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.2023.56874

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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

"The Application of Linear Programming for Profit Maximization in a Bakery"

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Abstract: ***This research paper examines how linear programming can be strategically applied to maximize profits in a bakery. Considering the challenges faced by bakeries, such as varied product offerings and changing demand, the study investigates the use of LPP techniques to optimize production and resource allocation. By systematically defining linear objective functions and constraints, the research aims to pinpoint the most profitable combination of bakery products, taking into account factors like ingredient availability, production capacities and market demands. Real world case studies and practical and practical examples demonstrate how LPP assists decision makers in making informed choices, ultimately improving profitability while maintaining operational efficiency. The findings provide practical insights into the effectiveness of LPP as a decision – making tool within the dynamic and competitive landscape of the bakery industry.***

Keywords: Linear Programming, Bakery, Profit Maximization, Operational Efficiency, Resource Allocation, Case Studies, Best Practices.

I. INTRODUCTION

Businesses today aim to be lucrative and efficient in the fast-paced world of business. This is valid for companies across numerous industries. In order to accomplish these objectives, a lot of firms have started using mathematical tools as a way to inform their strategic decision-making. This study focuses on the particular field of bakery management and attempts to investigate the application of a mathematical tool called linear programming (LP) to maximize earnings.

As vital members of the food chain, bakeries face a variety of complex issues, including controlling production costs, juggling scarce resources, and responding to shifting consumer expectations. Systematic optimization becomes essential in this complex operational environment. The purpose of this study is to provide insight into the ways in which bakeries might use linear programming as a strategic strategy to address the unique problems they have while trying to maximize earnings.

The mathematical optimization methodology known as linear programming, which provides an organized approach to resource allocation, is the central focus of this study. The primary purpose is to maximize or reduce a linear objective function while adhering to a set of linear restrictions. Because of its simple mathematical language and ability to handle the complexities of decision-making, bakers find Linear Programming to be appealing. For bakeries hoping to streamline their manufacturing procedures and, as a result, increase their total profitability, it becomes an alluring and sensible option.

To sum up, this study delves deeply into the strategic application of linear programming in bakery management. The study is to provide workable solutions that can transform how bakeries approach the objective of increasing profitability in a competitive and dynamic market by recognizing the unique challenges faced by bakeries and utilizing the power of mathematical optimization.

A. Objectives

1) Investigate how Linear Programming can help optimize resource use in bakeries for higher profits.

2) Show how bakeries can use Linear Programming as a tool for decision-making, guiding choices that improve overall profitability.

II. LITERATURE REVIEW

This research paper investigates how Linear Programming (LP) techniques can be strategically applied to maximize profits in a bakery with a diverse product mix. By carefully defining linear objective functions and constraints, the study aims to pinpoint the most profitable combination of bakery products and their respective production quantities. Real-world case studies and practical examples are used to demonstrate the effectiveness of LP in assisting decision-makers to efficiently allocate resources, optimize the product mix, and meet market demands.

The findings contribute practical insights into the application of LP in bakery management, emphasizing its role in improving economic outcomes through well-informed decision-making and resource allocation. (Kayode Olakunle Oluwaseyi, Atsegameh Elizabeth, Omole Ezekiel Olaoluwa, 2020)

This research paper delves into the use of Linear Programming (LP) to enhance decision-making in the transportation of bakery products. The study systematically formulates linear objective functions and constraints to optimize logistical processes within the bakery's supply chain. By applying LP techniques, the paper aims to identify the most effective routes and quantities for transporting bakery goods, considering critical factors like delivery times, transportation expenses, and storage capacities. Real-world case studies and practical applications are utilized to demonstrate how LP assists decision-makers in refining product transportation, ultimately contributing to increased efficiency and cost-effectiveness in the distribution network of the bakery industry. (Muhammad Abid, Muhammad Saqlain, 2023)

This research paper investigates the use of the Simplex Method to maximize profits in a bakery store. The study systematically employs the Simplex Method, a mathematical optimization technique, to identify the best combination of bakery products and pricing strategies for achieving the highest profitability. By creating linear programming models and considering various constraints, the paper aims to offer decision-makers in the bakery industry a structured approach to refine their product offerings and pricing schemes. Practical case studies and real-world examples are presented to illustrate how the Simplex Method effectively guides decision-makers in making informed choices that contribute to overall profitability in a bakery store context. (Mohd Syafarudy Abu, Lim Eng Aik, Tan Wee Choon, Norazman Arbin, 2022)

This research paper delves into the pursuit of profit maximization in a bakery through the efficient allocation of raw materials. The study systematically explores methods to optimize the allocation of raw materials, employing practical techniques. Utilizing linear programming models and considering various constraints, the research aims to pinpoint the most effective way to allocate raw materials, thereby improving production efficiency and maximizing profits. The integration of real-world case studies and practical examples illustrates how optimal raw material allocation contributes to streamlined bakery operations and ultimately leads to improved economic outcomes. The findings offer practical insights for decision-makers in the bakery industry seeking to boost profitability through strategic resource allocation. (Laxmi Saoji, Sapna Bhat, Hitesh Manghnani, Somya Pathak, 2020)

This research paper examines how a Linear Programming Model approach is employed for profit optimization in a product mix company. The study systematically explores the application of linear programming models to identify the most profitable combination of products. By formulating linear objective functions and considering various constraints, the research aims to offer decision-makers in product mix companies a structured method to improve their overall economic outcomes. Practical case studies and real-world examples are presented in the paper to illustrate how the Linear Programming Model approach guides decision-makers effectively, aiding them in making informed choices that contribute to profit optimization within the context of a product mix company. (Garba M. K., Banjoko A. W., Yahya W. B., Gatta N. F., 2020)

This research study explores the use of optimization approaches to enhance bread production operations. The study's main goal is to use mathematical techniques to improve and optimize several production cycle components. It methodically examines and improves the bakery's scheduling, resource allocation, and general operational effectiveness. Finding practical methods to increase output while lowering expenses and wasting resources is the goal of the research. The study offers insightful information about how optimization techniques can be strategically used to improve production processes in bakery operations, resulting in increased productivity and efficiency. It does this by combining real-world case studies and practical implementations. (Naik Mahesh Sudhakar Dr., Desai Kruti, Lad Janhavi, Surve Vaishnavi, Bhatia Drishti, 2021)

This study looks into the real-world use of linear programming (LP) to optimize the product mix in order to maximize profits and minimize expenses. In order to determine the most beneficial combination of products, the study methodically develops linear objective functions and constraints using LP techniques and mathematical modelling. The study shows how LP can be a useful tool for decision-makers to more effectively allocate resources, optimize manufacturing processes, and enhance overall economic results through case studies and real-world applications. The results provide important insights into the dual function of LP and show how adaptable it is as a tool for making decisions for companies looking to reduce costs and maximize profits at the same time when deciding on a product mix. (Ruby Chanda, Vanishree Pabalkar, Sudeepa Gupta, 2022)

This study looks into the use of linear programming (LP) approaches to increase revenue. Using mathematical modelling and LP approaches, the study methodically creates linear objective functions and constraints to find the best set of variables to achieve maximum profitability. The article demonstrates how LP works well to help decision-makers strategically manage resources, optimize processes, and achieve better economic results through case studies and real-world examples.

Our knowledge of LP as a useful tool for companies looking to maximize profits through well-informed decision-making and efficient resource allocation is improved by the findings. (Umar, 2021)

This research paper investigates the use of Linear Programming (LP) for profit maximization. The study systematically explores how LP, a mathematical optimization technique, is utilized to determine the most effective allocation of resources and decisions that result in maximum profitability. By formulating linear objective functions and considering various constraints, the research aims to offer decision-makers in various fields a structured method to improve overall economic outcomes. Real-world case studies and practical examples are included in the paper to illustrate how the application of LP contributes to informed decision-making and strategic resource allocation, ultimately leading to profit maximization. (Oyekan Ezekiel A., Temisan Gabriel O., 2019)

This research paper investigates the achievement of an optimal mix of raw materials in Tehinnah Cakes and Craft using Linear Programming (LP). The study systematically explores the practical application of LP to determine the most efficient combination of raw materials, aiming to improve production efficiency and reduce costs. By formulating linear objective functions and considering specific constraints relevant to Tehinnah Cakes and Craft, the research aims to provide valuable insights for decision-makers in the bakery industry. Real-world case studies and practical examples are incorporated into the paper to highlight how optimizing the raw materials mix contributes to a more streamlined bakery operation and better economic outcomes for Tehinnah Cakes and Craft. The findings offer actionable recommendations for decision-makers seeking to enhance operational efficiency and profitability through strategic raw material allocation. (Egharevba, Aimuamwosa Julia, Ojekudo Nathaniel Akpofure, 2021)

This research paper investigates how the Simplex Method is applied for profit maximization in Baker's Cottage. The study systematically uses the Simplex Method, a mathematical optimization technique, to find the best combination of bakery products and pricing strategies that result in maximum profitability. By creating linear programming models and considering various constraints, the research aims to offer decision-makers at Baker's Cottage a structured method to improve their overall economic outcomes. Practical case studies and real-world examples are included in the paper to illustrate how the Simplex Method effectively guides decision-makers, helping them make informed choices that contribute to profit maximization within a bakery setting like Baker's Cottage. (Nur Zafira Mohd Azman, Nurul Akmal Mohamed, Nurul Farihan Mohamed, Muzirah Musa , 2022)

This study presents a Linear Programming (LP) model optimized for the product mix of a Small Medium Enterprise (SME) company with the goal of maximizing profits. The research methodically creates linear objective functions and restrictions in order to strategically identify the best possible product and production quantity combinations that will ultimately yield the maximum profitability. The research attempts to provide SMEs with a useful decision-making tool, easing resource allocation, production planning, and satisfying market expectations by utilizing mathematical modelling and LP methodologies. The study offers insightful information about the viability of LP in small- and medium-sized enterprise (SME) settings through the analysis of real-world case studies and useful applications, demonstrating its efficacy in enhancing profit results through well-informed and optimized product mix strategies. (Safwa Mohd Baki, Jack Kie Cheng, 2021)

This research paper focuses on how Linear Programming (LP) can strategically enhance the utilization of raw materials in the bread baking industry in Nigeria. It addresses the challenges related to variable resource availability and market demands by systematically exploring how LP techniques can efficiently allocate raw materials, thereby optimizing production processes and maximizing efficiency within the baking sector. The study aims to provide practical insights for decision-makers in Nigeria's bread baking industry by formulating tailored linear objective functions and constraints. Real-world case studies and practical examples are utilized to demonstrate how LP aids informed decision-making, ensuring the optimal use of raw materials amidst the dynamic nature of the industry in Nigeria. The findings offer valuable insights into the effective application of LP for resource optimization in the unique context of the Nigerian bread baking industry. (Amanawa, 2022)

This research paper explores the practical use of Linear Programming (LP) to optimize cake production in a bakery. The study systematically investigates how LP, a mathematical optimization method, is applied to improve bakery efficiency by determining the best allocation of resources and decisions for enhanced cake production processes. By creating linear objective functions and considering specific constraints applicable to bakery operations, the research aims to provide practical insights for decision-makers in the baking industry. Real-world case studies and practical examples are included in the paper to illustrate how the application of LP supports informed decision-making and strategic resource allocation, leading to increased efficiency in cake production and improved overall bakery operations. The findings present actionable recommendations for decision-makers aiming to boost productivity and streamline operations through the practical application of linear programming techniques. (Phanindra. G, Anitha Jandhyala, 2023)

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
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This research paper explores the use of Linear Programming Problem (LPP) for profit maximization in the context of bakery products. The study systematically investigates how LPP, a mathematical optimization method, is employed to determine the best combination of bakery products, pricing strategies, and resource allocation to achieve maximum profitability. By formulating linear objective functions and considering various constraints relevant to bakery operations, the research aims to provide decision-makers in the bakery industry with a structured approach to improve their economic outcomes. Real-world case studies and practical examples are incorporated into the paper to illustrate how the application of LPP supports informed decision-making and strategic resource allocation, ultimately leading to profit maximization for bakery products. The findings present practical insights for decision-makers aiming to optimize their product mix and pricing strategies through the practical application of linear programming techniques. (Pawan B V, Anitha Jandhyala, 2023)

III. RESEARCH METHODOLOGY

The company owner is the source of the quantitative data used in this project. We obtained data directly from the firm owner. The information obtained by contacting the warehouse manager is regarded as primary data. The primary motivation behind gathering this data is scientific inquiry.

Constraints	Breads (x)	Cookies (y)	Availability
Labor Hours	3	2	80
Oven Capacity	2	4	80
Raw Materials	2	3	100
Demand	1	1	40
Profit	**50**	**40**	

The main objective is to increase revenue by optimizing the sales of breads (x) and cookies (y).

Constraint 1: Labor Hours
$3x + 2y \leq 80$
This constraint ensures that the time spent on making both breads (x) and cookies (y) combined does not surpass the available 80 hours of labor.

Constraint 2: Oven Capacity
$2x + 4y \leq 80$
This constraint ensures that the total baking time for both breads (x) and cookies (y) combined does not exceed the available oven capacity, set at 80 units of time.

Constraint 3: Raw Material
$2x + 3y \leq 100$
This constraint ensures that the total use of ingredients for both breads (x) and cookies (y) does not go beyond the given amount of 100 units. It reflects the available quantity of essential ingredients needed for production.

Constraint 4: Market Demand
$x + y \leq 40$
This constraint puts a cap on the overall production, making sure it does not go beyond the total demand in the market. Here, the combined production of breads (x) and cookies (y) should not surpass 40 units, aligning with the market's overall expectations and needs.

1) Decision Variables
Let the quantity of breads to be produced in a day be x
Let the quantity of cookies to be produced in a day be y

2) Inequalities

$3x + 2y \leq 80$
$2x + 4y \leq 80$
$2x + 3y \leq 100$
$x + y \leq 40$

3) Objective Function

Maximum $Z = 50x + 40y$

The LPP for above data is,

Max $Z = 50x + 40y$
Subject to, $3x + 2y \leq 80$
$2x + 4y \leq 80$
$2x + 3y \leq 100$
$x + y \leq 40$
$x, y \geq 0$

IV. ANALYSIS AND INTERPRETATION

We are using the simplex method and the graphical way to analyze the data. A visual depiction is provided by the graphical method, and a computer approach for a comprehensive examination is provided by the simplex method.

C1	3	2	≤	80
C2	2	4	≤	80
C3	2	3	≤	100
C4	1	1	≤	40

C1		C2	
0	27	0	40
40	0	20	0
C3		C4	
0	50	0	40
34	0	40	0

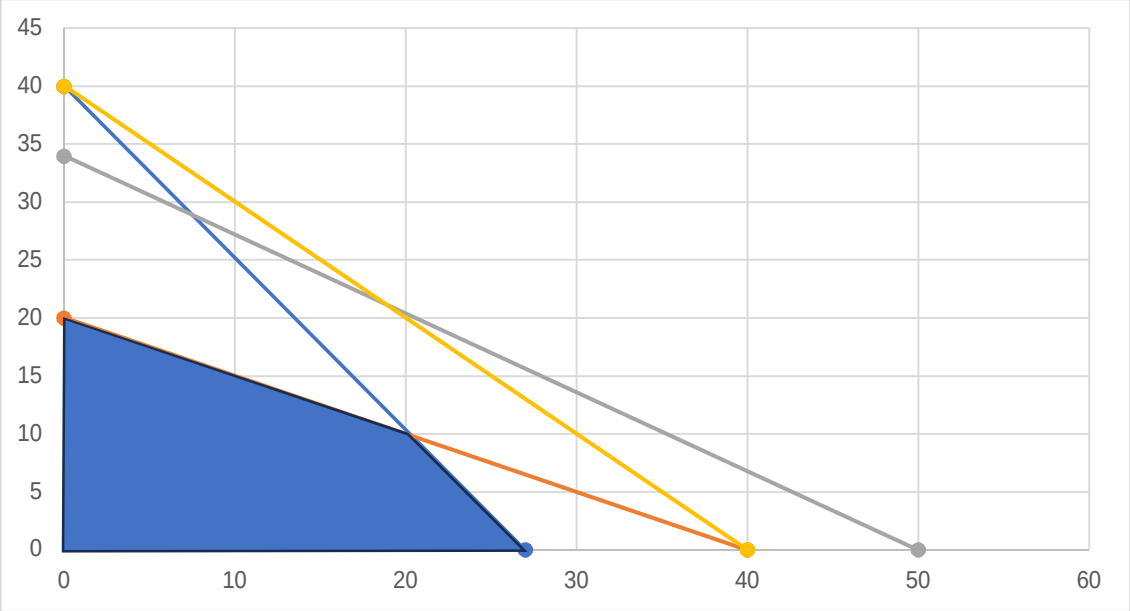
A	20
B	10

50	**40**	
0	0	0
27	0	1350
0	20	800
20	10	1400

VARIABLES	x	y
VALUES	20	10
COEFFICIENT	50	40

CONSTRAINTS	x	y	LHS		RHS
C1	3	2	80	≤	80
C2	2	4	80	≤	80
C3	2	3	70	≤	100
C4	1	1	30	≤	40

MAX	1400



We found the ideal values for x and y that maximize revenues while meeting all constraints by using both the solver approach and graphical analysis. The best option in this scenario is x = 20 and y = 10, which results in a maximum profit of 1400. By determining the best production numbers for bread and cookies, ensuring that there are enough ingredients, and satisfying minimal demand requirements—all while reducing capacity and demand constraints—the bakery owner maximizes profit.

V. CONCLUSION

In conclusion, this research emphasizes the strategic use of linear programming techniques to maximize profits in the challenging environment of bakery operations. It addresses the complexities arising from diverse product offerings and fluctuating demand, showcasing how Linear Programming Problem (LPP) methodologies effectively optimize production and resource allocation. The systematic formulation of linear objective functions and constraints helps decision-makers pinpoint the most profitable combination of bakery products, considering crucial factors like ingredient availability, production capacities, and market demands. The real-world case studies and practical examples provided underscore the tangible impact of LPP in facilitating informed decision-making.

In essence, the findings highlight the practicality and effectiveness of LPP as a valuable decision-making tool, offering insights that can significantly enhance profitability while ensuring operational efficiency in the dynamic and competitive bakery industry.

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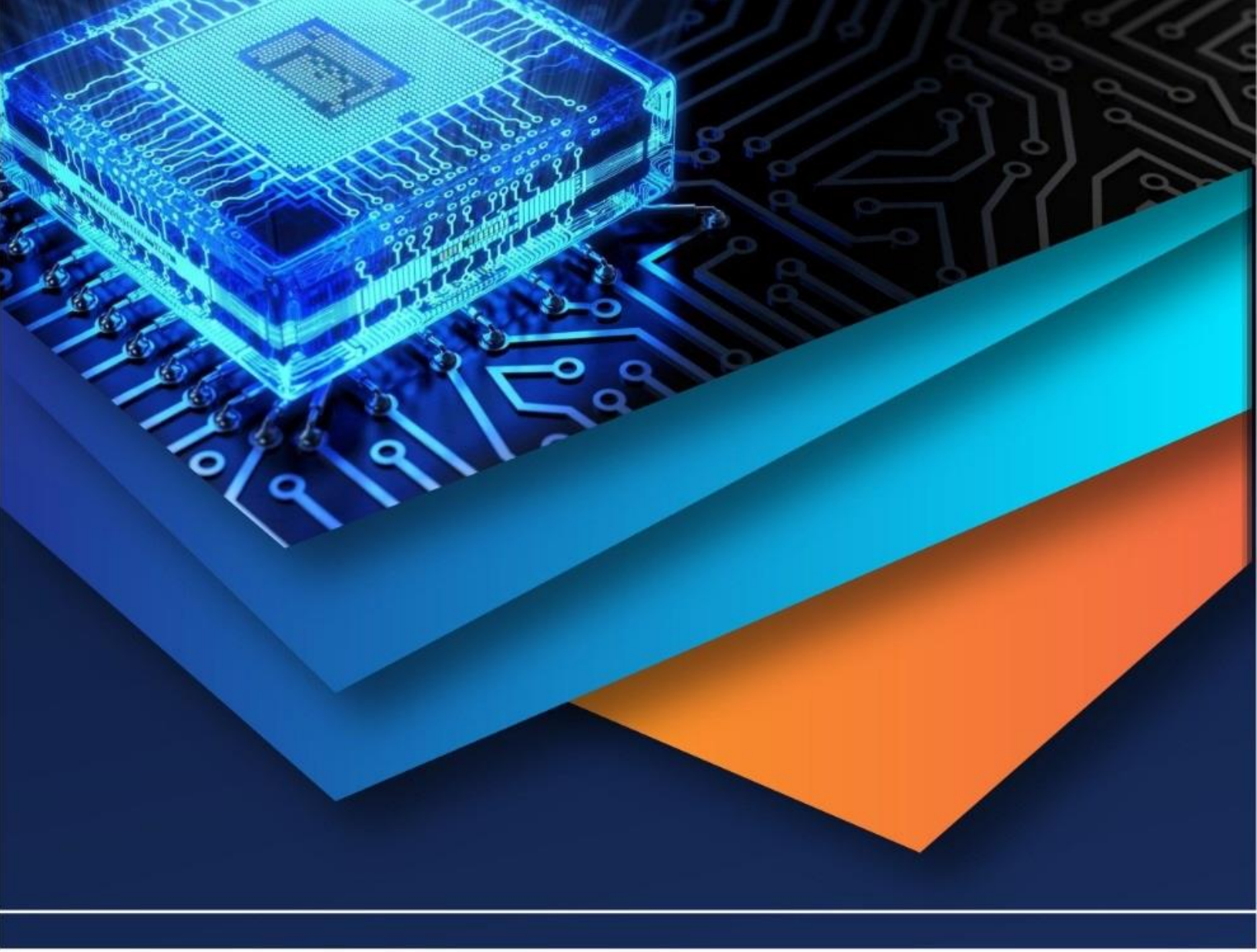

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