is assumed as an objective in the multiple objective model. In this case the goal deviation is minimized.
c) The right hand value of some of these constraints is changed according to decision maker (DM) or the management which are represented as constraints in the multiple objective model.
d) Not only does change the right hand value of at least one of these constraints, but also introduced as objective. The aforementioned points can be expressed as follow;

$$A_1X \geq B_1 \Rightarrow \begin{cases} A'_{12}X \geq B'_{12} \\ A'_{11}X \geq (1+\alpha)B''_{11} \\ A''_{12}X + N_1 - P_1 = B'_{13} \\ A'_{11}X + N'_1 - P'_1 = (1-\alpha'_1)B''_{11} \\ A''_3X \geq B''_1 \end{cases} \tag{3.20}$$

where N and P are negative and positive deviation variables, respectively, and a is a constant determined by DM or the management.

Since the slack variable for constraints with zero shadow price is not zero and the aspiration level for these constraints have been met, therefore if they are termed as objective, their corresponding deviation variable will not equal zero in the multiple objective model. As a result, these constraints will be considered the same in the multiple objective model.

The above relations may be also imagined for constraints (2.3) and (3.3) and expressed as follow

$$A_2X \le B_2 \Rightarrow \begin{cases} A'_{22}X \le B'_{22} \\ A'_{22}X + N_2 - P_2 = B'_{22} \\ A'_{21}X + N'_2 - P'_2 = (1+\alpha'_2)B'_{21} \\ A'_{21}X \le (1+\alpha_2)B'_{21} \\ A''_2X \le B''_2 \end{cases} \tag{3.21}$$

And for constraints (3.3) we have

$$A_3X = B_3 \Rightarrow \begin{cases} A'_{32}X = B'_{32} \\ A'_{32}X + N_3 - P_3 = B'_{32} \\ A'_{31}X + N'_3 - P'_3 = (1-\alpha'_3)B'_{31} \\ A''_{32}X = B''_{32} \\ A''_{31}X = (1+\alpha''_3)B''_{31} \\ A''_{32}X + N''_3 - P''_3 = B''_{32} \\ A''_{31}X + N'''_3 - P'''_3 = (1+\alpha'''_3)B''_{31} \\ A'_{31}X = (1-\alpha_3)B'_{31} \\ A'''_3X = B'''_3 \end{cases} \tag{3.22}$$

It can be inferred from all the aforementioned relations that in order to make multiple objective model, some constraints have the same form as in single objective model, some of them are changed in terms of their right hand side value by DM and other constraints change in to objectives in the model whose objective function is expressed by minimization of goal deviation.

It is worth mentioning that the objective function of the single objective model may be used in making the multiple objective model as a constraint or an objective. That is to say

$$CX < D$$
$$CX + N - P = D. \tag{3.23}$$

Hence the whole multiple objective relations are expressed as following

$$\begin{aligned} MIN \quad & WN + W_1N_1 + W_2P_2 + W'_2P'_2 + W'_3(N'_3 + P'_3) \\ s.t \quad & CX + N - P = D \\ & A'_{12}X + N_1 - P_1 = B'_{12} \\ & A'_{22}X + N_2 - P_2 = B'_{22} \\ & A'_{21}X + N'_2 - P'_2 = (1+\alpha'_2)B'_{21} \\ & A'_{31}X + N'_3 - P'_3 = (1-\alpha'_3)B'_{31} \\ & A'_{12}X \ge B'_{12} \\ & A'_{22}X \le B'_{22} \\ & A'''_3X = B'''_3 \\ & X \ge 0 \end{aligned} \tag{3.24}$$

Designing and Making the Model:

The WGP model explained in the previous section was employed to make a production programming model with multiple objective in Isfahan Kanaf Textile Co. The elements of this model are elaborated in the following.

Decision Variables:

The decision variables of the model are as follow:

C051:	one-ply cotton string with size 5
C101:	one-ply cotton string with size 10
C201:	one-ply cotton string with size 20
C301:	one-ply cotton string with size 30
C202:	two-ply cotton string with size 20
C302:	two-ply cotton string with size 30
PC201:	one-ply polyester cotton string with size 20
PC301:	one-ply polyester cotton string with size 30
PC401:	one-ply polyester cotton string with size 40
PC302:	two-ply polyester cotton string with size 30
PC202:	two-ply polyester cotton string with size 20
PV201:	one-ply polyester viscouse string with size 20
PV301:	one-ply polyester viscouse string with size 30
PV302:	two-ply polyester viscouse string with size 30
PV202:	two-ply polyester viscouse string with size 20
V201:	one-ply viscouse string with size 20
V301:	one-ply viscouse string with size 30
V302:	two-ply viscouse string with size 30

A product is made by different combinations of the raw material. Also a specific product is likely to be fabricated by changing the mixture ratio of the raw material. Therefore numbers representing the combination type of each product are added to the codes of the above list. For example, C2011 characterizes the one-ply cotton string with size 20 with combination code 1 from raw material.

Objective function:

After determining the goals of the factory, the sum of deviations from the goal is minimized as already explained based on WGP method. The general form of the objective function is

$$\sum_{i=1}^{k} w_i(p_i, n_i) \tag{4.1}$$

in which *m* and *pi* are negative and positive deviations from the goals, *k* is the number of goals and *Wi* is weighted coefficient defined as

$$W_i = W_i' W_i'' \tag{4.2}$$

w\ is the weighted coefficient enforced by the management and *w″* is used to standardize the goals and reduce the effect of large coefficients. *w″* is computed using the following relation

$$\|c_i\| = \left(\sum a_{ij}^{\ 2}\right)^{1/2} \quad , \quad W_i'' = \frac{1}{\|c_i\|} \tag{4.3}$$

where a_{ij} are the corresponding technical coefficients of each objective.

Profit Making as the Goal:

One of the most important goals of a factory is to achieve the maximum profit. To reach this goal, a predetermined value should be considered. It can be performed in two ways. In the first method, this value is announced by the management. In the second one, the value is obtained through the structure of the problem. To do so, the standard form of the model with one objective, that is reaching the maximum profit, is solved and then the obtained result from this model is considered as a destination for this goal. It is clear, however, that the latter method enjoys more precision and practicality because using the problem structure.

Two variables called NPROFIT and PPROFIT are considered as negative and positive deviation variables, respectively. NPROFIT represents the deviation from the goal, so NPROFIT enters the objective function of the model so that it counteracts the deviation. To determine the profit coefficient of each product unit, the following relationship is used Profit + Fixed cost =

$$\text{Sale price} + \text{Defected parts price} - \text{Raw material cost} - \text{Variable cost} \quad (4.4)$$

The profit and fixed cost for each product are considered together and after solving the model and finding the value of decision variables or production level, the net profit is found by subtracting the fixed cost.

Meeting Demand:

One of the important goals of all industries, especially textile is to meet the customers' demand. Meeting the demand makes a good reputation for the textile factory, otherwise bears loss and damage to the factory. The mentioned loss is not easily measurable therefore demand responding is a high priority goal which should be reached. In the case study, five types of product are on the demand list and considered as objective for the factory. For instance, one of the objectives is as follows

$$C2011 + C2012 + NC201 - PC201 = 45$$

The objective shows that the total production of one-ply cotton string with size 20 which is made from two combination should be 45 tons in 30 working days. As a result, less than 45 tons production equals deviation from the goal and is not desirable for factory management. Therefore only the negative deviation variable will enter the objective function of GP.

Optimal Usage of Capacity of Production Sections:

As explained before, in this case study a linear programming model was first solved with the objective of maximizing the profit. In this model some constraints are considered for the capacity of production line including speed machine and twisting machine. The results obtained from the model show that the capacity of these two sections has been fully used increasing the production capacity will make more profit because of shadow price. Hence complete use of the capacity of speed machine and twisting machine is an objective and due to the possibility of overwork on off days, the capacity of these sections were allowed to increase in comparison with usual work hours. Speed machine section plays a very important role in textile factories and is in fact the most significant phase of string production. So optimal and suitable usage of machines and the capacity of this part is an objective in textile factories.

Row Materials:

Optimal and suitable usage of the available raw material is an objective in all textile factories specially Isfahan Kanaf Textile Co. Some row material is considered for a specific term which may be either existent in the factory or entered during the period. It is not always possible to change the type and amount of raw material. Insufficient budget and the long time between order and delivery are some of the reasons behind inability to change. However in some emergency conditions we may be able to provide more raw material. Therefore consuming the available raw material is considered as an objective and at the same time it is permitted to provide more raw material to approach other goals of the factory. The entering raw material in our case study are cotton, polyester and viscouse of different types. Based on the final product, the raw material should be combined together and enter the production line from the starting phase of textile. In this model, the raw material consumed for each product is considered along with the waste material and the total consumption of each material is set less than the available amount of that material during the programming period.

Model Constraints:

The constraints used in this model are in fact related to the capacity of production line. Different production parts including blow room, carding, flier, doubling and winding frame have their own string capacity. The right hand value of all these constraints is the production capacity based on the standard string (C201) and the coefficients of variables is determined according to the consumption of each string and its standard.

Information Requirements of the Model:

The model introduced in the previous section requires some information to be solved and produce the desired output. In order to determine the coefficients and different constraints, it is necessary to collect the required data in an organized framework and then enter them in the model. To do so, the suitable forms have been made and the required data have been collected. The data needed for the raw material include code, name, the available material in the factory and the amount of material to be entered in the factory. The products data include product code and name, selling price and demand level. The data related to the mixture of raw material, the capacity and waste material of each section, variable costs of the factory and the relevant variable costs and raw material cost should be also included in the model.

Solving the Model and Results:

To solve the model we produced a software written by ACCESS. The software is able to receive all the required data for the model and then produce the model. It also enables the user to change the right hand values of a constraint or an objective, active or inactive a constraint or enter a specific product to the production line or take it out from the production line. The software uses LINDO to solve the model by calling and transferring the model to LINDO. The results will be then produced in an user-friendly manner.

Results:

The production programming model with multiple objectives was employed in Isfahan Kanaf Co. The obtained results are as follow:

[1] Various objectives of the factory management with their corresponding weights were considered instead of just one objective. Important outputs such as the acheivable value of the objective, the negative and the positive deviation from the objective, type and the production amount with their mixture code are given by the model. Consumption level of each source and the need to use extra source in section such as carding have also been determined.

[2] Having solved the model in a period of time the following results were obtained

[2.1] The factory exceed the projected profit and had a positive deviation in comparison with its projected profit (including the fixed cost).

[2.2] The minimum production of one-ply cotton string of size 20 with mixture code C2011 was attained as an objective.

[2.3] The minimum production of two-ply cotton string of size 20 with mixture code C2022 was achieved as an objective.

[2.4] The production of two-ply cotton string of size 30 with mixture code C3022 had a positive deviation of 55853 Kg. In other words this type of string should be sold more.

[2.5] The minimum production of one-ply cotton polyster string with size 20 and mixture code PC2013 was reached as an objective.

[2.6] The minimum production of two-ply cotton polyster string with size 30 and mixture code PC3023 was attained.

[2.7] The ring section had positive deviation; showing that owertime work is needed in this section.

[2.8] The management objective for doubling section was achieved.

[2.9] The positive deviation of material consumption become zero and the objective got a negative deviation. In other words, no material has been used beyond the management's idea.

[3] Due to the high flexibility provided in the definition of constraints and objectives, the produced model serves as a very effective and useful tool for decision maker and high ranking executives of textile factories. The management can program the production period and choose the best option by using this model.

Conclusion:

We presented a production programming model in textile industry by using a goal programming method. The production programming presented here is a new modeling method which employs a single objective model. To solve the model we produced a software written by ACCESS. The software is able to receive all the required data for the model and then produce the model. Considering the data needed for model entry, the desired model can make use of the information system of the factory or serve as a foundation to develop and complete a comprehensive database in the factory. The flexibility of the model gives the opportunity to apply the model in similar industrial units. The only thing to do so is to collect the required data and enter them in to the software.

REFERENCES

Araz, C., P.M. Ozfirat, I. Ozkarahan, 2007. An integrated multicriteria decision-making methodology for outsourcing management, Computers & Operations Research, 34: 3738-3756.

Blake, J.T. and M.W. Carter, 2002. A goal programming approach to strategic resource allocation in acute care hospitals, European Journal of Operational Research, 140: 541-561.

Charnes, A., W.W Cooper, R. Ferguson, 1955. Optimal estimation of executive compensation by linear programming, Management Science, 1: 138-151.

Charnes, A., W.W. Cooper, 1961. Management models and industrial applications of linear programming, Wiley, New York.

Hwang, C.L., A.S. Masud, 1979. Multiple objective decision making: Methods and applications, Springer-Verlag.

Ignizio, J.P., 1976. Goal programming and extensions, Lexington Books, Lexington, MA.

Ignizio, J.P., T.M. Cavalier, 1994. Linear programming, Prentice Hall.

Jones, D.F., M. Tamiz, 2002. Goal programming in the period 1990-2000, in Multiple Criteria Optimization: State of the art annotated bibliographic surveys, M. Ehrgott and X.Gandibleux (Eds.), 129-170. Kluwer publishers.

Lee, S.M., 1972. Goal programming for decision analysis, Auerback, Philadelphia.

Leung, S.C.H., W. Ng, 2007. A goal programming model for production planning of perishable products with postponement, Computers & Industrial Engineering, 53: 531-541.

Li, L., D.J. Fonseca, and D. Chen, 2006. Earliness-tardiness production planning for justin-time manufacturing: A unifying approach by goal programming, European Journal of Operational Research, 175: 508-515.

Oliveira, F., N.M. Volpi and C.R. Sanquetta, 2003. Goal programming in a planning problem, Applied Mathematics and Computation, 140: 165-178.

Romero, C., 1991. Handbook of critical issues in goal programming, Pergamon Press, Oxford.

Scniederjans, M.J., 1995. Goal programming methodology and applications, Kluwer publishers, Boston, 1995.