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Unleashing the Flavor: Strategies for Maximizing Profits in Fish Meatball (Bakso Ikan) Ventures

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A R T I C L E I N F O

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A B S T R A C T

This study focuses on optimizing the profit of selling fish balls and fish ball crackers through linear programming. Specifically, it targets aiding Ahan Fish Ball business in understanding the calculation to attain maximum benefits by determining the precise formula for production planning. Utilizing the simplex method within linear programming, the study aims to provide Ahan Fish Ball with an optimal solution by maximizing the objective function within a set of constraints. Data sourced from one-day observations of Ahan Fish Ball in Pontianak reveals three best-selling variants: plain fish ball, salted egg fish ball, and bitter melon stuffed fish ball. Through linear program solver, the optimal calculation suggests producing 1.95 or 2 salted egg fish balls per day to achieve maximum profit. This research offers insights into enhancing profitability for Ahan Fish Ball by leveraging linear programming techniques to determine the optimal production mix among their top-selling menu items.

1. Introduction

Fish, as one of the primary sources of animal protein, is a perishable commodity due to the rapid onset of spoilage caused by bacterial activity and enzymatic reactions within the fish's body (Widyaningsih & Martini, 2006). To mitigate spoilage and ensure fish quality, proper handling and processing techniques are essential along the food supply chain. These processes aim to preserve fish quality by inhibiting and preventing factors leading to quality deterioration and spoilage, thereby ensuring that fish remain suitable for consumption until reaching consumers (Andarwulan et al., 2011).

Bakso, a beloved food among the Indonesian populace, is classified as ready-to-eat cuisine (Wibowo, 1995). High-quality bakso can be crafted without the addition of any chemical additives, composed of primary ingredients and additives.

In essence, every business's objective is to seek profit (Indrayati in Abriani et al., 2020). Profit optimization is a primary goal in any business endeavor. The simplex method is employed to maximize profit while utilizing resources as effectively and efficiently as possible. This study employs the simplex method to seek optimal profit by utilizing resources effectively and efficiently. It aims to demonstrate the utility of the simplex method for Ahan Fish Ball businesses. Through the application of mathematical frameworks using the simplex method, this study endeavors to precisely identify the crucial determinants influencing the profit of fish ball businesses, including but not limited to raw material costs and selling prices, production capacity, and other pertinent variables. Moreover, a comprehensive examination of challenges hindering the ability of fish ball entrepreneurs to optimize profit, such as raw material scarcity and market demand based on production capacity, must be considered in this research. The ultimate goal is to design a mathematical model capable of providing an optimal business management solution prioritizing profit maximization, aligning with the significant potential observed in the culinary sector in Indonesia as part of the burgeoning MSME landscape, primarily serving primary needs, predominantly consisting of small or medium-sized enterprises typically managed by individuals or small groups.

Optimization, according to Esther et al. (2013:464), entails achieving the best possible state, directing towards maximum and minimum limits, aiming for optimal problem-solving solutions, either maximizing profits or minimizing production costs. Companies expect the best outcomes with limited resources; however, addressing problems with optimization techniques seldom yields the best solution due to various constraints beyond the company's reach (Herjanto, 2008:43).

According to Yulia Yudihartanti (2006), the simplex method is a technique for solving linear programming problems through algebraic procedures and using simplex tables. By utilizing these two methods and comparing them, it is hoped that one systematic approach can easily trace any errors that may occur from the beginning to the end of the calculation process to avoid suboptimal solutions. The simplex method is an advanced technique compared to the graphical method. The graphical method cannot solve management issues with a considerable number of decision variables, thus necessitating a more complex method, such as computer programming or using the simplex method. In practice, computer use is more efficient, but the basic method used in computer operations remains the simplex method.

The simplex method is employed to solve linear programming problems with more than two decision variables. It is one of the solutions to linear programming, iteratively determining the optimal solution by identifying feasible points towards the objective (Afni Rizqi Anti1, Ajat Sudrajat,2021). In the simplex method, one result is obtained gradually from one possible arrangement of basic solutions to the next. At each point, an optimal solution is sought (Valinov, 2018).

Further discussion regarding our focal topic, fish balls, reveals them as a popular food in Indonesia, made from processed fish meat formed into small balls. Fish balls offer several advantages over beef balls, such as higher protein content, comprising at least 50% mackerel fish meat mixed with spices and offering various fillings, including salted egg fish balls, bitter melon stuffed fish balls, fish balls wrapped in tofu, seaweed fish balls, among others.

Micro, Small, and Medium Enterprises (MSMEs) play a crucial role in enhancing and sustaining community economic growth. Their resilience is evident in their ability to withstand various economic circumstances to achieve community welfare. During the 1998 monetary crisis, while many large enterprises faltered, MSMEs persevered and even increased in number, showcasing their substantial contribution to a country's economic backbone, making them highly valued for their vital role in economic development and prosperity (Salman Al Farisi, Muhammad Iqbal Fasa, Suharto, 2022). The classification of MSMEs is based on annual revenue turnover, asset wealth, and the number of employees. Ahan Fish Ball is an MSME focusing on the production and sale of fish balls. In recent years, this MSME has gained popularity by offering a wider variety of flavors and improved quality. Additionally, Ahan Fish Ball has established several branches across Pontianak city. In efforts to enhance profitability, Ahan Fish Ball has employed the simplex method for revenue optimization. The simplex method is a linear programming technique used to find optimum solutions in decision-making problems involving unlimited variables and constants. By utilizing the simplex method, MSMEs can determine the optimal production combinations to achieve maximum profit. In striving to boost and enhance the success of Ahan Fish Ball, which has increased its popularity by offering various flavors and raising public awareness through events and festivals.

In summary, this introduction provides an overview of the significance of fish as a protein source, the importance of handling and processing in maintaining fish quality, the popularity of bakso as a ready-to-eat cuisine, the imperative of profit optimization in business, the utility of the simplex method for this purpose, the relevance of fish ball as our main research topic, the vital role of MSMEs in economic development, and the application of the simplex method to enhance the success of Ahan Fish Ball. This study aims to delve deeper into these aspects and provide valuable insights for the culinary sector and MSMEs in Indonesia.

2. Critical Riview

The utilization of the simplex method for profit optimization in the culinary sector, particularly in the context of Ahan Fish Ball, offers intriguing insights into the application of mathematical models for enhancing business performance. This critical review aims to assess the strengths and limitations of the research conducted by exploring relevant literature and evaluating the methodology, findings, and implications of the study.

The research builds upon previous literature concerning the perishable nature of fish and the significance of proper handling and processing techniques to maintain quality (Widyaningsih & Martini, 2006; Andarwulan et al., 2011). By incorporating these foundational principles, the study contextualizes the importance of optimizing profit in the fish ball business, recognizing its role within the broader culinary sector. Additionally, the review acknowledges the relevance of the simplex method as a mathematical tool for profit maximization, aligning with the overarching objective of businesses to achieve optimal outcomes (Indrayati in Abriani et al., 2020).

One of the strengths of the research lies in its application of the simplex method to identify the optimal production mix for Ahan Fish Ball, thereby maximizing profit. The utilization of mathematical modeling techniques, such as linear programming, offers a systematic approach to decision-making, enabling businesses to navigate complex production scenarios efficiently (Esther et al., 2013). Furthermore, the study's focus on MSMEs, particularly Ahan Fish Ball, underscores the importance of supporting small-scale enterprises in maximizing their potential within the culinary landscape (Salman Al Farisi et al., 2022).

However, while the simplex method provides a valuable framework for profit optimization, several limitations warrant consideration. Firstly, the reliance on historical data, such as observations from a single day, may not fully capture the dynamic nature of market demand and production constraints. Future research could benefit from incorporating data spanning longer periods to account for seasonal variations and changing consumer preferences. Additionally, the study primarily focuses on maximizing profit without explicitly addressing other business objectives, such as sustainability or customer satisfaction. Incorporating multi-objective optimization approaches could offer a more comprehensive framework for decision-making, balancing profit maximization with other organizational goals (Herjanto, 2008).

Furthermore, while the research emphasizes the importance of MSMEs in economic development, the broader socioeconomic implications of profit optimization within the culinary sector remain underexplored. For instance, the study could delve deeper into the distributional effects of profit maximization on various stakeholders, including suppliers, employees, and local communities. Understanding these dynamics is crucial for promoting inclusive growth and equitable development within the culinary industry (Salman Al Farisi et al., 2022).

In terms of methodology, the study effectively applies the simplex method to identify the optimal production mix for Ahan Fish Ball. However, greater transparency regarding the model's assumptions and constraints would enhance the robustness of the findings. Additionally, the sensitivity analysis could provide valuable insights into the model's stability and reliability, particularly in the face of fluctuating market conditions (Valinov, 2018).

In conclusion, while the research offers valuable insights into profit optimization within the culinary sector, particularly for MSMEs like Ahan Fish Ball, several areas warrant further investigation. Future research could explore alternative optimization techniques, incorporate multi-objective decision-making frameworks, and consider the broader socioeconomic implications of profit maximization. By addressing these gaps, scholars can contribute to a more nuanced understanding of the dynamics shaping the culinary industry and support sustainable growth and development within the sector.

3. Method Innovation

The simplex method is a widely used algorithm for solving problems in linear programming. Named after the concept of a simplex, a generalization of a triangle or tetrahedron in any dimension, the algorithm was proposed by T. S. Motzkin. Although actual simplices are not utilized, one interpretation suggests that the algorithm operates on conic rays (simple cones), which become simplices when an additional constraint is added. These conic rays refer to the edges of the geometric structure known as a polytope.

The shape of this polytope is defined by constraints that the objective function must satisfy. The manual calculation steps of the simplex method are as follows: 1. Determine the decision variables to be used and transform them into a mathematical model. 2. Define the objective function to be achieved and transform it into a mathematical model. 3. Determine the constraint functions obtained and convert them into mathematical model functions. 4. Arrange the resulting mathematical model equations into a Simplex table and determine the key columns and key rows.

Basic variables are variables whose values are equal to the right-hand side of the equation. - NK is the right-hand side value (key value) of the equation, i.e., the value behind the equals sign or the value of the available resource constraints. x1 ... xn are constraint functions. S1 ... Sn are slack variables, variables added to the mathematical model of constraint functions to convert inequalities into equations. Z is the objective function. The calculation process of the simplex method can be performed manually or using POM-QM software. The solution process using the simplex method involves repeated iterations until an optimal solution is obtained (Siringoringo & Hotniar, 2005).

According to Taha (2003), Linear Programming is a mathematical method for allocating limited resources to achieve a goal, such as maximizing profits and minimizing costs. Linear programming is an identification in distinguishing fundamental concepts made systematically to show limited resources to obtain ideal solutions (Herjanto, 2008). Linear programming can be considered as an optimization technique for linear objective functions, with problems consisting of linear equations and linear inequalities. Linear programming takes the form of a model, consisting of linear inequalities, and is one method used to solve various problems in everyday life. Linear programming aims to determine the optimum value of a linear problem. This optimal value can be a maximum or minimum value and is obtained from the values in a set of solutions to the linear problem. Linear programming has three basic components: the objective function to be simplified (strengthened or constrained), constraints or limitations that must be met by the solution obtained, and decision variables (H. A. Taha, 2007).

$$Z = C_1X_1 + C_2X_2 + \ldots + C_nX_n \quad (1)$$

Constraints (Subject to):

$$a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n \leq b_1 \quad (2)$$

$$a_{21}X_1 + a_{22}X_2 + \ldots + a_{2n}X_n \leq b_2 \quad (3)$$

$$a_{m1}X_1 + a_{m2}X_2 + \ldots + a_{mn}X_n \leq bm \quad (4)$$

The linear programming method aims to optimize the objective function subject to the given constraints, typically through algorithms like the simplex method. This study utilizes both the simplex method and linear programming to optimize profit in the fish ball business context, with the simplex method employed for its computational efficiency and ability to handle multiple variables and constraints.

4. Result and Discusion

The study aimed to optimize profit in the Ahan Fish Ball business by applying the simplex method through the utilization of POM-QM software. The data used in the research were obtained from observations conducted over one day at Ahan Fish Ball in Pontianak. The fish balls observed were white in color, without the addition of flour or thickening agents, and possessed a distinct fish flavor.

The business offered three variants that were the most popular: plain fish ball (X1), salted egg fish ball (X2), and bitter melon stuffed fish ball (X3).

The decision variables were grouped as follows:

a) Production requirements for plain fish ball:
   a. Production time = 10 minutes
   b. Production cost = Rp 2,000,000
   c. Selling price per unit = Rp 2,000
   d. Profit = Rp 1,800,000
b) Production requirements for salted egg fish ball:
   a. Production time = 10 minutes
   b. Production cost = Rp 4,200,000
   c. Selling price per unit = Rp 6,000
   d. Profit = Rp 3,900,000
c) Production requirements for bitter melon stuffed fish ball:
   a. Production time = 10 minutes
   b. Production cost = Rp 2,000,000
   c. Selling price per unit = Rp 4,000
   d. Profit = Rp 1,750,000

Upon opening the POM-QM software, the "Module" menu was selected, followed by "Linear Programming" (see Figure 1). Then, the "New" menu was chosen to initiate a new linear programming problem (see Figure 2). Subsequently, the necessary data such as the number of constraints, variables, row names, and column names were entered (see Figure 3).

Next, the production data was inputted into the provided table (see Figure 4). Once all the data was entered into the table, the "solve" button was pressed to compute the simplex method (see Figures 5 and 6).

The study successfully applied the simplex method to optimize profit in the Ahan Fish Ball business. Various constraints such as production time, production cost, and selling price were considered in the decision-making process to achieve optimal results using the simplex method.

The utilization of POM-QM software proved to be effective in simplifying and expediting the calculation process, leading to accurate results. The calculation results obtained from the POM-QM software indicated that the maximum profit could be achieved by producing 1.95 or 2 salted egg fish balls per day.

The effectiveness of mathematical optimization techniques, particularly the simplex method, in improving decision-making processes within the culinary industry is underscored by various studies and research findings. By considering multiple production constraints and utilizing computational tools like POM-QM, businesses can indeed streamline operations and enhance profitability.

The integration of technology, such as computational software, has become increasingly vital for small and medium-sized enterprises (SMEs) operating in the culinary sector. This sentiment is echoed by research conducted by Lim, et al. (2018), who highlighted the significance of technology adoption in enhancing operational efficiency and competitiveness among SMEs in the food industry. By embracing digital tools for inventory management, production scheduling, and cost optimization, businesses can achieve higher levels of efficiency and cost-effectiveness.

The application of mathematical modeling and optimization methods to address real-world challenges in the culinary sector has been extensively studied and validated by researchers. For instance, a study by Liu and Peng (2019) demonstrated the practical implementation of linear programming models to optimize menu planning and ingredient sourcing for restaurants. By optimizing ingredient quantities and minimizing costs, restaurants can enhance menu diversity while maximizing profitability.

In addition to enhancing profitability, mathematical optimization methods can also contribute to sustainability efforts within the culinary industry. Research conducted by Chen et al. (2020) explored the application of optimization models in food supply chain management to minimize environmental impacts and reduce food waste. By optimizing distribution routes and inventory management, businesses can mitigate carbon emissions and promote sustainable practices.

Collaboration and knowledge sharing among industry stakeholders play a crucial role in driving innovation and advancement in the culinary sector. Research by Lee and Wu (2017) emphasized the importance of collaboration between food producers, suppliers, and retailers in adopting advanced technologies for supply chain optimization and quality control. Through collaborative efforts and information exchange, businesses can enhance efficiency, quality, and consumer satisfaction.

The potential of mathematical modeling and optimization methods to drive growth, sustainability, and profitability in the food industry is immense. Future research directions may focus on the integration of artificial intelligence and machine learning algorithms to further enhance decision-making processes and predictive analytics in food production and distribution. Additionally, exploring the application of optimization methods in emerging food trends, such as plant-based alternatives and sustainable packaging, can pave the way for innovation and sustainability in the culinary sector.

5. Conclusion

In conclusion, the integration of mathematical optimization techniques and computational tools offers significant opportunities for enhancing efficiency, profitability, and sustainability in the culinary industry. By leveraging technology, embracing innovation, and fostering collaboration, businesses can overcome challenges, adapt to changing market dynamics, and drive growth in the evolving landscape of the food industry. Continued research and innovation in mathematical modeling and optimization methods will undoubtedly play a pivotal role in shaping the future of the culinary sector.

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6. Table and Image

Figure 1. Initial view of the software

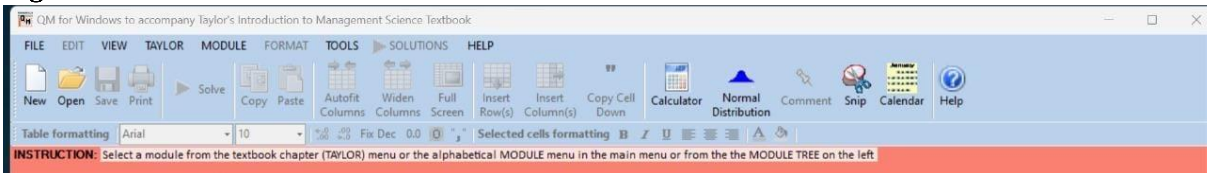


Figure 2. Display on file

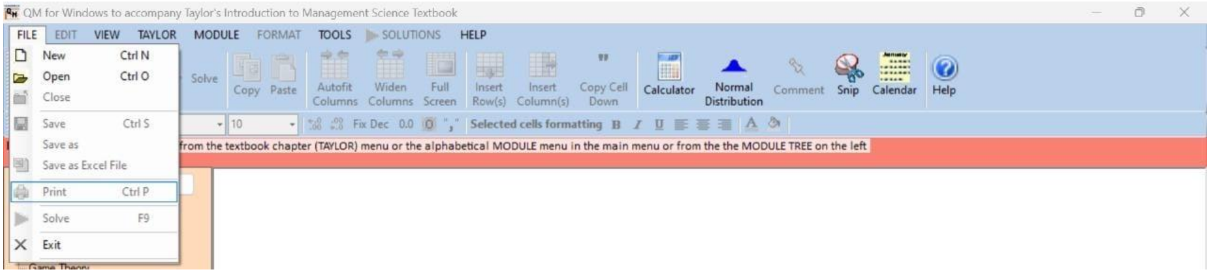


Figure 3. Initial view for create data set

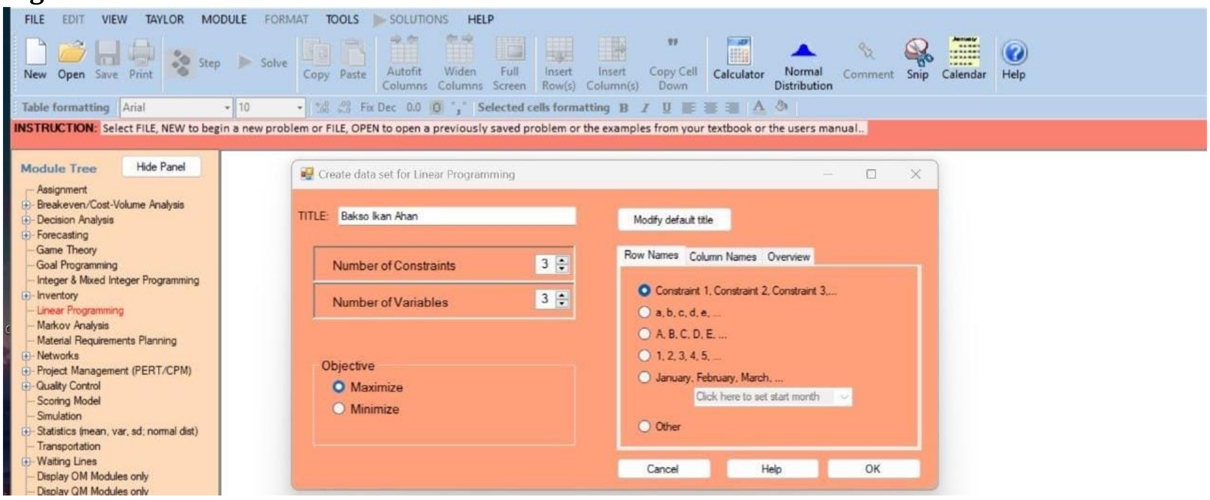
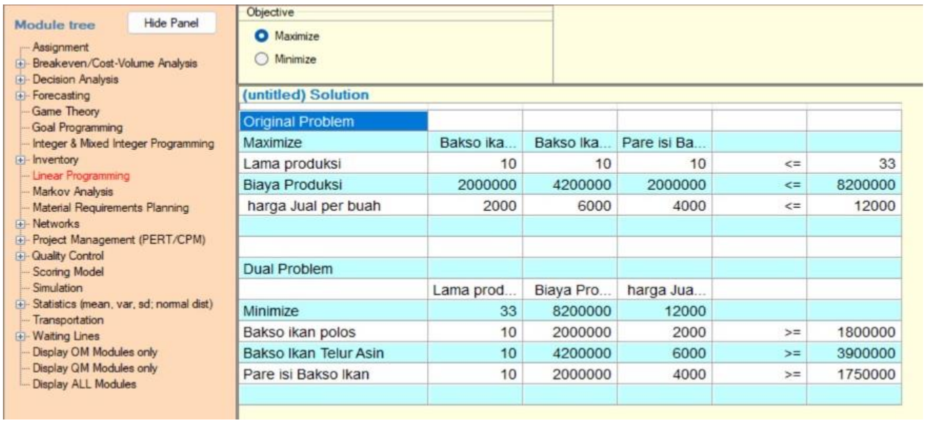


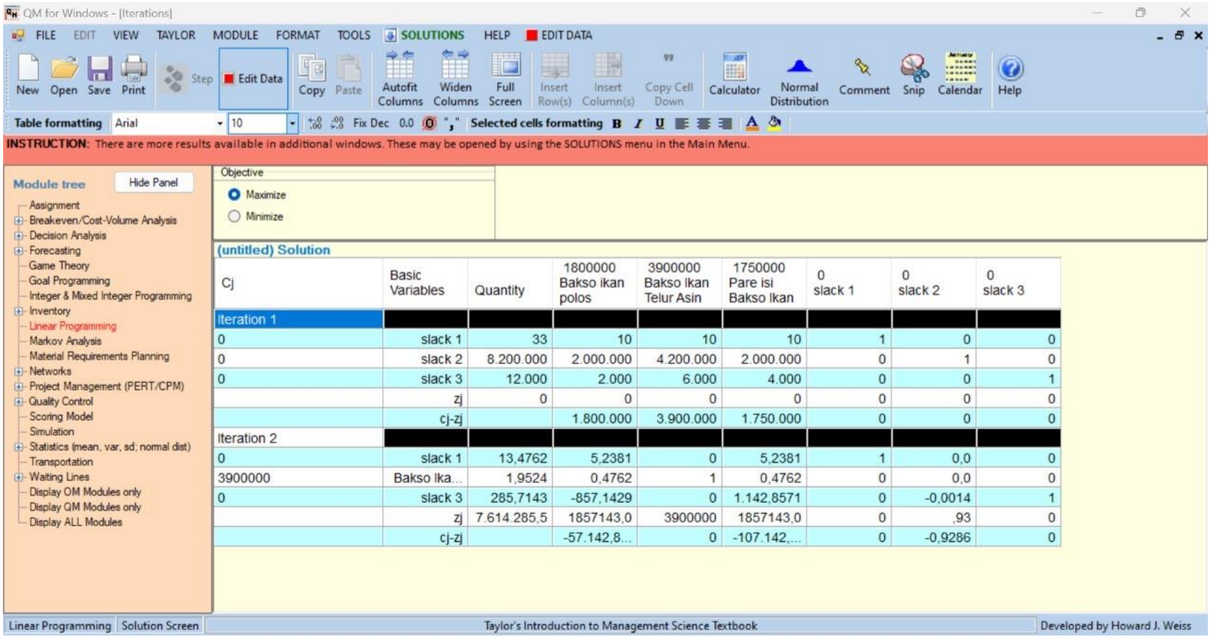
Figure 4. Linear programming with production data



(untitled) Solution

Original Problem					
Maximize	Bakso ika...	Bakso Ika...	Pare isi Ba...		
Lama produksi	10	10	10	<=	33
Biaya Produksi	2000000	4200000	2000000	<=	8200000
harga Jual per buah	2000	6000	4000	<=	12000
Dual Problem					
	Lama prod...	Biaya Pro...	harga Jua...		
Minimize	33	8200000	12000		
Bakso ikan polos	10	2000000	2000	>=	1800000
Bakso Ikan Telur Asin	10	4200000	6000	>=	3900000
Pare isi Bakso Ikan	10	2000000	4000	>=	1750000

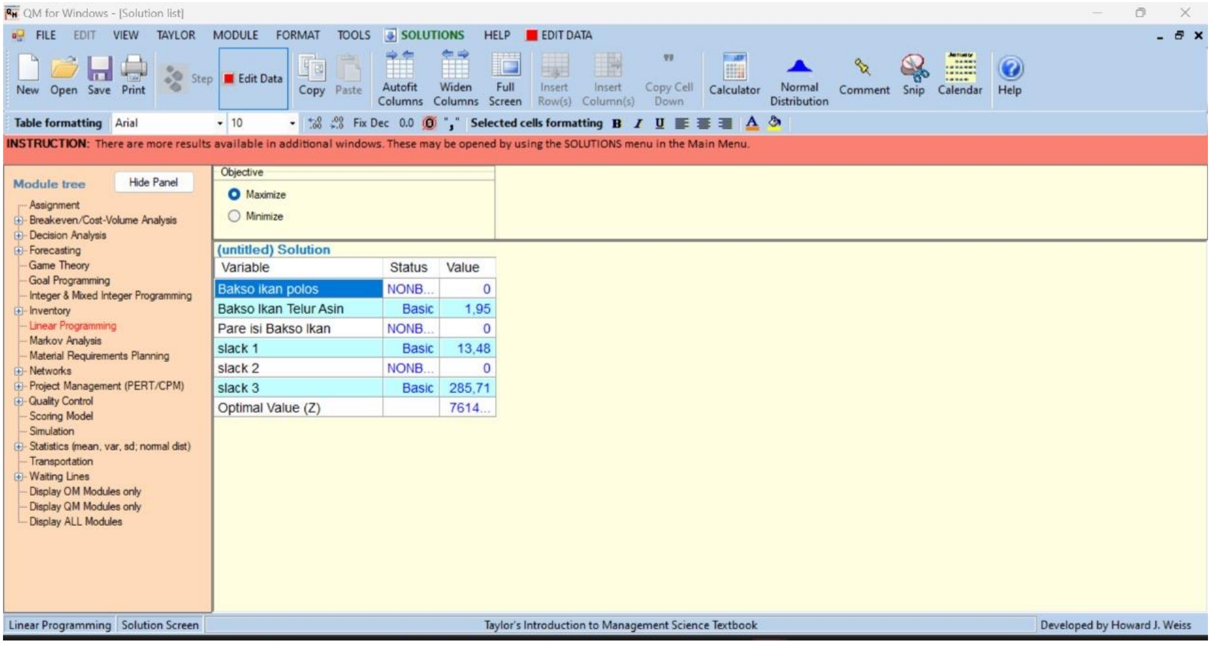
Figure 5. Menu Ilterations



(untitled) Solution

Cj	Basic Variables	Quantity	1800000 Bakso ikan polos	3900000 Bakso Ikan Telur Asin	1750000 Pare isi Bakso Ikan	0 slack 1	0 slack 2	0 slack 3
Iteration 1								
0	slack 1	33	10	10	10	1	0	0
0	slack 2	8.200.000	2.000.000	4.200.000	2.000.000	0	1	0
0	slack 3	12.000	2.000	6.000	4.000	0	0	1
	zj	0	0	0	0	0	0	0
	cj-zj		1.800.000	3.900.000	1.750.000	0	0	0
Iteration 2								
0	slack 1	13,4762	5,2381	0	5,2381	1	0,0	0
3900000	Bakso Ika...	1,9524	0,4762	1	0,4762	0	0,0	0
0	slack 3	285,7143	-857,1429	0	1.142,8571	0	-0,0014	1
	zj	7.614.285,5	1857143,0	3900000	1857143,0	0	,93	0
	cj-zj		-57.142,8...	0	-107.142,...	0	-0,9286	0

Figure 6. ***Solution list***



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