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Comparison between Goal Programming and other Linear Programming Methods

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Abstract: ***Linear Programming (LP) widely used mathematical technique designed to help operation manager's plan and make the decision necessary to allocate resources. It is often desirable to find production level that will produce maximum profit and minimum cost. The production process can be described with a set of linear inequalities which is called as Constraints. The profit and cost function to be maximize or minimize is called as Objective Function. The process of finding optimal level with the set of linear inequalities is called as Linear Programming. In manufacturing problem LP problem determines the number of units of different products which should be produced and sold by firm when each product requires fixed manpower, machine hour, labour hour per unit of product, warehouse space per unit of output etc. in order to make maximum profit. The scope of current study is to determine appropriate method among various LP problems by comparing any LP problem and Goal Programming (GP) problem.***

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

I. INTRODUCTION

The purpose of this paper is to give the brief introduction of Linear Programming Problem (LPP) and to look at the three methods say; Integer Linear Programming, Simplex method and Transportation method in solving Linear Programming Problem and find out the method that will maximize profit and increase the productivity. Linear programming (LP) is a tool for solving optimization problems. It is a mathematical modelling "System" which has found widespread uses in providing decision maker with an efficient means for resolving complex operational alternatives. It is applicable to the general category of problems that require the optimization of a linear objective function subject to linear constraints. Linear Programming is a technique used to determine the best utilization of limited resources to reach a desired objective of either maximizing the benefit (Profit) or minimizing the costs. There are many ways to solve linear programming basics but starts from Simplex Method and Big-M Method. After the advancement in operation research field and considering demand in companies there are many other quit types to solve linear programming for single objective problem as well as we can solve for multi-objective problem like Integer Programming (Gomory's cutting plane method), Sensitivity Analysis, Dynamic Programming, Stochastic Programming, Goal Programming and etc.

Integer programming techniques have gained a lot of interest in our practical life, we come across many business and production industries which have to usually face problems of economics optimization such as cost minimization of non- economic items that are most vital to the existence of their firms. Integer Linear Programming (ILP) problems belong to a particular class of Linear Programming Problems (LPP). In LPP, the decision variables are assumed to be continuous, but in ILP the decision variables are restricted so that it can take only discrete values. Many practical problems can be formulated as general Integer Programming Problems and so ILP problems have an outstanding relevance in many fields.

The simplex method is an iterative algebraic procedure for solving linear programming problems for optimization of productivity and profit, therefore, keeping in view this feature of the simplest method. A Dynamic Programming model is an appropriate way to solve this inventory problem because a decision variable in one stage is related to another decision variable in the next stage, and the objective function consists of 0-1 integers and quadratic terms. Dynamic programming approach to solve single-period multi-product control inventory problem with re-entry and downward substitution which affects the productivity. Linear programming has been adopted in most of the studies, and the issues such as downgrading routes, downgrading ratios, control wafers WIP level in different grades and control wafers safety stock in different grades, were not considered simultaneously in most of them. In the literature reviewed, most of the objective functions are linear equations, and linear programming (LP), mixed 0-1 linear programming (M01LP), network LP, heuristics method and simulation can solve the problem without too much difficulty. The Goal Programming (GP) technique has become a widely used approach in Operations Research (OR). GP model and its variants have

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been applied to solve large-scale multi-criteria decision-making problems. The Goal Programming Method is an improved method for solving multi-objective problems. Goal programming is one of the model which have been developed to deal with the multiple objectives decision-making problems. This model allows taking into account simultaneously many objectives while the decision-making is seeking the best solution from among a set of feasible solutions.

Goal programming is still to be one of the stronger methods available. It has a close correspondence with decision-making in practice. Furthermore, it has some attractive technical properties. Several empirical findings from related to manufacturing problems are, according to practitioner's opinion, rather convincing to demonstrate the practical usefulness of multiple goal programming. Aim of this comparison of the different Linear methods and Goal Programming that Goal Programming is best way to solve multi-objective problems by hiring them Priorities and it is simple and quick method for minimization of cost which directly reflects to profit of the company.

II. LITERATURE REVIEW

Aboozar Jamalnia, 2017 [1] proposed a novel decision model to APP decision making problem based on mixed chase and level strategy under uncertainty where the market demand acts as the main source of uncertainty. He proposed a novel stochastic, nonlinear, multi-stage, multi-objective decision making model to APP based on mixed chase and level strategy which considers multiple objectives such as total revenue, total production costs, total labour productivity costs, total costs of the changes in workforce level and customer satisfaction subject to constraints on inventories, backorders, subcontracting, workforce level, and so forth where the forecasted demand acts as the main source of uncertainty

Rama.S et al, 2017 [2] Extended linear programming model to a private transport agency, where the number of drivers required for each day varies and also each day has four shifts. Here the constraints are obtained by taking the maximum number of drivers required for each shift and the objective is to minimize the allocation of drivers for each day. In mathematical LPP models, the respective organizations have baan saved more revenue than before if the organization implements the optimality obtained from the linear programming technique.

Naveen Kant Sharma et al, 2016 [3] observed that the strong links make strong supply chains while the weak links hurt every member of the chain. They decided to investigate to analyze the authenticity of quota distribution using LINDO (Linear, Interactive and Discrete Optimizer) software. They almost achieved but the rejection objective was overachieved by 143.69 tons and the late delivery objective was over-achieved by 142.72 tons. On that time the industry was ordering as (S1) = 3600 tons, (S2) = 2400 tons, (S3) = 4800tons and (S4) = 1200 tons. This model did not take into account the uncertainty or fuzziness or imperfect information inherent in some of the dynamic parameters like merchant capacities, their budget distributions etc.

Afrooz Ansaripour et al , 2016 [4] carried out technique developed for finding a closed form expression for the cumulative distribution function of the maximum value of the objective function in a stochastic linear programming problem, where either the objective function coefficients or the right hand side coefficients are continuous random vectors with known probability distributions. This is the "wait and see" problem of stochastic linear programming. They solved problems with two different method and concluded that EFK method substantially reduces the computational time. In addition, Bereanu's method was not able to solve some larger sizes of the problem. All times measured in seconds.

T. Kliestik M. Misankova et al , 2015 [5] Strategic planning was expressly significant for company's success and competitive advantage making in an increasingly competitive business environment. Unique goal programming model was created for the implementation of strategic goals of the company into the business plan. Based on these they created a unique goal programming model to allow management of the company implement strategic goals into the business plans easier.

Ayansola Olufemi Aderemi et al, 2015 [6] they presented a Linear Programming Problem (LPP) to minimize the cost of transportation of NBC, PLC products from three distribution centres to ten depots. The results of our analysis revealed that using any of the three methods of obtaining the optimal solution in transportation problem, i.e Simplex Method, Integer Linear Programming Method and Transportation Method yield the same optimal cost.

Davood Garakhani, 2014 [7] has set objectives of this paper are: To minimize excess material needed in store, prevent shortages of raw materials, Timely delivery of products to sell in accordance with market demand, Reduce and minimize production stoppages, prevent immediate purchases, reduce costs and ultimately increase profits. The results of this paper was: To minimize excess material needed in store, prevent shortages of raw materials, Timely delivery of products to sell in accordance with market demand, Reduce and minimize production stoppages, Prevent immediate purchases, Reduce costs and ultimately increase profits.

Engr. Dr. Uzorh et al, 2014 [8] this paper reviewed the major decision areas in supply chain management and identified areas for future research consideration by Sensitivity Analysis(SA) that will facilitate the advancement of knowledge and practice in the area

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of supply chain optimization. Based on the existing body of research in supply chain management, suggestions were made for future research in the following three areas: (1) Evaluation and development of supply chain performance measures, (2) development of a model that can integrate the four major decision areas in supply chain management. A transportation problem was developed with respect to the operations of the Coca Cola Company of Aba, Owerri, Port Harcourt and Enugu in its depots in Mbaise, Orlu, Umuahia, Calabar and Uyo with respect to truckload movement between the cities. An industrial case was used to demonstrate the feasibility of applying the LP method to real-world transportation costs problem.

Shinto K.G et al, 2013 [9] they approximated solution fails to satisfy the optimality condition, then a search will be conducted on the optimal hyperplane to obtain an optimal integer solution using a modified form of Branch and Bound Algorithm.

Analyzed a method to solve pure integer linear programming problems using integer approximated solution method discussed.

He-Yau Kang et al, 2011 [10] objective was to set an acceptable inventory level to minimize the total cost of control wafers through reducing various types of costs without halting production throughput. By calculating control wafers acquisition cost, pulling cost, holding cost and management cost for each PURR process, inventory level and cost for each grade have been determined. This leads to an increase in acquisition cost, pulling cost and holding cost and a decrease in management cost, and the total cost is higher than that obtained from our proposed DP model. As a result, the algorithm proposed in this study can be very useful for managers in mini-mizing the total control wafers cost and in determining the optimal replenishment level of control wafers while maintaining a satisfactory level of production throughput.

Sasank Mouli Kommerce et al, 2011 [11] the purpose of this paper was to illustrate how linear goal programming model can be used as an aid for solving transportation problems with various considerations. The data used in their transportation problem was collected from Indian oil Company. The marginal result on total transport cost minimization points to imperativeness of some trade-off with a given desired policy.

Namdeo W. Khobragade et al, 2009 [12] found revised simplex method sometimes involves less or at the most equal number of iterations as compared to computational procedure for solving LPP on digital computer.

They observed that the optimum solution obtained in less iteration or at the most equal iteration by our modified technique, where as usual simplex method took five iterations while LINDO package at step three and also Bharambe's method took three iterations to reach optimum solution.

Erhan ada et al, 2005 [13] Plant location models were considered only with the aim of locating the plant without taking supplier and warehouse location problems. For the quantitative factors cost becomes significant to assign weights to each quantitative factor inversely proportional to the cost and then coefficients are assigned to qualitative factors through Analytical Hierarchy Process.This study mentioned the importance of qualitative factors, which was an important point in the management as well as quantitative factors because it would be a failure to be based solely on qualitative factors. As a resulted the need for a new way of thinking and a new methodology was required for the management in order to combine quantitative and qualitative factors. Then the quantitative factors were modeled based on the cost figures and then inversely normalized in order to assign an coefficient to each factor to be used in the linear integer programming.

Belaid Aouni et al, 2001 [14] found, there has been a marked transformation in the development of new methodologic to assist the decision-making processes, especially in the development of procedures in multi-criterion decision-making and in multi objective programming(MOP), Goal programming(GP) was the most commonly known model of MOP and on that time it is today alive more than ever , supported by a network of research and practitioners continually feeding it with theoretical developments and applications, all of these with resounding success. They concluded that GP (Goal Programming) model would be a powerful tools, allowing to model the collective decision-making process of globalization, competitiveness and networking.

Harpreet Grewal, 1999 [15] has found Lot size inventory control problem with ambiguous variable demand is important in industry as inventories can be a major commitment of monetary resources and affect virtually every aspect of daily operations. Inventories can be an important competitive weapon and are a major control problem in many companies, and improper lot sizes can affect the inventory levels and the costs associated with them. Linear programming assigned equal priority to all the goals whereas goal programming treated the problem differently as desired by the researcher goal programming identifies the point that best satisfies a problem's set of goals. One of the key advantages of goal programming was that it has provided information beyond that provided by linear programming, and this was more useful as an aid to management in its decision-making process.

Mehrdad Tam et al, 1997 [16] discussed Modelling techniques such as detection and restoration of pareto efficiency, normalization, redundancy checking, and non-standard utility function modelling are overviewed. It was hoped that the analysis in this paper gives a clear overview of the area of GP as a decision support tool. It has been documented that the recent advances in this area should

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lead DMs into a clearer understanding of the pitfalls to be avoided and benefits gained from, the use of GP to provide solutions to the real-world multi-objective problems they were facing.

III.CONCLUSION

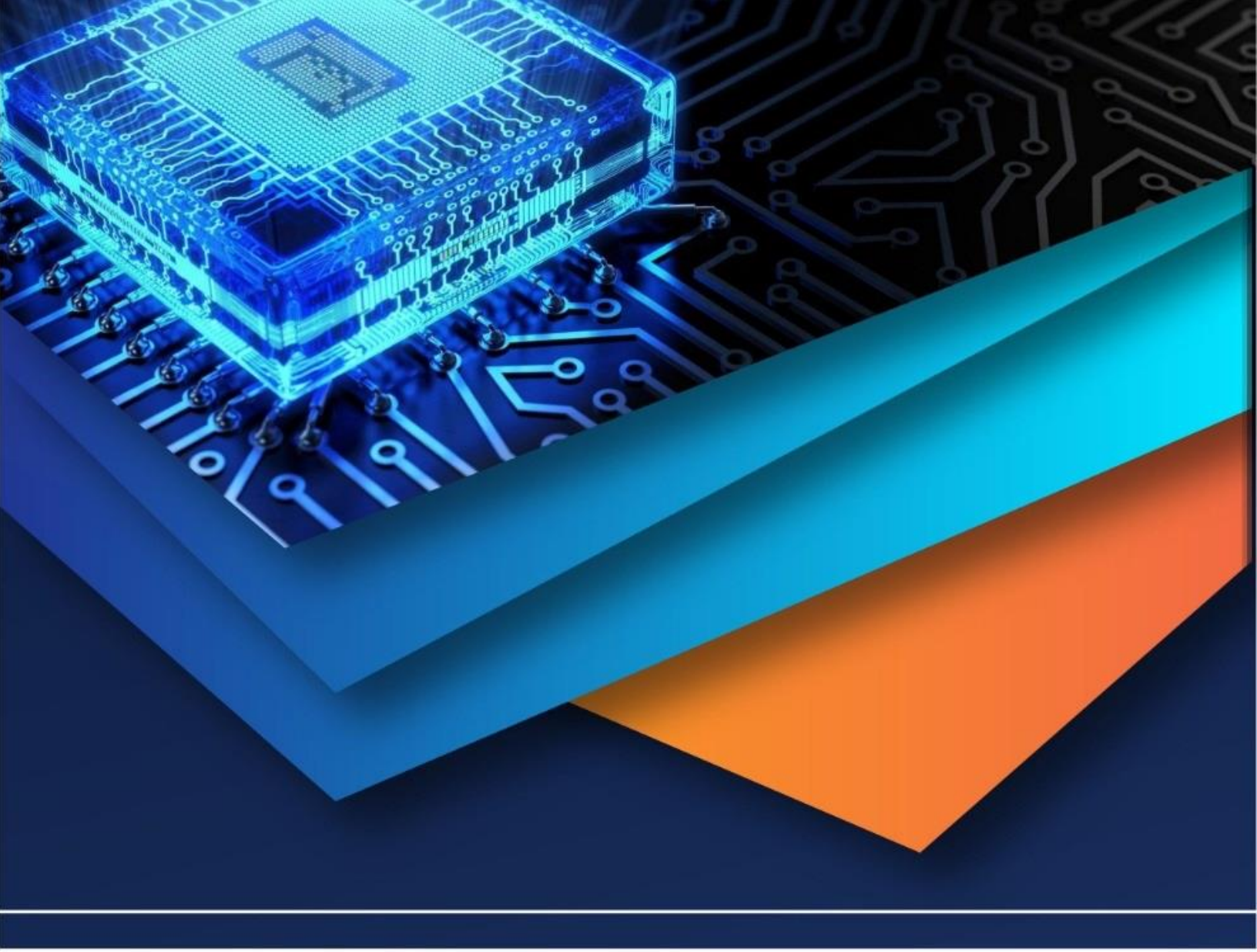
The advantage of using goal programming over other techniques is with dealing with real-world decision problems is that it reflects the way manages actually make decisions. GP, represents a substantial improvement in the modeling and analysis of the real-life situation. GP model is also formulated and 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.

All these assumptions imply constant returns to scale and perfect competition in the market. But in fact the relations are not always linear and imperfect competition prevails in the market. GP allows decision maker to incorporate environmental, organizational, and managerial consideration into model through goal levels and priorities.

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