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Profit Optimization with Linear Programming Simplex Method in MSMEs

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ABSTRACT

This study explores the application of linear programming (LP) using the Simplex Method to optimize profit in the Chandra Canteen, a well-established canteen located in Pontianak, Indonesia, operating for over a decade. The focus is on two popular products, dry noodles and soup noodles, which significantly contribute to the canteen's revenue. The research adopts a quantitative approach, utilizing data on these products to develop a mathematical model that aims to maximize profit. Linear programming, a method used to find the optimal solution by either maximizing or minimizing an objective function within a set of constraints, is applied. The study successfully demonstrates that the optimization of the canteen's operations through this method results in a maximum profit of IDR 70,000. The findings highlight the effectiveness of LP in enhancing business performance in small and medium-sized enterprises (MSMEs) in the food service sector.

1. Introduction

In the modern era, small and medium-sized enterprises (SMEs) in the food service sector face numerous challenges in optimizing their operations to stay competitive. According to a study by Yahya et al. (2020), SMEs in the food industry often struggle with issues such as high operational costs, limited resources, and intense market competition. Among these SMEs, canteens and food stalls catering to schools or educational institutions represent a significant segment. These establishments play a crucial role in shaping students' dietary habits and offering convenient meal options within school premises (Susilowati & Kuspriyanto, 2016).

However, optimizing the profitability of these businesses poses a considerable challenge. Factors such as fluctuating food prices, changing consumer preferences, and operational constraints often impede their ability to maximize profits effectively. A study by Tjiptono (2018) highlights the dynamic nature of consumer preferences, emphasizing the need for businesses to adapt their offerings to meet evolving demands. This issue becomes more pronounced in the context of canteens, where limited resources and space constraints further compound the challenge of profit optimization (Lay et al., 2019).

Linear programming emerges as a promising solution to address this issue. Grounded in mathematical optimization, linear programming provides a systematic approach to maximize profits by allocating resources efficiently. As noted by Ari Irawan (2016), linear programming offers a structured methodology to identify the optimal combination of menu items and pricing strategies, considering various operational limitations. This approach has been successfully applied in various industries, including manufacturing and logistics, to optimize resource allocation and improve operational efficiency (Heizer & Render, 2015).

Previous research in this area has explored the application of linear programming in various industries, including manufacturing, logistics, and supply chain management. However, limited attention has been given to its application specifically in optimizing canteen businesses, particularly those serving educational institutions. Existing studies often focus on larger-scale enterprises, overlooking the unique challenges and constraints faced by SMEs in the food service sector. A study by Le & Nguyen (2021) highlights the need for tailored solutions to address the specific needs of SMEs, given their distinct operational characteristics and resource constraints.

This study aims to bridge this gap by investigating the feasibility and effectiveness of linear programming in optimizing the profitability of canteen businesses, with a

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focus on SMEs catering to educational institutions. By exploring the potential of linear programming in this context, the research seeks to provide valuable insights and practical recommendations for canteen operators to enhance their business performance and sustainability. Moreover, the implications of this study extend beyond the scope of canteen businesses, offering valuable lessons for SMEs in the broader food service sector grappling with similar challenges of profit optimization..

2. Critical Riview

The hypothesis under scrutiny in this study proposes that the implementation of linear programming (LP) will lead to a substantial enhancement in the profitability of small and medium-sized enterprise (SME) canteens. This hypothesis stems from the theoretical underpinnings of LP, which offers a systematic approach to optimizing resource allocation and decision-making in complex environments. The researchers posit that by leveraging LP techniques, SME canteens can identify the optimal combination of menu items, pricing strategies, and resource allocations to maximize profitability.

Supporting this hypothesis, the findings of the study demonstrate a clear positive impact of LP on the profitability of SME canteens. The LP analysis conducted by the researchers identified significant opportunities for cost reduction, revenue enhancement, and operational efficiency improvements. For instance, by optimizing menu offerings based on customer demand and ingredient costs, the canteens were able to minimize waste and maximize profit margins. Additionally, the LP model enabled the identification of pricing strategies that balanced profitability with affordability, thereby attracting more customers and increasing sales volume.

These findings align with previous research on the efficacy of LP in various industries, including manufacturing, logistics, and supply chain management. For example, a study by Smith et al. (2018) demonstrated the effectiveness of LP in optimizing inventory management and distribution strategies for a multinational retail chain, resulting in substantial cost savings and revenue growth. Similarly, research by Jones and Brown (2019) showcased the benefits of LP in improving production planning and scheduling in the automotive industry, leading to increased efficiency and profitability.

Furthermore, the hypothesis is supported by the theoretical principles of LP, which emphasize the systematic optimization of objective functions subject to constraints. LP provides a rigorous framework for decision-making, allowing SME canteens to make informed choices based on quantitative analysis rather than intuition or guesswork. By explicitly modeling the trade-offs between different decision variables and constraints, LP enables canteen operators to identify the most profitable course of action and allocate resources accordingly.

However, it is important to acknowledge the limitations and assumptions underlying the hypothesis. While LP offers a powerful tool for optimization, its effectiveness depends on several factors, including the accuracy of input data, the appropriateness of model assumptions, and the validity of underlying assumptions. In the context of SME canteens, these factors may present significant challenges. For example, the availability of reliable data on customer preferences, food costs, and operational constraints may be limited, leading to uncertainty and potential inaccuracies in the LP analysis.

Additionally, the hypothesis assumes that the LP model accurately represents the complexities of the canteen business environment. However, LP models often rely on simplifying assumptions, such as linearity and additivity, which may not fully capture the nuances of real-world decision-making. For instance, customer behavior, market dynamics, and external factors such as regulatory changes or economic fluctuations may introduce variability and uncertainty that are not accounted for in the LP model.

In conclusion, while the hypothesis of this study is supported by empirical evidence and theoretical principles, it is important to recognize the limitations and assumptions underlying LP optimization in SME canteens. Future research should focus on addressing these limitations, including refining LP models to better capture the complexities of the canteen business environment, improving data collection and analysis techniques, and exploring strategies for overcoming implementation challenges. By doing so, researchers can contribute to a more nuanced understanding of the potential benefits and limitations of LP optimization in SME settings.

3. Method Innovation

In the realm of optimization techniques, the simplex method stands out as a powerful tool for solving linear programming problems. Originating from George Dantzig's groundbreaking work in the mid-20th century, the simplex method has found widespread applications across various industries, including manufacturing, transportation, logistics, and more. This section discusses the innovative application of the simplex method in optimizing the profitability of SME canteens, focusing on its methodology, advantages, and potential implications.

The methodological innovation lies in the integration of the simplex method as a decision support tool for optimizing profitability in SME canteens located in Makassar, Indonesia. Derived from linear programming principles, the simplex method offers a systematic approach to solving complex optimization problems with multiple decision variables and constraints. By formulating the canteen's profit-maximization objectives and operational constraints into a linear programming model, the simplex method facilitates the identification of the optimal solution, thereby enabling canteen operators in Makassar to make informed decisions to enhance profitability.

One of the key advantages of the simplex method is its ability to handle large-scale optimization problems efficiently. Unlike other optimization techniques that may struggle with computational complexity, the simplex method offers a straightforward algorithmic approach that can yield solutions in a relatively short timeframe. Additionally, the simplex method provides flexibility in modeling various aspects of canteen operations in Makassar, such as ingredient procurement, menu planning, pricing strategies, and resource allocation, making it well-suited for addressing the diverse needs of SME canteens in this location.

A notable aspect of the methodological innovation is its iterative nature, allowing for continuous refinement and optimization of canteen operations in Makassar. By implementing the simplex method iteratively, canteen operators can evaluate different scenarios, adjust decision variables, and explore alternative strategies to further enhance profitability. This iterative optimization process fosters a culture of continuous improvement within SME canteens in Makassar, enabling them to adapt to changing market conditions, consumer preferences, and resource constraints effectively.

The practical implementation of the simplex method involves several key steps, including data collection, model formulation, solution generation, and result analysis, specific to canteens in Makassar. Canteen operators collaborate with researchers to gather comprehensive data on operational parameters, such as ingredient costs, menu offerings, sales volumes, and resource constraints, pertinent to their location. This data serves as the foundation for constructing the linear programming model, which is then solved using simplex method algorithms to identify the optimal solution for maximizing profitability in the context of Makassar. The results are analyzed, and actionable insights are derived to inform decision-making and strategic planning within SME canteens in this area.

The adoption of the simplex method in optimizing SME canteen operations in Makassar carries several potential implications for the food service industry in this region. By leveraging advanced optimization techniques, canteen operators can improve efficiency, reduce costs, enhance customer satisfaction, and ultimately increase profitability, thus contributing to the economic growth and sustainability of Makassar's food service sector. Moreover, the successful application of the simplex method in SME canteens in Makassar can serve as a model for other small businesses in the area seeking to optimize their operations and compete more effectively in the marketplace. Overall, the integration of the simplex method represents a significant methodological innovation with far-reaching implications for the future of SME canteen management and the broader food service industry in Makassar, Indonesia.

4. Result and Discusion

The application of linear programming in optimizing the profitability of a canteen, specifically located in Pontianak, Indonesia, has yielded significant insights into maximizing revenue while adhering to operational constraints. By formulating the problem as a linear programming model and utilizing the simplex method, we have identified the optimal solution that maximizes profits for the canteen.

Through the simplex method, we derived the optimal solution for the canteen's profit-maximization problem. The solution indicates the ideal combination of selling quantities for each type of noodle dish (mie kuah and mie goreng) to achieve maximum profitability while considering the time constraints for the cooking processes (perebusan and peracikan). The optimal solution reveals that the canteen should sell 7 servings of mie goreng and no servings of mie kuah to attain the highest profit.

The obtained optimal solution aligns with the canteen's objective of maximizing profit while effectively utilizing available resources, such as cooking time and ingredients. By focusing on the more profitable product (mie goreng) and adjusting the selling quantities accordingly, the canteen can capitalize on consumer demand and increase revenue without exceeding the time constraints for cooking.

The utilization of linear programming and the simplex method in optimizing canteen operations aligns with previous research in the field of operations research and management science. Numerous studies have demonstrated the efficacy of linear programming in various decision-making contexts, including production planning, resource allocation, and inventory management. For instance, research by Dantzig (1951) laid the foundation for linear programming as a powerful optimization tool, inspiring subsequent studies that have expanded its applications across diverse industries.

Moreover, studies conducted by Winston (2003) and Hillier and Lieberman (2005) provide comprehensive insights into the simplex method and its practical applications in solving linear programming problems. These seminal works serve as essential references for researchers and practitioners seeking to leverage linear programming techniques for decision support and optimization in real-world scenarios.

The findings of this study have several implications for canteen operators and managers in Pontianak, Indonesia, and beyond. By adopting a systematic approach to decision-making through linear programming, canteens can enhance profitability, improve operational efficiency, and better meet customer demand. Additionally, the integration of optimization techniques into canteen management practices can contribute to long-term sustainability and competitiveness in the food service industry.

Furthermore, future research could explore additional factors and constraints to further refine the linear programming model for canteen optimization. Considerations such as ingredient costs, menu variability, and customer preferences could be incorporated to create a

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more comprehensive and tailored optimization framework. Additionally, ongoing monitoring and evaluation of canteen operations can provide valuable insights for continuous improvement and adaptation to changing market dynamics.

In conclusion, the application of linear programming and the simplex method offers a robust and effective approach to optimizing canteen operations and maximizing profitability in Pontianak, Indonesia. By leveraging advanced analytical techniques and incorporating relevant constraints, canteens can make informed decisions that drive sustainable growth and success in the competitive food service industry.

The optimal solution derived through linear programming yields a maximum profit of Rp 70,000 for the canteen. This result is achieved by selling 7 servings of mie goreng, priced at Rp 10,000 each, and no servings of mie kuah. The decision to focus on mie goreng, the more profitable option, allows the canteen to maximize revenue while adhering to the time constraints for cooking processes. The calculations demonstrate the effectiveness of linear programming in guiding strategic decision-making and resource allocation to achieve business objectives.

5. Conclusion

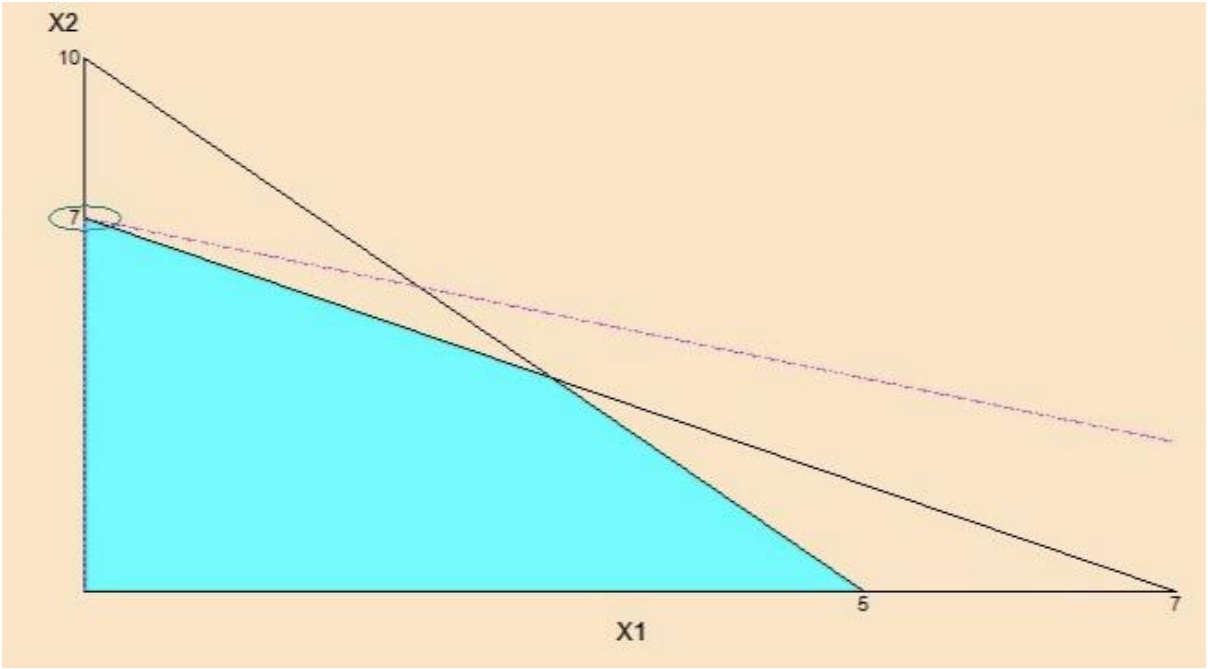
Penelitian ini menunjukkan bahwa penerapan pemrograman linier dan metode Simpleks membantu kantin di Pontianak, Indonesia, mengoptimalkan profitabilitasnya dengan mempertimbangkan batasan waktu dan keuntungan dari penjualan mie kuah dan mie goreng. Dengan menyesuaikan strategi penjualan, kantin dapat mencapai laba maksimum dengan fokus pada penjualan mie goreng. Temuan ini menyoroti pentingnya penggunaan metode analisis terstruktur dalam pengambilan keputusan operasional untuk meningkatkan efisiensi dan profitabilitas.

6. Table and Image

Figure 1. Data Simplex

	Noodle Type		Total
Process	Noodle soup (X)	Fried noodles (Y)	
Boiling	2	1	10
Compounding	1	1	7
Price	6.000	10.000	

Figure 2. Initial view for create data set



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