iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.56894

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Maximizing Manufacturing Efficiency through Linear Programming

Krithi C N[1], Dr Anitha Jandhyala[2]
[1]*Student, BBA Department, PES University*
[2] *Associate Professor, BBA Department, PES University*

Abstract: Linear Programming (LPP) is a mathematical method used to optimize resource allocation systems with linear relationships, it aims to maximize or minimize a linear objective function while adhering to linear constraints. This paper showcase how to optimize linear programming problems through the simplex and graphical methods. The excel environment facilitates efficient modeling and solution generation. The simplex method is executed step – by – step, showcasing its versatility, while the graphical method provides visual insights. The solver add in automates the optimization process, adjusting decision variables within constraints. Comparative analysis reveals insights into the strengths of both the methods used in the process of the study. This research contributes to practical applications of LP, emphasizing the significance of excel and solver for real – world problem solving.
Keywords: Linear Programming, Simplex Method, Graphical Method, Optimization, M.S Excel, Solver, Decision Variables.

I. INTRODUCTION

Operations research, often known as management science, is critical in improving decision – making through the use of analytical methodologies. It offers optimal or near – optimal answers to a wide range of decision – making issues. Real – world objectives like as risk, loss, or cost minimization, as well as performance, profit, or output maximization, can be effectively identified using operations research tools and techniques.

Linear programming problem (LPP) Graphical method is a visual methodology for solving linear programming problems with two variables. It entails projecting the projecting the problem’s constraints on a graph and identifying viable location where the constraints overlap. The target function is then represented by a contour line, and the optimal solution is often located within the feasible zone at the highest or lowest point of this contour line. This method interprets the problem geometrically, allowing for intuitive understanding and speedy identification of the optimal solution. It’s especially effective for first – time demos and issues with only two decision factors.

The simplex method is a well – known and often employed approach in linear programming. This process offers a methodical way to assess numerous prospective remedies. Until an ideal solution is found, it moves repeatedly along the boundaries of feasible zone determined by the restrictions. The simplex technique can be employed by graphically depicting the constraints, which makes it especially suitable for systems with only two variables and inequalities.

Good life furniture’s and marketing, founded by Sundara K Gowda in 2004, is a reputable furniture company based in Mangalore. The business is renowned for flawlessly fusing practicality with beauty and provides a wide selection of furnishings that are adapted to different design styles. Good life furniture’s and marketing has established a reputation for quality and dedication to innovation in the Mangalore furniture market. They specialize in crafting high – quality wooden furniture’s, with primary focus on sofas and tea tables.

A. *Objectives*

1) To demonstrate the application of linear programming in maximizing profits for good life furniture’s and marketing
2) Comparative analysis of solution by graphical and simplex methods

II. LITERATURE REVIEW

1) The paper discusses a proposed approach to solve hesitant fuzzy linear programming problems without transforming them into crisp linear programming problems. It explains that if the cardinality of all hesitant fuzzy numbers is different, the approach fails to find the correct trapezoidal hesitant fuzzy number. To overcome this limitation, a new approach called the Mehar approach is proposed, which ultimately obtains the optimal trapezoidal hesitant fuzzy number. (Raina Ahuja, 2023)

2) This paper presents a new algorithm for solving multilevel multi objective linear programming problems (ML-MOLPP) using the adaptive method of linear programming. It generates a set of compromises and develops an algorithm based on the adaptive method to select the best compromise. The algorithm is then applied to resolve all multi objective linear programming problems. (Mustapha Kaci, 2023)
3) This paper explores daily eating problems using Stigler's idea and linear programming. It optimizes nutritional intake using a Simplex method, resulting in a lower minimum cost than Stigler's. However, the study's limitations and outdated data need further research. (Shengtai Ding, 2023)
4) The proposed adaptive fuzzy dynamic programming technique is designed to solve fuzzy constraints in linear programming problems, resulting in a 94.8% improvement in the objective function and a more practical, robust, and flexible approach (Izaz Ullah Khan, 2023)
5) This paper introduces a novel method for solving multi objective linear programming problems (MOLPP) that eliminates the need to calculate the optimal value of each objective function. It uses a geometric approach to sensitivity analysis and a numerical example to demonstrate its effectiveness. (Sonia Radjef, 2023)
6) This paper explores the use of zero-one integer assignment in transportation problem solving to reduce complexity. It presents a model using Python programming to minimize transportation costs and introduces a mathematical algorithm for zero-one transportation programming, transforming transportation problems into integer programming. (Amit K Jha, 2023)
7) The study explores various solution approaches for a bilevel linear programming model in an Industrial Symbiosis network, comparing KKT, fuzzy, and goal approaches. Findings suggest KKT approach is most suitable due to its hierarchical nature. (Büşra Altinkaynak, 2023)
8) This paper presents a mathematical model for optimizing linear programming problem mixes using graphical methods and Excel solver software, aiming to maximize production with limited time and contribution. (Dr Bhawna Agrawal, 2023)
9) This paper aims to solve a Multi-Objective Linear Programming problem using a matrix inversion method to minimize production and transportation costs, comparing results with existing methods and illustrating the method through numerical examples. (Bhavana Shrivastava, 2023)
10) The paper discusses the development of "Simplex Algo", a software that calculates and solves a simplex algorithm for educational purposes in linear programming. The software, developed using C# and Visual Studio desktop, uses various attributes and network connections to solve exercises. Comparisons show that the execution time of the algorithm is faster than existing ones. (Endrit Rushiti, 2022)
11) The paper explores the odds problem, a 2000 Bruss proposal, and its variants using dynamic programming equations. Buchbinder, Jain, and Singh proposed a linear programming formulation for the classical secretary problem, highlighting that ordinary DP equations are a modification of the dual problem of linear programming. (Sachika Kurokawa, 2021)
12) The article introduces an n-dimensional mathematical model for visualizing linear programming problems using artificial neural networks. It introduces an objective hyperplane, a receptive field, and an image of a polytope. Parallel algorithms are constructed, and scalability is estimated. The model's efficiency is confirmed through large-scale computational experiments. (Nikolay A. Olkhovsky, 2022)
13) This paper presents a detailed summary on linear programming and the diet problem, focusing on finding foods that meet daily nutritional requirements for the least amount of money. The goal is to minimize costs while limiting calories, vitamins, minerals, fats, salt, and cholesterol. (Zheng, 2022)
14) This paper analyzes the impact of external transport costs on logistics activities, particularly short sea shipping, and aims to optimize transportation costs. It considers fuel, service, and vehicle charges, and adds external transportation costs to original costs. The study suggests that environmental maintenance costs are zero if not affected by the environment. (M. M. Trivedi, 2023)
15) This paper discusses linear programming, a mathematical tool used in real-life applications like agriculture, management, business, and industry. It provides an introduction, historical overview, definition, assumptions, components, characteristics, and highlights of real-life applications. Linear programming aims to optimize outcomes and maximize resources, making real-life situations easier and more comfortable. (Rajendra Kunwar, 2022)
16) This study demonstrates the practical use of linear programming in small to medium – sized furniture manufactures such as simple furniture. It demonstrates how this strategy improves production efficiency and cost effectiveness while balancing expenses and allocating resources. The ideas and approaches offered can be implemented in a variety of setting, giving helpful assistance for firms looking to increase productivity while lowering costs in competitive marketplaces. (Tia soni, 2023)

III. RESEARCH METHODOLOGY

The report obtained is primary data collected from the company's owner. The initiative centered on the utilization of quantitative data. The data was collected using non – probability sampling. This signifies that the data was not choose at a random, but was intentionally chosen for the study's goal, striving for accurate values.

Let the unit's production for sofa be x units and units of production for tea table be y units

The following are the information on which the constraints are formed:

Maz Z = 15000X + 10000Y

1) *Step 1:* Define The Decision Variables

X = Number of units of sofas produced in a month

Y = Number of units of tea tables produced in a month

2) *Step 2:* Formulate The Objective Function

The objective is to maximize the profits, which is represented by the following function:

Max Z= 15000X + 10000Y

This means that for each unit of product X produced, the company gains 15000 in profit, and each unit of product Y produced, the company gain 10000 profits respectively

3) *Step 3:* Formulating The Constraints

   a) CONSTRAINT 1 – Production Capacity

   Good life furniture's and marketing is wood furniture manufacturing company. It produces two type of furniture that is sofa set and tea table, the raw materials available including labors, machineries, woods are sufficient to produce 220 units of furniture per month

   $X + Y \leq 220$

   b) CONSTRAINT 2 – Raw Materials

   The quantity of wood requires to produce one unit sofa set is 4cft and wood requires to produce one unit of tea table is 3cft, and the total quantity of wood available for the production process is only 150cft

   $4X + 3Y \leq 150$

   c) CONSTRAINT 3 – Labour

   To produce one unit of sofa set the labour requires is 5 people and labors required to produce one unit of tea table is 2 people. The total labour hours available to produce the products is 180 hours.

   $5X + 2Y \leq 180$

   d) CONSTRAINT 4 - Demand

   The company gets a demand of 20 units of sofa set per month, they need to produce this quantity, so as to maintain competitive advantage in the market.

   $X \leq 20$

   e) CONSTRAINT 5 - Demand

   The company gets a demand of 30 units of tea table per month, they need to produce this quantity, so as to maintain competitive advantage in the market.

   $Y \leq 30$

4) *Step 4:* Non-Negative Constarints

   $X \geq 0$ and $Y \geq 0$

This tells us that the company cannot produce a negative quantity of products

Linear programming problem is to maximize the profits of the company

Maximize Z = 15000X + 10000Y

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Subjected to

$X + Y \leq 220$ (Production Capacity constraint)

$4X + 3Y \leq 150$ (Raw Materials constraint)

$5X + 2Y \leq 180$ (Labour constraint)

$X \leq 20$ (Demand constraint)

$Y \leq 30$ (Demand constraint)

$X \geq 0, Y \geq 0$ (non – negative constraints)

IV. DATA ANALYSIS AND INERPRETATION

In this study the problem has been solved in two methods namely

Method 1: Simplex method

Method 2: Graphical method

1) Method 1: Simplex Method

The simplex approach was used to solve the following problem:

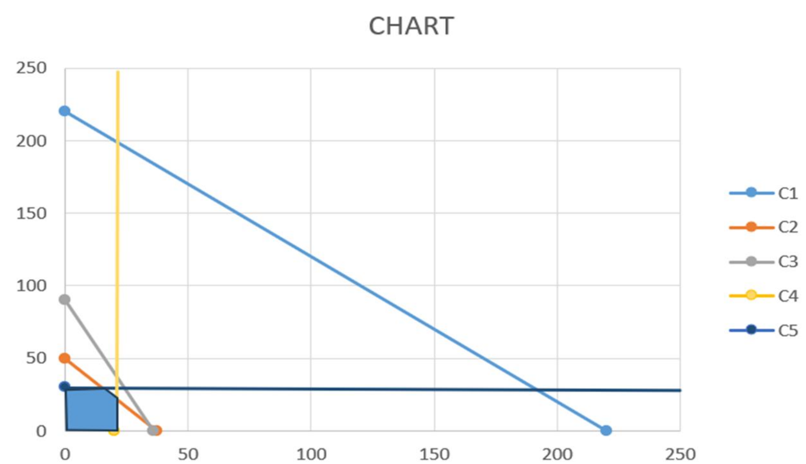
Decisoion Variable	X	Y	
Values	20	23.33333333	533333
Coeffceient	15000	10000	

Contraints	X	Y
c1	1	1
c2	4	3
c3	5	2
c4	1	0
c5	0	1

LHS		RHS
43.33333333	≤	220
150	≤	150
146.6666667	≤	180
20	≤	20
23.33333333	≤	30

2) Method 2: Graphical Method

The graphical method was used to solve the following problem:



C1	
X	Y
0	220
220	0

C3	
X	Y
0	90
36	0

C4	
X	Y
20	0

C5	
X	Y
0	30

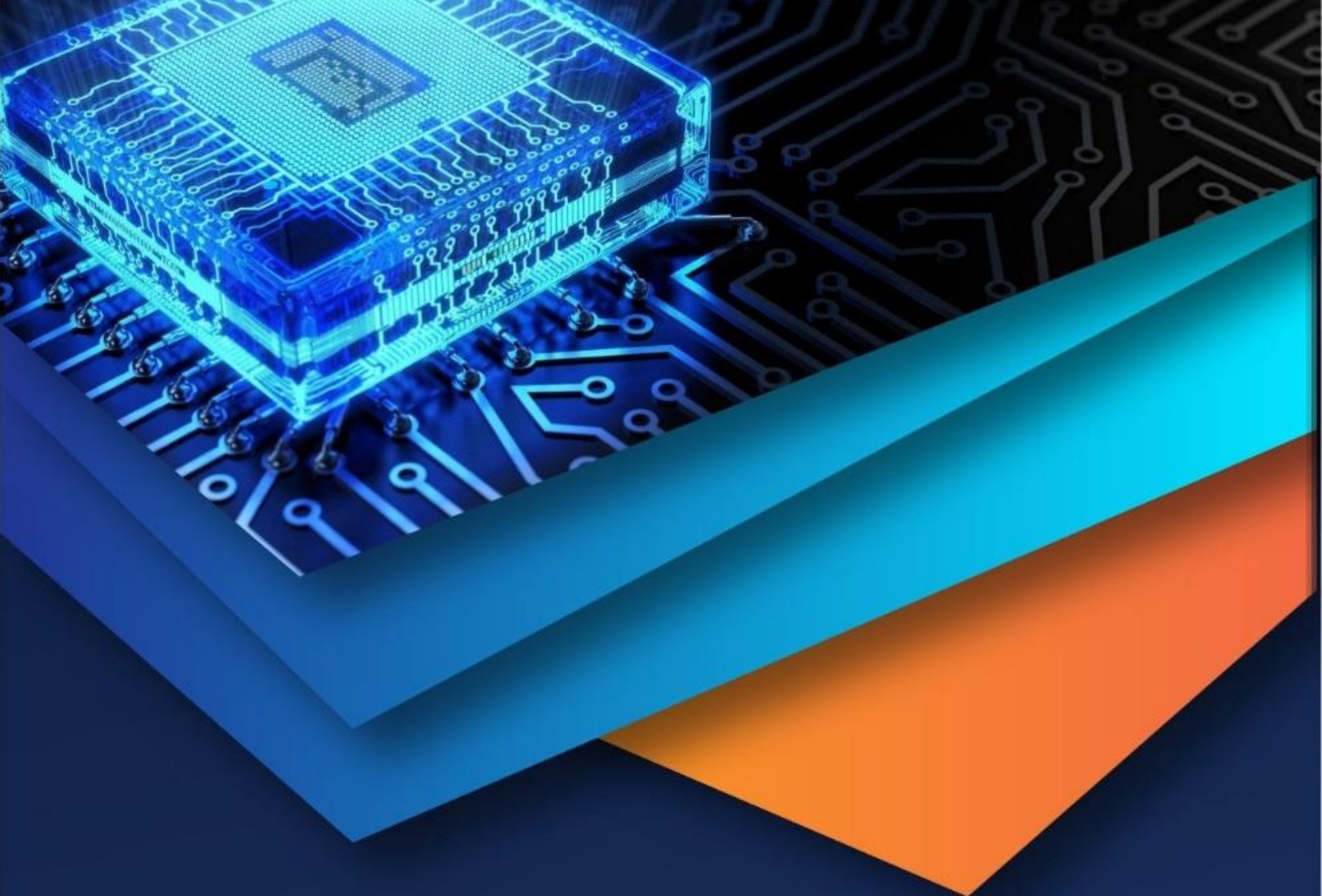
Fesiable Region		Z = 15000X + 10000Y
X	Y	
0	0	0
20	0	300000
20	23.33	533333
15	30	525000
0	30	300000

V. CONCLUSION

The study explores the optimization of linear programming problems using both graphical and simplex methods. The graphical approach offers insightful visuals, but the simplex method's step – by – step execution demonstrates its adaptability. The usefulness of the excel environment is highlighted in real-world applications by the way it facilitates effective modelling and solution production. Moreover, the optimization procedure is automated by integrating the Solver add – in, proving its ability to modify decision variables with in predetermined bounds. This study highlights the benefits of both approaches and highlights how they work well together to solve practical issues through a comparative examination. The study emphasizes the usefulness of linear programming in practical applications overall, with excel and solver being essential tools for efficient problem-solving.

BIBLIOGRPHY

[1] Amit K Jha, G. S. (2023). Modeling of Transport Problem in Linear Programming with Python (PULP).
[2] Bhavana Shrivastava, D. B. (2023). Computation of Multi-Objective Linear Programming Problem by Matrix Inversion Method.
[3] Büşra Altinkaynak, T. g. (2023). Comparison of Fuzzy Solution Approaches for a Bilevel Linear Programming Problem.
[4] Dr Bhawna Agrawal, M. S. (2023). Optimal Mix of Two or Moreproducts to Maximize the Contribution of Linear Programming Problem.
[5] Endrit Rushiti, A. B. (2022). SimplexAlgo Software for Solving Problems in Linear Programming.
[6] Izaz Ullah Khan, M. A. (2023). Adaptive fuzzy dynamic programming (AFDP) technique for linear programming problems lps with fuzzy constraints.
[7] M. M. Trivedi, J. P. (2023). An analytical study on impact of external transportation cost in linear programming problem and their application.
[8] Mustapha Kaci, S. R. (2023). An adaptive method to solve multilevel multiobjective linear programming problems.
[9] Nikolay A. Olkhovsky, L. S. (2022). Visualizing Multidimensional Linear Programming Problems.
[10] Raina Ahuja, A. K. (2023). Mehar approach to solve hesitant fuzzy linear programming problems.
[11] Rajendra Kunwar, H. P. (2022). An Introduction to Linear Programming Problems with Some Real-Life Applications.
[12] Sachika Kurokawa, T. M. (2021). Dynamic Programming and Linear Programming for Odds Problem.
[13] Shengtai Ding, R. W. (2023). Diet problem by using Linear Programming.
[14] Sonia Radjef, M. K. (2023). A new geometric approach to multiobjective linear programming problems.
[15] Tia soni, A. J. (2023). optimizing the cost effectiveness in a manufacturing sector: a linear programming approach for simple furniture
[16] Zheng, J. (2022). Diet problem and the method linear programming.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY