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Material Requirement Planning (MRP) Using Goal Programming Method

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Abstract

Material Requirement Planning (MRP) is plan for the production and purchase component used in making item Master Production Schedule (MPS). It shows the quantities needed and when manufacturing intends to make or use them. MRP is widely accepted planning method within Furniture Company that can be used for the planning and controls techniques based on the dependent demand principle, enables manufacturing organizations to provide better customer service, reduce inventory investment and increase resources utilization. Current study takes into consideration most commonly facing problems during manufacturing of the product and would use Optimized MRP using Goal Programming model approach to minimize production cost, holding cost and minimize cost of extra time used by resources and the cost of the lazy time of resources.

So the problem is taken to implement optimized MRP on home furniture factory floor to reduce the extra time and cost as much as possible to increase the productivity and profit of the factory.

Keywords: *LPP(Linear Programming Problems), GP(Goal Programming), ILP(Integer Linear Programming), Simplex Method, Dynamic Programming Model.*

1. Introduction

MRP is a commonly accepted approach for replenishment planning in major companies. The MRP based software tools are accepted readily. Most industrial decision makers are familiar with their use. The practical aspect of MRP lies in the fact that this is based on comprehensible rules, and provides cognitive support, as well as a powerful information system for decision making.Material requirements planning which is a method based on planning the requirements according to the master production schedule (MPS) which is prepared depending on customers' demands. Two basic data are necessary for MRP: (1) Master Production Schedule (MPS), and (2) Bill of materials (BOM). MPS is a plan showing the product, which will be produced when and in what quantity, based on forecasting or received customer orders. BOM shows which subcomponent or raw material is used for which product and in what quantity. Required material quantities are calculated by hierarchically multiplying the production quantities in MPS by unit usage coefficients in BOM. MRP determines the quantity and timing of the acquisition of dependent demand items needed to satisfy master schedule requirements. One of its main objectives is to keep the due date equal to the need date, eliminating material shortages and excess stocks.MRP breaks a component into parts and subassemblies, and plans for those parts to come into stock when needed. Fig. shows the how MRP system runs in manufacturing company. Material requirement planning systems help manufactures determine precisely when and how much material to purchase and process based upon a time phased analysis of sales orders, production orders, current inventory and forecasts. They ensure that firms will always have sufficient inventory to meet production demands, but not more than necessary at any given time. MRP will even schedule purchase orders and/or production orders for JIT receipt.

(Aboozar Jamalnia, 2017) proposed a novel stochastic, nonlinear, multi-organize, multi-target basic leadership model to APP in view of blended pursue and level procedure which considers various goals.

In production planning, attention the capacity of available resources is very important. In fact, for production in different periods of planning horizon should be observed capacity of available resources. This considers capacity of available of two types of sources, these sources are respectively: (1) Manpower, (2) Machinery. The goal programming technique appears to be an appropriate, powerful and flexible one for decision analysis to help the troubled modern decision maker who is burdened with achieving multiple conflicting objectives under complex environmental constraints. The general aim of GP is the optimization of several conflicting goals precisely defined by the decision maker(s) by minimizing the deviations from the target values. The original objectives are expressed as a linear equation with target values and two auxiliary variables.
(Akpan, Etim Ekom, Waribugo Sylva, Wilson Ofoegbu C.,2016) carried out the result which showed that 962 units of small loaf, 38 units of big loaf and 0 unit of giant loaf should be produced respectively in order to make a profit of N20385 .

2. Scope & Objectives of Study

2.1 Technological Development

Nowadays several manufacturing firms working in development of Material Requirements Planning (MRP) software with programming language C that can be used by the local industries for inventory management in a job shop-manufacturing environment. An algorithm is used to develop to understand the MRP processing logic. The main purpose of MRP software is to facilitate the calculation of requirements of materials and timing. Thus, it is a technique for determining the quantity and timing for the acquisition of dependent demand items needed to satisfy master production schedule (MPS) requirements by converting three inputs, bill of material, inventory data and master production schedule into time-phased requirements for subassemblies, component parts and raw materials, working backward from the due date using lead times and other information to determine when and how much to order. The major objectives of an MRP system are to 1) ensure the availability of materials, components, and products for planned production and for customer delivery, 2) maintain the lowest possible level of inventory, 3) plan manufacturing activities, delivery schedules, and purchasing activities.
(Fitriani Katlea, 2017) recognized how far the examination about RL (Reverse Logistics) has clarified, particularly RL demonstrate utilizing Goal Programming (GP).
MRP has its strength in job shops that require exibility in the production sequence, in the quantity of production, and in the timing of the production process. That is why the Japanese are looking to MRP in their own job shops. MRP does not need to run head-to-head in competition with any other system on their area of strength. However, even in a repetitive environment, MRP can be made to be much more competitive by adjusting the usage errors that are now incorporated into the MRP environment. That is one of the reasons why the Japanese are using MRP in most of their developing country plants. By refocusing MRP, we can cash in on its strengths, while still remaining competitive against materials focused systems like JIT.

2.2 Objective of the Study

(Bhatia Onkar Singh,Sharma Naveen Kant, 2016) watched that the solid connections make solid supply chains while the frail connections hurt each individual from the chain. They chose to examine to break down the validness of quantity dispersion utilizing LINDO (Linear, Interactive and Discrete Optimizer) programming.
The objective of GP model is used to solve the multi-objective Material requirement planning problem. The company has indicated three goals to be achieved:
(1) Minimization of cost of normal working (normal production goal);
(2) Minimization of cost of overtime working (overtime production goal); and
(3) Minimization of cost of carrying stock over 100₹ per unit.

3. Methods

3.1 Formulation Description of Goal Programming Problem

Formulation of goal programming problem is similar to that of linear programming problems. Goal programming (GP) extends the LPP formulation to accommodate mathematical programming with multiple objectives. The major differences are an explicit consideration of goals and the various priorities associated with the different goals and composed of deviational variables only. In the formulation two types of variable are used. They are decision variables and deviational variables. There are two categories of constraints. They are structural or system constraints (strict as in traditional linear programming) and goal constraints, which are expressions of the original functions with target goals, set priorities and positive and negative deviational variables.

The goal programming model may be categorized in terms of how the goals are of roughly comparable importance, goal programming is known as non-preemptive. In cases of preemptive goals programming, the goals are assigned priority levels. The goals are ranked from the most important (goal 1) to the least important (goal m) and the objective function coefficient assigned for the (deviational) variable representing goal is Pi. The original objectives are expressed as a linear equation with target values and two auxiliary variables. These two auxiliary variables represent under achievement of the target value by negative deviation ($d-$) and over achievement of the target value by positive deviation ($d+$). If the desire is not to underachievement the goal, $d-$ should be driven to zero. To the contrary, if $d+$ is driven to zero, the overachievement of the goal will not be realized. (Davood Garakhani, 2014) targets of this paper were: To limit abundance material required in store, avoid deficiencies of crude materials, Timely conveyance of items to offer as per advertise request, Reduce and limit generation stoppages, forestall quick buys, lessen costs and at last increment benefits. The unwanted deviations between target values of objectives are minimized hierarchically. Hence, the goals of primary importance are satisfied first, and it is only then the goals of second importance are considered, and so forth.

This relationship is mathematically expressed as,

$$\boldsymbol{di^{+} . di^{-} = 0}$$

(Kumar Ch Karthik Pavan, Nynaru Venkatachalapathi,Raghavulu P.,Satya D. Anirudh, 2016) introduced a far reaching utilization of Goal programming with programming apparatus for a genuine circumstance case was exhibited alongside changing objective needs to the best production network of merchants with ideal cost.

It may be noted that the structure of a GP model involves two types of constraint: system and goal constraints. The system constraints are those which are more restrictive in nature and have to be satisfied before the goal constraints, as they represent the existing capabilities, rather than what we would like to achieve. From the above discussion, it can be deduced that deviational variables are mutually exclusive.

3.2 General Goal Programming Model Formulation

In this paper, a goal programming model is used to solve the multi-objective Material requirement planning problem. The company has indicated three goals to be achieved:

(1) Minimization of production cost (production goal);

(2) Minimization of holding cost (holding goal); and

(3) Minimization of costs of the extra time used by sources, and the costs of the lazy time of sources (sources goal).

The general goal programming model which can be expressed mathematically as:

$$\text{Minimize: } \mathbf{Z}=\sum_{i=1}^{m} di^{+}+di^{-}$$

Subject to the linear constraints:

Goal constraints: $\sum_{j=1}^{n}$ **aijxj** $-\ di^{+}+\ di^{-}=$ $\mathbf{b_{j}}$, for i=1,…,m

System constraints: $\sum_{j=1}^{n}$ **aijxj** $-\ di^{+}+\ di^{-} =_{\geq}^{\leq}$ $\mathbf{b_{j}}$, for i=m+1,…,m+p

Where there are m goals, p system constraints and n decision variables

Z = objective function = Summation of all deviations

aij = the coefficient associated with variable j in the i^{th} goal

xj = the j^{th} decision variable

bi = the associated right hand side value

di^{-} = negative deviational variable from the i^{th} goal (underachievement)

di^{+} = positive deviational variable from the i^{th} goal (overachievement)

4. Results and Discussion

Table 1: Factory Planning Problem (Dinning & Fittings)

Time period)Week(	1	2	3	4
Demand)Unit(1	80	60	150	50
Normal Production capacity)Unit(2	55	65	80	80
Normal Production Cost)₹ /Unit(	291	387	194	155
Overtime Production Capacity)Unit(	30	40	50	45
Overtime Production Cost)₹ /Unit(	310	407	214	175

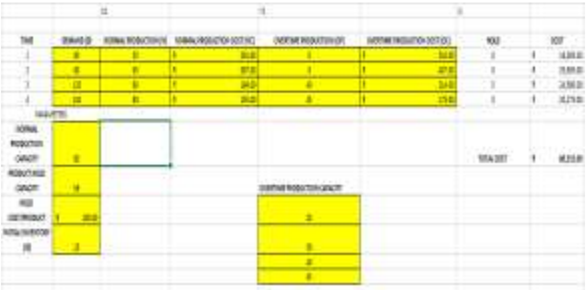

Fig.2 Solution of Problem on Excel Sheet

Where,
Xt = number of units produced by normal working in period t (t=1,2,3,4), where xt >= 0
Yt = number of units produced by overtime working in period t (t=1,2,3,4) where yt >= 0
It = number of units in stock at the end of period t (t=0,1,2,3,4)

5. Conclusions

The advantage of using goal programming over other techniques is with dealing with real world problems. It reflects the way manages actually make planning. Goal programming allows plan maker to incorporate organizational and managerial consideration into model through goal levels and priorities. Goal Programming, although far from a panacea, often represents a substantial improvement in the modeling and analysis of the real life situation.
The goal programming model is also formulated and entered in a similar manner as for linear programming, the difference being that the details of all the objective functions are entered in the desired priority. Another approach to goal programming is to state the goals as constraints in addition to the normal constraints of the problem. The objective function is then to minimize the deviation from the stated goals. The deviations represented by the objective function are given weights as coefficients in accordance with priorities assigned to the various goals. The problem is then solved using the linear programming model.
This solution gives a result of the study of effect optimized MRP using GP, therefore, the goal programming is one of the mathematical tools, designed in context of solving the multi-objective problems in different areas for taking the efficient, timely and accurate decision. The various researches have been made so far and the researchers have been continually exploring this field for more than five decades and even today the process is on to gets a lucid picture of this tool attributing to clearly understanding the meaning of this technique in the perspective of problem solving relating to industry.

References

[1] Aboozar Jamalnia, Evaluating the performance of aggregate production planning strategies under uncertainty, Alliance Manchester Business School University of Manchester, pp. 1-46, 2017.
[2] Akpan, Etim Ekom, Waribugo Sylva, Wilson Ofoegbu C.,The Impact of Knowledge Management on Product Innovation of Manufacturing Firms in Nigeria, Information and Knowledge Management, Vol.6, No.6, pp. 78-87, 2016
[3] Fitriani Katlea, Reverse Logistic Decision Using Goal Programming: A Review, Asia Pacific Journal of Advanced Business and Social Studies (APJABSS), Volume: 3, Issue: 1, pp. 91-100, 2017
[4] Bhatia Onkar Singh,Sharma Naveen Kant, Application of Linear Goal Programming (LGP) To Case Study Provider Quota Distribution, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 13, Issue 2 Ver. II , pp. 38-40, Mar. - Apr. 2016
[5] Gharakhani Davood, Optimization of Material Requirements Planning (Case Study: Oil Companies of ETKA Organization), Nat Sci ;12(2), pp.108-111, 2014
[6] Kumar Ch Karthik Pavan, Nynaru Venkatachalapathi,Raghavulu P.,Satya D. Anirudh, Assessing the Effectiveness of Vendors through Goal Programming using Changing Goal Priorities: Case Study, Indian Journal of Advances in Chemical Science, S1, pp. 146-151, 2016