BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCES

DEPARTMENT OF PHYSICS AND MATHEMATICS

PROFIT MAXIMISATION IN FOOD PRODUCTION (BAKERS INN BREAD) USING LINEAR PROGRAMMING

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B191519B

A DISSERTATION SUBMITTED IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONOURS DEGREE IN STATISTICS AND FINANCIAL MATHEMATICS

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DECLARATION OF AUTHORSHIP

I declare that this research project herein is my own original and independent work and has not been copied or extracted from previous sources without due acknowledgement of the sources.

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ACKNOWLEDGEMENTS

In the first place, I want to thank God for leading me ever since I was in first grade.It was by his favor, not by chance, that I was able to finish this part of my degree.

Second, I want to convey my sincere gratitude to Mr. T KANJODO, my supervisor, for his guidance, encouragement, and real kindness throughout the writing of this dissertation. Working with him was great, and I really appreciated his advice, criticism, and recommendations. I also want to thank my mother for everything. I wouldn't be where I am now without her gracious, unflinching support. I also want to express my gratitude to my friends for always supporting me and walking with me on this journey. Saluted, ladies and gentlemen. Last but not least, I'd want to thank Mrs. Hlupo, the project coordinator, for her inspiration and assistance during this process..

May the Lord grant you all blessings?

ABSTRACT

This work utilized the concept of Simplex algorithm; an aspect of linear programing to allocate raw materials to competing variables (big, short-long, medium, and small bread) in Bakers inn bread for the purpose of profit maximization. The objectives of this research project were, to create a type of linear programming for production of Bakers Inn Bread, to identify the best response to the formulated model, to create an effective strategy for the business that will yield the most return and to use quantitative analysis to improve the company's performance and success. Secondary data for the period May 2023 was used, and it was collected of the firm's data base. The analysis was carried out and the result showed small loaf, big, and medium size in order to make a profit of 150 USD per batch of production and it was observed that medium loaf, contribute objectively to the profit. From the results I obtained I recommend that baker inn bread produces only all three types of bread because it is the only one that is contributing to maximum profits of the brand

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CHAPTER ONE

1.0 Introduction

The linear programming mathematical programming technique focuses on the effective distribution of constrained resources to widespread practices with the purpose of accomplishing a desired outcome of maximizing revenues or minimizing expenses. In mathematics and statistics, linear programming (LP) is a method for maximizing an object-oriented linear function that is in accordance with linear equality and linear in equality constraints. Informally, using a set of provided constraints stated as linear equations, linear programming illustrates how to maximize profits or reduce costs in a given mathematical model. Despite the widespread misperception that linear programming, a branch of operations research (OR), is a relatively new field, the concept of maximizing profits has existed in any organizational context, such as a production firm or manufacturing corporation, for a very long time. Among various models within operations research, linear programming figured out how to get the most accurate result in a certain mathematical model specified a set of specifications written as a list of equations in linear form. Highly talented craftspeople have been working to produce models to help manufacturers and production businesses maximize their revenues for ages.

1.1 Background of the Study

To find the most effective answers to issues that may be expressed as linear equalities or inequalities, a mathematical technique known as linear programming (LP) is utilized. In operation research, (LP) is a specific approach for maximizing functions that are linear while taking linear disparities and equality into account. Within a specific mathematical model and given a list of requirements as a linear equation, LP determines the optimal approach to achieving the preferred objectives, for example, maximum profit / minimum cost. A linear programming approach is employed in many industries, includes the fields of agriculture, industry, transportation, economy, healthcare, behavioral and sociological studies, and the armed forces.

Despite the fact that many commercial businesses consider linear programming a "new science" The purpose of any organization, like a production company or manufacturing facility, regardless of recent developments in mathematical history is to increase profit.

Using a predetermined optimality criterion, the linear programming family of mathematical programming seeks to efficiently distribute limited or scarce resources among numerous competing activities.

In order to create an affordable diet that may meet daily nutritional needs, Miller (2007) asserts that Linear algebra is a generalization of linear programming that is used to describe a range of real-world challenges, such as designing aircraft routes and transferring oil from refineries to cities. LP approaches have found widespread use in research and business during the past 45 years. One of the most significant scientific breakthroughs of the middle of the 20th century was the creation of linear programming.

In today's world of developed nations, most businesses or enterprises of even moderate size use linear programming as a regular method that has made millions or hundreds of dollars in savings. Numerous research has indicated that the use of linear optimizations is foreign to many industrial companies, particularly those operating in Zimbabwe, or that they have not fully grasped it. Many industrial companies occasionally struggle with the problem of how to best utilize available resources to increase profits due to linear programming, which offers a correct mathematical decision-making strategy, is not adequately employed.

Linear programming is a subject that interests a lot of scholars. For instance, Jordan (1866) improved the technique for calculating the least squared errors as a measure of fit, Dantzig (1947) developed the Simplex method, Fiacco and Cormick (1968) developed the interior point method, and Kar (1980) developed the Kar. Gauss (1820) also solved a linear system of equations that is now known as Gaussian elimination. Linear programming is used to maximize a variable-based function called the objective function, according a group of linear equality and inequality requirements referred to as restrictions. The objective function can be any measure of effectiveness that should be obtained in the best or most efficient method, incorporating any measure of efficiency, such as a profit or loss measure, a cost or production capacity measure, etc. The issue with making decisions based on the usage of finite resources was one of the primary causes of utilizing the linear programming model, one of the most effective weapons that everyone who makes decisions must apply before reaching making decisions effectively.

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1.2 Statement of the Problem

Bakers inn Bread is one of the bakeries in Zimbabwe that has been producing bread for a long time. However, the plant has been losing money, which has caused a production shortfall and other marketing issues. Insufficient production and marketing issues are sufficient evidence that Bakers Inn Bread Bakery's production has to be optimized.

Due to the underuse of linear programming, which offers a sound quantitative strategy to decision-making, the factory is having difficulty maximizing the use of the resources now available. The plant will maximize profits by applying techniques for linear programming.

1.3 Research Questions

The following are the research guiding questions for this study:

1. What needs to be done to enhance the performance of the company?

2. What is the best linear programming paradigm for maximizing profits?

3. What is the created linear programming model's ideal solution?

1.4 Aim and Objectives

The purpose of this research project is to employ the linear programming idea to achieve the best possible production of Bakers Inn Bread with the following specific objectives:

1. To create a type of linear programming for production of Bakers Inn Bread.
2. To identify the best response to the formulated model.
3. To create an effective strategy for the business that will yield the most return.
4. To use quantitative analysis to improve the company's performance and success.

1.5 Significant of the Research

This research work is significant to Bakers Inn Bread for profit maximization

Reasons and other related factory for optimality reason.

Any interested person willing to study similar problem for optimal solution.

1.6 Scope and Limitation

In order to determine the highest profit based on the combination of the raw materials using only linear programming, this research project is concentrated on Bakers Inn Bread and other related factories.

1.7 Definitions of Basic Terms

1.7.1 (Objective function :) In other words, an objective function is a function that may be optimized over the feasible region. A mathematical model that depicts the behavior of a performance indicator is known as an objective function.

1.7.2 (Feasible solution :) A set of decision variable values that satisfy every constraint in an optimization problem is known as a viable solution**.**

1.7.3 (Optimal solution :) A solution is said to be optimal when the goal function reaches its maximum (or minimum) value**.**

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1.7.4 (Infeasible solution :) A solution is considered to be infeasible if at least one restriction is broken.

1.7.5 (Non-optimal solution :) If and only if: a. it lacks a workable solution; a problem cannot have an ideal solution.

b. The constraints do not prohibit the values of the goal function from continuously increasing in a positive way.

1.7.6 (Feasible region :) All viable options are gathered into a feasible region**.**

1.7.7 (A corner-point feasible solution :) A feasible solution that sits at the corner of the feasible region is known as a corner-point viable solution.

1.7.8 (Constraint :) These are linear inequality or equations. It has the general form
As: $\sum$ ai xi $\leq$ bi.

1.7.9 (Slack variable :) A non-negative variable called a slack variable is added to the constraint's left side to transform a ($\leq$) of the inequality to an equal sign (=).

1.7.10(Surplus variable :) A Surplus variable is a non-negative variable subtracted
From left hand side of the constraint to convert a ($\geq$) of the inequality to an equal sign (=).

1.7.11 (Basic feasible solution :) If a linear program takes the form of, then it is in a standard form;
Objective function $Z = CtX$
Subject to $Ax = B$
With $X \geq 0$ (non-negative constrain)
The fundamentally workable answer is found after standardization by setting the n-m of the x-variable to zero.
Where mn is the number of constraints, n is the number of variables, and n is the number of equations. The basic feasible solution is degenerated if it is non-degenerated if all of the fundamental variables are positive and the basic feasible solution is degenerated.

1.8 Chapter summary

The first chapter outlined the context, problem statement, purpose, relevance, and constraints. In the first chapter, the study's goals and its research objectives were also highlighted. Low profit margins are still a major problem for bakers of bread, as the background and introductory sections made clear. In relation to the context of the study, the researcher specified several goals. As a result, the chapter creates a study road map.

CHAPTER 2: Literature Review

2.0 Introduction

The major goal is to employ the linear programming paradigm to achieve the best possible output of Bakers Inn Bread. The theoretical and empirical research literature from past initiatives is summarized in this chapter. Its objective is to highlight the several widely accepted methods for using linear programming. The theoretical literature on linear programming, which forms the basis of the paper, is examined in the first section. The empirical review will evaluate prior studies on this topic.

2.1 Theoretical literature review

According to Fagoyinbo and Ajibode (2010), the capacity to make wise decisions has a significant role in determining the success or failure of a person or organization's business strategy. They argue that because the consequences of a bad decision are so costly, a management can't decide something based on their own experiences. speculation, or feeling. As a result, decision-maker must have a fundamental understanding of how the quantitative method can be used to make decisions. The junior staff and senior staff are the model's decision variables, and the constraints were the amount of training time available because the program is in-service training. They applied linear programming to the efficient use of resources for staff training and described it is an essential quantitative approaches to making choices. According to Dennis (1998), advancement in any field of study results from building on the efforts of those who have gone before. There are differing opinions on how well the linear programming method can be used to different administrative decision-making processes. These opinions changed throughout time as a result of improvements made to the method's application to actual business problems including allocation, transportation, and network challenges. The vast majority of financial progress literature bolsters the notion that (LP) is an important analytical tool for developing countries' economies since it helps determine how to best use scarce resources. In 1947, the simplex was developed by George B. Dantzig, It is employed to resolve linear programming, as a result of his research done while serving at the Pentagon with Mil during World War II. This approach works to resolve the majority of linear programming issues. The theoretical and empirical framework is presented in this chapter. Theoretical and earlier empirical investigations on the use of linear programming for profit maximization contain some gaps.

2.1.1 Linear programming

As Stapel and Elizabeth (2006), (LP) is the act of taking into account a number of linear inequalities related to certain scenarios and figuring out the "best" output that can be attained under those conditions. A basic example would be to determine the ideal production levels for maximum profits given the constraints of labor and supplies. Linear programming, as defined by Noyes, James, and Weisstein, Eric (1999), is the process of maximizing or minimizing a linear function over a convex polyhedron subject to linear and non-negativity constraints. Simply put, linear programming is the process of optimizing a result based on a set of constraints using a linear mathematical model. In the Wolfram language, implementing linear programming is known as linear programming. [c, m, b], which finds a vector x that minimizes the number cx subject to the restriction mx ≥b and xi ≥ 0 for x = (x1,........., xn). Linear programming (LP) is a mathematical approach for determining how to distribute a company's limited resources to best meet its goals. In operations research (OR) and management science. Numerous mathematical techniques for enhancing performance in terms of resource combinations fall under the umbrella term "linear programming" (Lucey, 1996). Turban and Merdith (1991), who concur with Dwivedi (2008), say that one of the most widely utilized technologies in managerial science is linear programming. However, linear programming can be seen as providing an operational method for handling economic interactions that involve discontinuities, according to Koutsoyiannis (1997). However, she claims that neither linear programming nor the economic theory have anything to say about how to carry out the optimum course of action. They merely determine the best solution to every given problem.

The majority of researchers contend that an approach to operations research is linear programming. (Wagner, 2007, Lucey 2002, etc.). According to Wagner (2007), there is strong evidence that this is one of the most economically significant uses of operation research. They continue to support this claim. He adds that operation research accepts the notion that managers can approach problem-solving through a reasonably structured process. So it is possible to use a scientific approach to managerial decision-making. He defines operations research technique as a rigorous approach to handling senior management problems. Emory and Niland (1968) cited the determination the formulation of these in linear equations as the most challenging problems of the essential restriction (constraints or row equations) and the possible alternatives (column vectors) when utilizing linear programming techniques.. The challenging part is creating a precise mathematical characterization of the issue. In order to apply the linear programming paradigm, it is necessary to have a thorough understanding of the issue at hand as well as specifics about how the business is run. It can be astonishing how quickly real situations demand matrices of a size that taxed even the largest modern processors, therefore computer storage capacity is a crucial concern. Experience with applying linear programming challenges has shown that gathering the appropriate financial and technical data requires a lot of time and money.

According to Emory and Niland (1968), the cost of obtaining the necessary relevant data can make the linear programming issue more expensive in some cases than the actual solutions. According to Turban (1993), the issue of risks and uncertainties relating to customer behavior, resource availability, and commodity prices makes it challenging for management to select the optimal course of action from the available options. Consequently, he advises managers to become more sophisticated and to understand how to exploit the new tools and approaches being produced in their industry. These recently created tools make use of a quantitative methodology.

When there are numerous activities that need to be completed, numerous ways to complete them, and limited resources or facilities for performing each activity in the most effective manner, management is faced with the challenge of figuring out the best way to combine these activities and resources in an optimal way to ensure that overall efficiency is maximized.

According to Charles, Cooper, and Henderson (1963), this is referred to as an optimization problem and can be approached using mathematical programming. Another name for linear programming is single-objective restricted optimization. This is due to their perception that it simply seeks to reduce or expand the amount of variables in a model that are unknown. Optimization of an objective function, which is a variable function, along a linear path under the management of a set of linear equations and/or inequalities known as constraints is the subject of linear programming, according to Gupta and Hira (2009). The objective function could be profit, cost-effectiveness, or any other measure of effectiveness that must be accomplished in the best or most ideal manner. Limits may be imposed by several resources, including market demand, storage capacity of industrial processes and equipment, raw material availability, and soon.

2.1.2 Limitations of Linear Programming

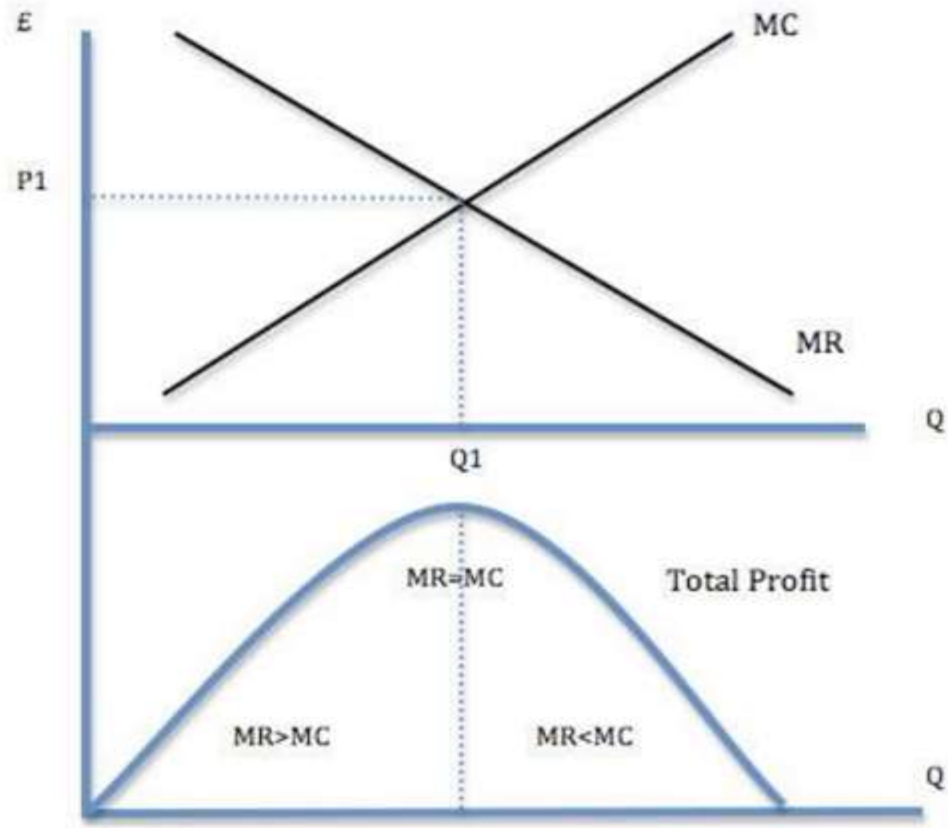
According to Corr S. Pondent (2018), there should be an objective that is easily recognized and quantifiably measurable. This is one of linear programming's drawbacks. It can be something that is impossible in real life, like maximizing sales or minimizing expenses. The activities that must be included must be clearly definable and quantifiably measurable. For instance, if a production planning issue involves a product and all of the activities, such as when a worker is sick and his performance is reduced, cannot be quantified, the problem cannot be solved.

It is not practical to have a linear relationship between the objective function and constraint equations or inequalities, which represent the objective and resource limitation issues, respectively. According to Kurtz (1992), the linear programming model frequently ignores very real organizational difficulties like morale, the effects of strikes, and internal power struggles because they are so difficult to assess. The decision-makers should have access to a variety of workable alternate courses of action, which are determined by resource restrictions. Additionally, because they do not understand how it might be applied, Managers who are accustomed to its exacting models oppose its adoption. In contrast, Taha (1992) cites more programming paradigms in his contributions, including stochastic, convex, quadratic, and integer programming. He claims that they are different in terms of the kind of data they can manage and the assumptions they make. The author shows how the Ozark Poultry Farm established the feed mix using linear programming to keep a healthy ratio that incorporated the proper amounts of protein, fiber, and calcium.

2.2 Profit Maximization

Profit is defined in 2016 by Happy Kite Economics Help.org as total earnings less cost overall. Consequently, profit maximization takes place. Where total revenue and total expense are most dissimilar. A business can increase earnings if it designs output so that (MR) = (MC)**.**

2.2.1 Diagram of profit maximization



www.economicshelp.org

Figure 2.1: **Illustration of the pursuit of profit**

A description of the diagram is given below. When the company's output falls short of Q1, MR exceeds MC. The company's overall profit will increase since it is earning more money than it is spending on costs associated with this increased output. As we approach Q1, MR is just barely greater than MC, thus profit hasn't increased much, but profit is still rising. But after Q1, the marginal cost of the output outweighs the marginal revenue. As a result of these additional units' higher costs than revenues, the company's profit would decline.

2.3 Limitations of profit maximization

As it is in the actual world, challenging to determine your precise margins of profit and expense of last sold items. For instance, it might be hard for companies to comprehend how the MR is impacted by the price elasticity of demand for their products. Additionally, it depends on how other companies react. If the price is raised and other firms follow suit, the demand may become inelastic (see the kinked demand curve and game theory). Businesses may, however, provide their best guess. To increase their profits, many businesses may have to experiment. For instance, if they see that rising prices results in a lesser decline in demand than anticipated, they may raise prices as high as feasible until demand becomes elastic. In addition to pricing, there are many other factors that can affect demand, making it difficult to separate the impact of demand. For instance, corporations may decide to make less than maximum profits in order to increase their market share because raising prices to maximize profits in the near term could lead to an increase in the number of firms entering the market.

2.4 Profit margin

EBIT divided by sales equals operating profits per dollar of sales, also known as profit margin (return on sales). EBIT/sales, according to Marcus, Kane, and Bodie (2010), equals profit margin. Profit margins come in a variety of forms, including gross, operational, and net margins. Based on these criteria, they can be divided. Gross margin, according to Neil Kokemuller (2017), is a measurement for efficiency of profit produced after understanding your whole revenue for a specific time frame. Revenue less gross profit is the method for computing gross margin, commonly known as the gross profit margin. According to Rajat Sharma, the operating profit margin ratio measures solely the return a company gets from its operations. It is the portion of profits that remain after covering operating expenses including labor costs (wages & salaries), raw material costs, selling and management costs, etc. The operating profit produced by the company and its affiliated businesses serves as the numerator when calculating the operating profit margin on a consolidated basis. As a result, the operating revenues earned by each employee of the company, including minority, will be added up to form the denominator.

2.5 Effects of low Profit Margins

Low gross profit margins have negative impacts, as explained by Brian Hill. According to him, less money is available to pay for the company's running costs. Low profit margins also put a company's survival in peril since they may be unable to cover even the most fundamental selling, overall, and management costs, such as the owner's salary, if the profit margins differ materially from what is typical for the sector. If the business is unable to boost gross margin through actions like locating less expensive suppliers, it can continue to endure adverse cash flow and finally have to shut down.

2.6 Empirical Review

Any observation, whether direct or indirect, can be used in empirical analysis to support or invalidate reality. There have been earlier investigations into the use of linear programming for maximizing earnings. This portion evaluates earlier empirical research on the use of linear programming for profit maximization. It looks at the results and recommendations made by other academics regarding the key factors influencing profit maximization. Simplex method algorithm models, one-way ANOVA, and logistic regression are often used statistical techniques in use of linear programming for profit maximization has been studied in the literature.

2.6.1 Sociological Overview

Using linear programming approaches, Fagoyinbo and Akinbo (2018) investigated how to maximize profits in manufacturing industries: Geepee Nigeria. With the intention of optimizing profitability, they used the improved simplex approach, a feature of linear programming, to solve business challenges. The manufacturer GEEPEE Nigeria Limited specializes in producing several types of tanks. For the investigation, samples of the Combo, Atlas, Rambo, and Jumbo tanks in a range of sizes were gathered. According to an analysis of the data gathered, combo tanks were discovered to guarantee increased objective value addition and maximum earnings at a particular level of production capacity. Given the variety of materials available, the manufacturing of the various sizes of the items employed polyethylene (rubber) and oxy-acetylene (gas).

N. P. Akpan and Iwok (2017) In addition, I.A. did research on the use of linear programming for the best possible use of raw materials in bakeries. In order to maximize profits, he also employed the simplex method algorithm, a component of linear programming, to distribute raw materials among competing variables (large bread, huge loaf, and little loaf) in bakeries. Following the study, it was determined that 962 tiny loaves, 38 gigantic loaves, and 0 tremendous loaves ought to be made in that order in order to generate a profit of N20385. According to the evaluation, the small bread contributes more objectively to the profit than the big loaf. In order to maximize the profit, he arrived to the conclusion and suggested that more little loaves and large loaves be created and sold.

Additionally, Popoola and Susu (2015) conducted study on the use of linear programming to optimize the profits from the column used to distill crude oil at the Nigerian Port Harcourt Refinery. They used linear programming to examine crude oil distillation column profit optimization. Additionally, they collected actual data from a crude oil distillation column in operation of the Port Harcourt refinery in Nigeria in order to assess the created paradigm for linear programming developed in MATLAB. The limitations were scenarios where each crude oil fraction was considered to be the most valuable good, and the objective function was the difference between the earnings from the sale of crude oil fractions and the price of crude oil at varied flow rates. The MATLAB multi objective constrained linear programming efficiency tool box was used to solve the model equations. The highest profit was 15.71 106 per hour in Case 1 with a full flow rate of 243.5 m3/hr, where automotive gas oil was thought to be the most valuable product. The estimate was based on the assumption that the cost of purchasing crude oil was $75.18 per barrel (or 75,667.107/m3) and used a continuous flow rate of 708.4 m3/hr. The maximum profit comes from the maximum income of $36.28 106 per hour obtained from the sale of AGO since profit and income are often linearly and instantaneously related. In order to determine if the entire process is cost-effective, they came to the conclusion that operational costs necessary for refining crude oil into finished products should be taken into account.

In the context of the 2016 paper Optimizing Profit with the Linear Programming Model: Benedict I. Ezema and Uzochukwu Amakom's Focus on Golden Plastic Industry Limited, Enugu, Nigeria. Despite the fact that businesses at Emene Industrial Layout tend to utilize the error and trial approach more frequently, it was discovered in this study that linear programming, an operations research methodology, is frequently employed to find solutions to difficult managerial decision problems. This has made it difficult for businesses at the Layout to allocate their limited resources in a way that will guarantee profit maximization or cost minimization. This research was done to find and determine the best product combination for the layout of a successful company, Golden Plastic Industry Limited. The company's production issue was conceptualized and assessed as a linear programming issue. Only two diameters of the eight total "PVC" pipe sizes, according to the results, should be produced. The resulting raw material's unit contribution to the objective function (profits) was shown by the shadow pricing, which also give management guidance on what prices to use for purchase or sale.

Igweet al. (2011) claim that linear programming is a practical method for enhancing the efficacy of production planning, particularly for increasing agricultural productivity. They discovered this while conducting study on how to increase the revenue from light commercial farming in the Ohafia zone of Abia state. The amount of hectares a farmer devotes to agricultural production and the variety of crops or livestock he can raise are the criteria for making decisions in generic deterministic model. The goal of the general deterministic model is to find the optimal solutions through gross margin maximization. Choosing which enterprises to merge in order to maximize their income while making the greatest use of their limited resources is a continuing challenge for commercial farmers, according to Majeke (2013). He was aware of the agricultural industry's exponential increase in the application of linear programming, particularly in the optimization of farm resource availability to maximize income (profit). In rural areas, he developed a linear programming method that maximizes farmers' income. He identified the hectares allotted for soya bean production, the hectares for tobacco production, and the hectares for maize production conserved for family consumptions (i.e., five decision variables) as the model's decision variables. There were also six restrictions found.

Igbinehi et al. (2015) applied the linear programming model at a nearby soap manufacturer that makes three different kinds of soap: 5g white soap, 10g white soap, and 10g colored soap, to maximize profits. The data study shows that while the company makes more money from white soap than colorful soap, it spends more money on colored soap. The firm was instructed to create more white soap (5g and 10g) than colored soap in order to increase profits. Taha (2003) claims that differential calculus is necessary to maximize an objective function under constrained constant functions. . Taha's Karush-Kuhn-Tucker strategy for the structure of non-leaner programming is the best method for resolving optimization concerns with continuous functions that are subject to equality constraints when the limitations are continual and non-linear. It's called "classical optimization" to describe this. Numerous real-world studies have demonstrated the effectiveness of the linear programming technique for a range of optimization issues. For instance, Koji and Gunner (2002) demonstrate the effectiveness of linear programming in image reconstruction by locating and updating noisy pixels as well as making use of the v-trick to tangibly display the proportion of pixels that need to be restored. To create an automatic Tamil POS tagger in India, Dhanalakshm et al. (2009) using linear programming and an SVM approach that was based on it. Gerard (1986) demonstrated how to identify a multiphase system utilizing X-ray Powder Diffraction (XRO) and ideal point-counting approaches in his research "Quantitative Analysis of Mineral Mixtures Using Linear Programming."

For MIMO systems, Cui et al. (2006) also created an effective linear programming detector (LPD) to obtain astoundingly high special efficiencies in situations with abundant scattering. They used a high data-rate MIMO communication method that has many antennas at the transmitter and receiver. According to Balogun et al. (2012), the challenge in the manufacturing sectors is the management issue, since several enterprises must choose how to allocate finite resources including cash, raw materials, and employees. They were successful in applying it to identify the Coca-Cola Company's ideal production plan in their study titled "Use of linear programming for optimal production". Coke, Fanta, Schweppes, Fanta tonic, Krest soda, etc. have been selected as the decision variables during the development of a linear programming model for the production process, and the constraints were identified as the levels of the drinks, sugar content, water volume, and carbon (iv) oxide. .There could be up to nine decision variables in total. Only two of the nine products the company was producing—Fanta orange 50cl and Coke 50cl—contributed most to their objective of maximizing profit, with specified quantities of 462,547 and 415,593 and N263,497,283 respectively. The simplex algorithm was used to solve the model. Following data analysis, it was found that only two of the nine products the company was producing—Coke 50cl and Fanta orange 50cl—did. To avoid incurring exorbitant costs, they urge the company to focus on producing only these two items.

Despite the fact that many energy systems are non-linear, Milorad Snezanza and (2009) contend that (LP) is an essential tool for managing energy. They contend that by employing Taylor series expansion, the nonlinearity of many energy systems may be transformed into a linear form, enabling the application of the optimization method to determine the most efficient means of producing energy. According to VeliUlucan (2010), mixed integer linear programming is said to play a significant planning for aggregate production, also known as planning large-scale production, which deals with the issue of determining how many workers the company should keep as well as, for production companies, the volume and mix of items that will be produced. Veili argues that in order to satisfy the restrictions and the goal function, the integer programming's decision variables problem must be integers. It is necessary to further investigate and provide examples in underdeveloped countries like Zimbabwe, the linear programming model is used for commercial decision-making and profit maximization. based on the literature that was provided above, both theoretically and empirically. A noteworthy potential for such an application is the product combination chosen by Crunches Chicken and Golden Plastic Industries Limited, with headquarters in Emene Industrial Layout, Enugu, and South East of Nigeria. This study will not only demonstrate the uniqueness of using the LP approach for maximizing profits in the context of Zimbabwe, but it will also provide beneficial answers to the problems.

2.6.2 Historical Review

The history of how to solve the LP problem is not very old. Making the best choices in challenging circumstances is regarded as a revolutionary advance (Wiley & Sons, 2020). Lagrange made the first attempt to solve optimization problems with straightforward equality constraints in 1762 (Kanno, 2020). Gauss also figured out how to solve linear equations in 1820. The first person to publish a book on strategies for resolving networks of linear inequalities is thought to have been Jean-Baptiste Joseph Fourier (1768–1830), a French mathematician, in 1827 (Zwols, 2015). This was the first time an optimization problem had been attempted to be solved. Similar formulations of resource allocation issues using linear optimization were provided by the Soviet mathematician Leonid V. Kantorovich (1912–1986) in 1939, which were utilized in World War II to cut expenditures and improve the effectiveness of the army on the battlefield. In the interim, the linear optimization problem was also 0developed by American economist Tjalling C. Koopmans (1910–1985).

Similar to how George Stigler developed the nutrition problem in 1945, Frank Hitchcock developed the transportation problem in 1941 (Hill, 2016). Under the direction of George B. Dantzig, the U.S. Army put the optimization issue into actual practice during World War II to allocate resources efficiently. As a result, Kantorovich and Koopmans shared the 1975 Nobel Prize in economic sciences for their respective contributions. Dantzig also created the linear programming approach to address challenges in military logistics. The Simplex approach for resolving LP problems was created by American mathematician George Dantzig in 1951, following the creation of the digital computer in 1945 (Bill, 2015). Gerald Ford, who saw George Dantzig as the creator of LP issues, presented him with the National Medal of Science in 1976 for this accomplishment.

It was thought that the Simplex method offered a streamlined approach to solving linear programming issues. The computation became increasingly challenging when more variables were employed due to the exponential growth in the number of operations needed. The ellipsoid method was therefore a polynomial-time algorithm developed in 1979 by Soviet mathematician Leonid Khachiyan. When used in practice, this approach is seen as being more slowly than the Simplex approach. Similar to this, in 1984 Narendra Karmarkar, an Indian mathematician, created the interior point method, yet another polynomial-time method (Sinha, 2018). This approach was demonstrated to be competitive with the Simplex approach. The Interior Point Method 1968 was invented in 1968 by Fiacco and McCormick. Similar to this, Karmarkar used the Interior Method in 1984 to address linear programming issues.

In both the theoretical advancement and the practical implementations of the LP problem, gradual but significant progress was made. John von Neumann saw the importance of the idea of duality, and later Kuhn and Tucker made contributions to the theoretical growth of the duality theory, which is thought to have had the greatest influence on the creation of LP issues. The industrial applications of the LP problem have also been significantly influenced by the works of Charles and Cooper. In a similar vein, numerous more approaches to solve LP problems have been developed over time. In comparison to Dantzig's simplex algorithm at the time, Karmarkar's technique from 1984 was faster (Sharma, 2017). As a result, the development of various methods for solving LP problems contributed to the effective and efficient resolution of the method of determining decisions. In contrast, real methods for LP problems have been effectively used in a variety of fields, including civic, industrial, and educational.

The simplex algorithm for addressing the LP issue has been developed at a quicker rate thanks in part to the advancement of computers. Additionally, this promotes the rapid development of linear optimization issues in both theory and practice. Modern multiple variables and restrictions can be handled in linear optimization problems. Because to advances in computer software. For the majority of current quantitative decision-making in academia, industry, and the civil services, linear optimization problems are applied.

2.7 Chapter Summary

The researcher was helped in identifying a clear gap where fresh contributions may be made by the literature review chapter. The chapter provided a conceptual framework, understanding the meaning, consequences, types, and causes of profit margins, as well as an introduction to the basic ideas behind the issue under study. The chapter gives the researcher the opportunity to identify some gaps in the literature that must be filled in order to ensure adequate solutions to the current issues of causes related to low profit margins at baker's inn bread.

CHAPTER 3

METHODOLOGY

3.0 Introduction

The research methodology, which offers a framework for analyzing the use of linear programming in profit maximization, is the chapter's main topic. According to Coyle (2003), research technique is the theoretical examination of the practices and philosophies of a particular field of knowledge. This chapter focuses on the approach taken to address the goals and questions of the research. The study's framework, known as the research design, maximizes authority over elements that could affect whether the results are legitimate, will serve as the investigation's beginning point. To gather a wide range of data relevant to the research subject, both quantitative and qualitative research approaches are used. This chapter also examines the benefits and drawbacks of the data gathering techniques employed in the quest for empirical findings that meet the study's research goals. The simplex technique analysis operation research algorithm is also covered in this chapter.

3.1 Research Design

Taking measurements of the variables indicated in the research problem and analyzing the results makes up the study design. A strategy, layout, and method of examination that is thought of as a manner of acquiring answers to research questions, Bhattachayya and Kuma (2006)'s description of Kerlinger, is referred to as a research design. According to Best (1993), a study is conducted using a research design, which is a framework and structure. The study's descriptive methodology was employed to collect data based on the use of LP from the perspective of profit maximization.

3.1.2 Descriptive Research Design

Observing and describing a study topic or issue using a descriptive research design is done without changing or modifying the variables in any manner. The use of a descriptive design was chosen for this study due to its many advantages in helping to resolve the research challenge. Because it acknowledges the attitudes and viewpoints of a representative sample, the design appears more appropriate. More specifically, it entails the establishment of a connection between variables through the use of quantitative data. Comprehensive information can be gathered using the data collection, which can be either quantitative (in the form of surveys) or qualitative (in the form of observations or case studies). This enables the gathering and analysis of data to take a multidimensional approach. Descriptive research yields significant and rich amounts of data. The strategy offers a low-cost method of gathering data because the design makes the inquiry easier, faster, and more practical given that the research study would only require a small amount of resources. The method does have certain drawbacks, though, namely the inability to statistically assess the outcomes due to the absence of manipulated factors. Because of the study's very subjective data collecting, the findings cannot be verified again. For general advice and information on bakers Inn bread, quantitative data gathered from the most significant informants (statisticians) was employed.

3.2 Population and Sample

We can infer information about a population from a sample using statistical inference. Here, the Bakers Inn factory is presented as an example. There is only one Bakers Inn bread factory in Harare, and it has been automatically chosen to take part in this experiment. With the time limits and limited financial resources that were available for executing this study, it would have been difficult to collect data from every Bakers Inn factory in Zimbabwe, let alone analyze and understand enormous amounts of data. The methodologies used by the researcher led to the choice of such a sample size since they are perfect for resolving issues at Bakers Inn Bread. Additionally, choosing a big sample will lead to a complex analysis, increasing the possibility of error. On the other hand, the results would be more accurate the higher the sample size.

3.3 Sampling Techniques

According to Borg and Gall (1986), whenever it is impractical to investigate the complete group or take into account every one of its participants because of resource limitations, a sample is a group selected to serve as an extensive population, ten percent of the total population is typically the aim. Therefore, it is sampling process of choosing study subjects based on intended audience. To avoid the time and financial constraints involved with investigating a large population, the researcher chose a sample that is representative of the target population. Additionally, sampling allowed the researcher to combat accessibility and resource limitations. What is known as convenience sampling or purposeful sampling is this.

3.4 Research Instrument for data collection

In the words of Saunders et al. (2009), instruments for research are means utilized to carry out orderly data collecting. Data on bread making was gathered for the Bakers Inn database. For the literature study, theories, and foundational knowledge, the researcher studied a variety of textbooks. The researcher will gain access to a wide variety of current material by using the internet to access earlier work on the simplex approach.

3.5 Validity of research instrument

A frequent definition of validity is the extent to which an instrument truly measures what it claims to gauge [Blumberg et al., 2005]. A research tool's validity refers to the extent to which it captures the objectives for which it was designed (Robson, 2011). What counts is how objective the results are. The data was collected straight from the financial and manufacturing data source of Bakers Inn; thus it is reliable.

3.6 Data collection procedure

The researcher gathered information relevant to the research topic using secondary data. In order to put the necessary pieces of information together and accomplish the research goal, data collecting is crucial. The researcher requested information on the raw materials utilized over the time period in a letter. The information on each product's resource needs is gathered from the head office department. The financial data source for Bakers Inn Bread was used to gather the research capital needed for each input.

3.7 Data Analysis and Presentation Procedure

Data analysis is the method of transforming and using data modeling with the intention of detecting relationships that will support the findings of the study. According to Alexopoulos (2010), data analysis seeks to derive reliable information from unprocessed data. Displaying statistical data that has been evaluated makes it easier to understand trends. Data analysis, according to Kojo (2011), is a process for gathering and combining data in a way that makes sense and is simple to understand. The standard linear programming algorithm with n option variables as well as m constraints is represented by the following form.

Optimize (min or max) Z = $c1x1 + c2x2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. cnxn$

$s.t$

$a11x1 + a12x2\ldots\ldots\ldots\ldots\ldots\ldots\ldots. a1nxn$ (≤, =, ≥) $b1$

$a21x1+a22x2\ldots\ldots\ldots\ldots\ldots\ldots\ldots. a2nxn$ (≤, =, ≥) $b2$

.

.

.

.

$am1x1 + am2x2 + \ldots\ldots\ldots\ldots\ldots\ldots amnxn$ (≤, =, ≥) bm

Where$c1$, $c2$, ………………………. cn Represents the decision's per-unit cost

variables$x1$,$x2$,…………..xn to the value of objective function.

And $a11$, $a12$ ………. $a2n$……. amn is an indicator of the amount of resources required for every element of the decision variable.

bi Represent the entire range of the ith resource

Z reflect the performance metric, which in our instance is profit.

3.8 Ethical Consideration

The following ethical guidelines were set for the investigation's time frame:

1. Respect for and protection of students' rights were always upheld.

2. The researcher received approval from the personnel to use their actual names in the research report, and the study's research data stayed private at all times.

3.9 Simplex Method

When a search is conducted using the Simplex approach, the best basic viable solution (if one exists) is found by going over each basic feasible option in turn. The Simplex algorithm is another name for the Simplex method. An algorithm is a method that solves a class of problems iteratively. An algorithm's finiteness— the assurance that any issue instance in the specified class will have a solution in a limited number of iterations—is a desirable quality.

3.10 Hypotheses for the Simplex Method

Every variable, slack variables included, except objective z, must be ≥ 0. We are presented with a tableau with a workable common solution. We shall keep this all through our pivot.

3.11 Choosing a pivot

In the objective row, select a variable that is not basic and has an adverse coefficient. The entering variable will be this.

If there are no more than one possible entering variables, we stop: the tableau is ideal the most minus coefficient rule states that if there are multiple candidates, pick the one with the highest negative coefficient, even though there are alternative possibilities. c) If there is a tie for the most adverse, we shall select the candidate to the left of the center.

Calculate the ratio for each entry in the column of the entering variable that is positive. Right-side entrance Ratio of the incoming variable the smallest ratio should be used. For the row in which this occurs, the basic variable is the leaving variable.

Stop: the problem is unbounded if no ratios need to be calculated since every entry in the column for the entering variable is 0 or negative.

In the event of a tie for the least ratio, the position higher in the tableau shall be chosen.

3.12 Pivoting

The row and column in the tableau that are in the pivot are known as the pivot entry, which are the row and column, respectively, the leaving and incoming variables serve as labels.

The pivot row divided by the pivot entry.

Multiply each subsequent row by the proper multiple of the pivot row in order to remove the item for that row from the pivot column.

Change the pivot row's label to reflect the entering variable.

Go back to step 1.

3.13 Chapter Summary

The research approach served as a guideline for future research because this chapter gives a clear description of the research steps, strategies, and tools used in the study. The recommendations made by earlier research, which were presented in the second chapter, guided the chapter's organization. The chapters' highlights include research methodology, tools, and data sources for statistical analysis. This chapter also covered data evaluation methods, such as the statistical program selected to generate both inferential and descriptive output, which forms the basis for addressing the study's objectives. The chapter covered data analysis procedures as well as models that the investigator used to provide information from secondary sources that has been inferred and described. The research method prepares the reader for the discussion, data display, and result analysis that will take place in the next chapter before the conclusion, conclusions, and research recommendations in the final chapter.

CHAPTER 4: DATA PRESENTATION & DISCUSSION

4.0 Introduction

After taking a broad picture of the method, the previous chapter concentrated on its components. This chapter presents the research findings, analysis of data, presentation, and findings explanation. The details provided cover the response rate, demographic information about the respondents, and a comparison of the findings to each individual study objective. The responses to the questions in the surveys and interviews that were conducted formed the basis for the data analysis and presentation. The results of this study are also examined using descriptive statistics.

4.1 Data Presentation and Analysis

Backers Inn's Bakery division manufactures Bread in four sizes: big, short-long, medium, and small. Ingredients for the dough for each size of bread include Butter, water, yeast, sugar, salt, flour, a substance that oxidizes, and an improved. The pastry dough is cooked in an electrically powered oven at a temperature of 200 for a crisp bread exterior before being lowered to 150°C. Each unit of bread size produced by the bakery changes, the manager claims, and is ostensibly determined by the previous day's market. Now, based on information gathered from a discussion with the firm’s staff management and a participant in its production crew in the first week of May 2023, the product mix will be decided.

Table 1: Estimated daily output capacity for the bakery

Bread Size	Dough input (kg)	Chamber capacity (in layers i.e. l1,l2,l3)	Production output (Cups)
Small	150	200	600
Medium	240	130	390
Short Long	340	110	330
Large	600	100	300

The total number of cooked bread cups was divided by the amount of dough that was used in an effort to calculate the amount of dough necessary to produce a unit of each bread size. The outcome is tallied together with the baking time (per cup), the typical resource availability, and the revenue per cup size unit.

Table 2: Resources available per unit of production

Bread Size	Dough input (kg)	Baking time (Min)	Profit ($)
Small	0.25	5	10
Medium	0.62	8	20
Short Long	1.03	8	30
Long	2	10	50
Available Resources	175	30	

Now, the linear programming paradigm is as follows:

$$Maximize: Z = 10x_1 + 20x_2 + 30x_3 + 50x_4 \quad (1)$$

$$Subject\ to: 0.25x_1 + 0.62x_2 + 1.03x_3 + 2x_4 \leq 175 \quad 2$$

$$5x_1 + 8x_2 + 8x_3 + 10x_4 \leq 30 \quad 3$$

$$With\ x_1 \geq 0,\ x_2 \geq 0,\ x_3 \geq 0\ and,\ x_4 \geq 0$$

For all non-negative conditions

The inequalities become equal when the slack variables are added to the objective function above, and may thus be expressed as follows:

$$Maximize: Z = 10x_1 + 20x_2 + 30x_3 + 50x_4 + 0s_1 + 0s_2 \quad 4$$

$$Subject\ to: 0.25x_1 + 0.62x_2 + 1.03x_3 + 2x_4 + s_1 = 175 \quad 5$$

$$5x_1 + 8x_2 + 8x_3 + 10x_4\ s_2 = 30 \quad 6$$

$$With\ x_1 \geq 0,\ x_2 \geq 0,\ x_3 \geq 0\ and,\ x_4 \geq 0$$

$$s_1 \geq 0\ and\ s_2 \geq 0$$

It is built out below in an initial simplex tableau.

Table 3: Initial Solution

B	**X_1**	**X_2**	**X_3**	**X_4**	**S_1**	**S_2**	**X_s**
S_1	0.25	0.62	1.03	2	1	0	175
S_2	5	8	2	10	0	1	30
$C_J – Z_J$	-10	-20	-30	-50	0	0	

The net profit per unit attained by introducing one unit of a particular variable into the solution 1 is shown in the bottom (Cj - Zj) row of table 4.3.

4.2 Pivoting

The most (least) negative entry in table 3's (Cj-Zj) row, x_4, serves as the key column. A ratio test is run as follows to determine the key row:

$\theta_1 = 175/2 = 87.5$

$\theta_2 = 30/10 = 3$

Since S_2 is the least positive of the aforementioned numbers, it is the key row. In order to create a new table, the pivotal entry is now situated at the intersection of the leaving variable row and the incoming variable column. Next, use the essential element for removal to reach zero. Thus, by adding x_4 to the solution and eliminating the S_2 variable, now (old) R2, we produce a new simplex table. Table 4 is produced by doing the row procedure below.

(New)R_1: $R_1 - 2NR_2$

(New)R_2: $R_2 \times 1/10$

(New)R_3: $R_3 + 50NR_2$

Table 4: First Iteration

B	**X_1**	**X_2**	**X_3**	**X_4**	**S_1**	**S_2**	**X_s**
S_1	-0.75	-0.95	-0.57	0	1	0.2	169
X_4	0.5	0.8	0.8	1	0	0.1	3
$C_J – Z_J$	15	20	10	0	0	5	150

Since there isn't a negative item in the variables column of the (Cj - Zj) row of table 4. This is the instance of the best option, therefore. We have the following from the table's (X_B) column: $X_4 = 3$, $x_1 = x_2 = x_3 = 0$ $S_1 = 169$, $S_2 = 0$, and 150 is Z's highest possible value.

4.3 Results

The simplex approach previously mentioned accustomed to solve the LP model, and the best result is displayed in Table 4. As a result, we can conclude that the creation of three huge Kings Advances in Mathematical & Computational Sciences Journal, Bread units will result in an objective value contribution of $150 USD with an objective coefficient of $50 USD. Sensitivity Analysis is required because the finding is not substantial enough to support a legitimate conclusion.

4.4 Application of Sensitivity Analysis

Approximations are utilized when reality is described by a mathematical model. The complexity of the real world exceeds the complexity of the optimization issues we can currently tackle. Typically, linearity assumptions are close approximations. Since one cannot be certain of the data being entered into the model, another significant approximation is necessary. Additionally, data may alter. Sensitivity analysis is a methodical investigation into the degree of sensitivity of solutions to (minor) changes in the data. Sensitivity analysis, in other words, focuses on determining how much we can alter the input data while maintaining relatively constant results from our linear programming model.

The main goal is to be able to respond to queries of the following type:

1. How does the solution alter if the objective function coefficient changes?

2. How does the solution alter if the resources that are accessible vary?

3. How does the answer alter if a constraint is introduced to the issue?

In order to address issue (1) for the sake of this study, we will examine what transpires when one of the difficulties changes.

4.4.1 Changing the Objective function coefficient

We vary the coefficient of the objective function in this case while keeping the restrictions constant, but objective function only contains one coefficient. We take into account the previously developed LP model, whose answer is, $x_1 = x_2 = x_3 = 0$ and $x_4 = 3$, and $Z = 150$. The pertinent non-basic variables from this answer are x_1, x_2, x_3

Now let's think about what would happen to the answer if the value of a non-basic variable's coefficient decreased. For instance, suppose the goal function's coefficient of x3 was changed from 30 to 25. Consequently, the objective function is:

Maximize: $Z = 10x_1 + 20x_2 + 25x_3 + 50x_4$ …………………………………… (3)

The answer that stays the same. We analyze the following scenarios below:

Case 1What happens to the answer if the non-basic variable's coefficient is increased?

In theory, increasing it a little shouldn't make a difference, but increasing the coefficient significantly might cause a change in the value of x that makes $x_3 > 0$. Therefore, it is anticipated that the solution for a non-basic variable will hold true for a range of coefficient values (let's say 5 to 15). The answer might alter if the coefficient rises by a significant amount (let's say by 20).

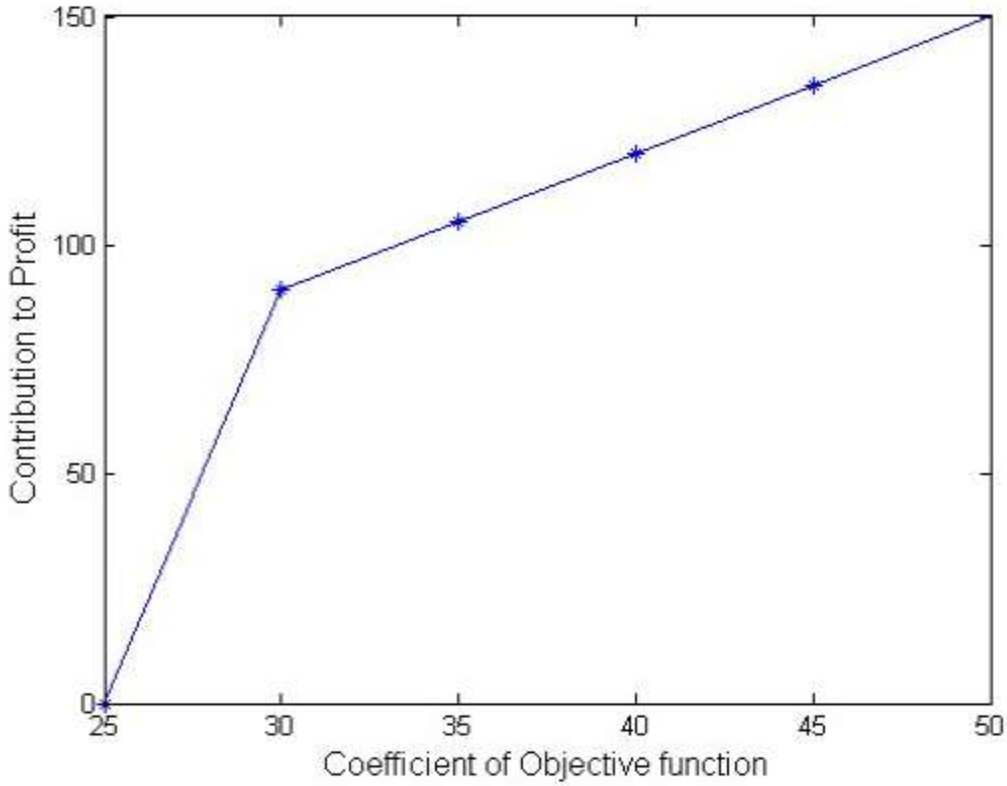


Figure 1: Solution modifications caused by a rise in the non-basic variable

Case 2: What happens to the answer if the fundamental variable's coefficient falls?

The previous circumstance is not at all like this one. The modification reduces the variable's contribution to profit. It is anticipated that a significant enough reduction will alter the solution. For instance, suppose the goal function of the model's formulation's x_4 coefficient was 30 rather than 50. Consequently, the objective function is:

Maximize: $Z = 10x_1 + 20x_2 + 30x_3 + 30x_4$ …………………………………… (4)

It may (may require) that we set $x_4 = 0$ instead of $x_4 = 3$. On the other hand, the solution would normally not change if the objective function coefficient of x_4 were reduced somewhat (say, by 5 to 15). Contrary to the non-basic variable, such a modification will have a detrimental effect on the objective function's value. Plugging x into the objective function yields the result; if $x_4 = 3$, the coefficient of x_4 decreases from 150 to 90 (presuming the solution doesn't change).

The arguments above make it clear that if a fundamental variable's coefficient increases, its value also increases and we can continue to utilize the variable. Since the value of the problem changes every time the coefficient of the basic variable is modified, it makes intuitive sense that there ought to exist a range of numbers for the coefficient of the objective function (a range that includes the initial value(in which the problem's answer remains the same). The answer will alter outside of this range.

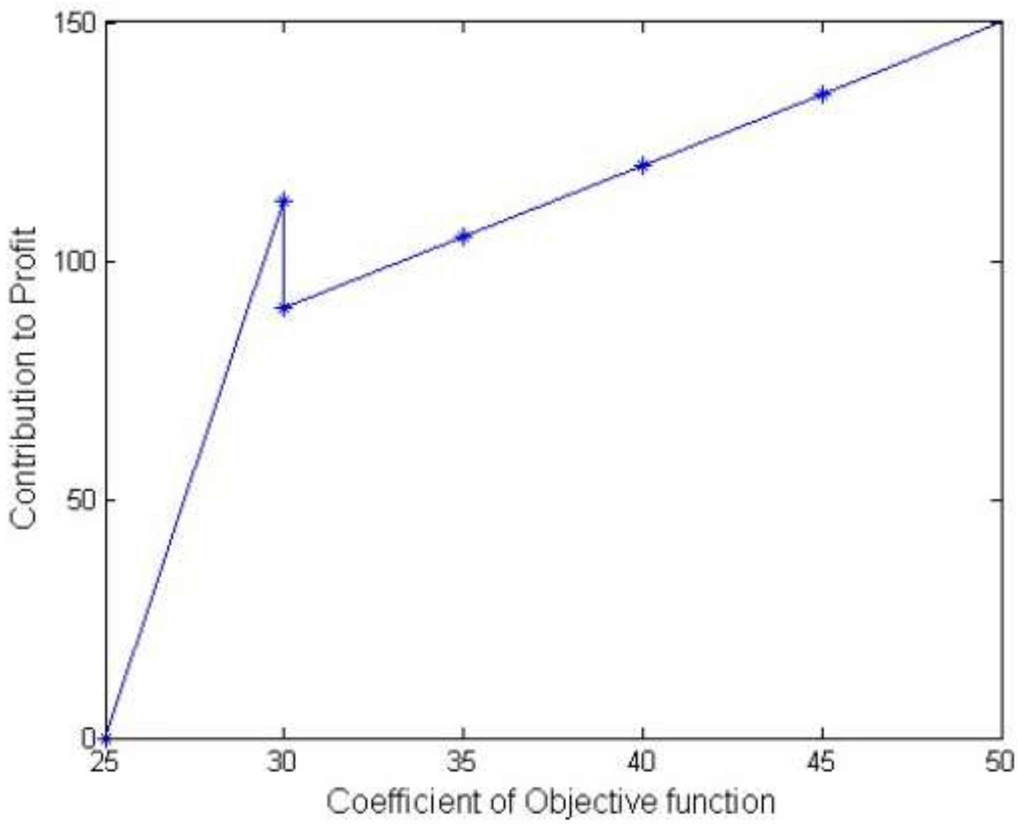


Figure 2: changes in the solution caused by a drop in the basic variable

We now know how much a change in the input data affects the best solution, thanks to the sensitivity analysis that was done. And the coefficient of x_4 must stay within the range of 50 to 30 for the best solution to remain essentially constant. Otherwise, it will make no contribution to profit. So altering the best course of action so that $x1 = x2 = x4 = 0$, $x3 = 3.75$, and $Z = 112.5$.

4.5 Conclusion

Over any other known theory of profit maximization, this work has been successful in giving more insight into the financial viability of applying linear programming techniques in manufacturing. Based on the information acquired from the company, it was determined that the manufacture of bread must be limited to three units in order for the business to make the most money. It guarantees an objective value contribution of $150 USD, as compared to the initial (total) commitment of $110 USD. The sensitivity analysis also revealed the range of input parameter changes at which the ideal solution changes.

Chapter 5: Summary, Conclusions & Recommendations

5.0 Introduction

The study's executive summary, conclusions, and recommendations regarding the use of linear programming techniques to enhance profit maximization are all included in this chapter. The summary of the study is offered first, then the conclusion and policy recommendations. This chapter will focus on the issues that the researcher has identified as needing more investigation.

5.1 Summaries

5.1.1 Summary on Objective 1

The objective of this study was to use the data that was gathered to build a linear programming model for the manufacturing of Bakers Inn Bread. Quantities required to solve the problem were chosen as the first stage in creating a linear programming problem. The decision variables are those. What the problem's restrictions are was decided in the second stage. For instance, a decision variable may have a maximum or lowest value it can take, or there may be a link between two choice variables. The third stage was chosen based on the goal that needed to be accomplished. Which quantity needed to be optimized—its minimization or maximization? The function of the choice variables is optimized to provide the objective function.

5.1.2 Summary on Objective 2

The most appropriate response to the model's formulation was explored in the second objective. A viable solution is a group of values for the decision variables that satisfy each and every constraint in the Solver model. In some situations, the problem may be in coming up with a practical solution; in others, a workable solution may already be recognized. An acceptable solution is said to be optimal when the goal function reaches its highest (or lowest) value, such as the highest profit or the lowest cost. The solution is deemed to be globally optimal if no practical alternatives exist with better objective function values. The objective function and/or the constraints may produce a position at the "peak" or the "bottom" of a "valley" that corresponds to a locally optimal solution.

If there are no other potential solutions "close by" that have superior objective function values, the solution is said to be locally optimum. The simplex algorithm must be used in the study to archive the model's ideal solution.

5.1.3 Summary on Objective 3

The third goal relates to the way to formulate a strategy that will give the business the best possible returns. One of the best methods to minimize risk and increase profits is to diversify your investing portfolio. You can lessen the effects of any individual investment that doesn't perform as well as anticipated by diversifying your holdings. The simplex approach and linear programming were used in this study as a strategy to increase returns on investments, which in turn led to higher pricing or more sales and revenues. Your return was improved by a rise in sales and revenues without an increase in costs, or by an increase in costs that only resulted in a net increase in profits.

5.1.4 Summary on Objective 4

The third goal is to determine a strategy that will give the business the best possible return. One of the best methods to minimize risk and increase profits is to diversify your investing portfolio. You can lessen the effects of any individual investment that doesn't perform as well as anticipated by diversifying your holdings. The simplex approach was used in this study together with linear programming as a strategy to increase returns on investments, which in turn led to higher pricing or more sales and revenues. Your return was improved by a rise in sales and revenues without an increase in costs, or by an increase in costs that only resulted in a net increase in profits.

5.2 Conclusions

According to the analysis of the data used in this research study and the findings, Bakers Inn Bakery should produce all three types of bread (small loaf, big loaf, and medium size) in order to satisfy its customers. Additionally, larger loaves should be made because they add to the company's profit and can be manufactured to maximize raw materials and achieve maximum profit. The study's findings also indicate that the company can maximize its raw material use with its current resources by creating a large number of large loaves of bread and ceasing production of smaller loaves in order to maximize profit. Additionally, production managers should use linear programming techniques in their production planning as this will boost overall profitability and increase firm performance by maximizing the use of scarce raw materials. The study also shows that profit maximization is more important for production organizations to pursue than raw material optimization alone because it will benefit the business more. The study comes to the conclusion that a manufacturing organization can effectively employ linear programming to maximize the utilization of the raw materials they have on hand.

5.3 Recommendations

In light of the findings, the pursuing suggestions are made;

1. In order to maximize their use of raw materials, bakery management should understand how to apply linear programming techniques.
2. Bakery management should use an analytical and scientific approach when making choices as opposed to depending on intuition and experience.
3. In order for other production/manufacturing enterprises to effectively use their available raw materials, they should embrace linear programming.

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