Available online at http://www.iorajournal.org/index.php/ijgor/index

International Journal of Global Operations Research

e-ISSN: 2722-1016
p-ISSN: 2723-1739

Vol. 5, No. 4, pp. 251-255, 2024

Game Theory as a Marketing Optimization Tool: A Case Study on Kelom Geulis

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Abstract

Competition in the market for traditional art products, such as Kelom Geulis, has become increasingly intense along with the growing public interest in aesthetically and culturally valuable items. This competition forces producers to develop effective marketing strategies to maintain their competitiveness. This study adopts a game theory approach to evaluate and formulate optimal marketing strategies between two major producers. The research method involves the use of questionnaires covering three main aspects: improving product quality, setting competitive prices, and enhancing customer service. Data analysis is conducted using a payoff matrix to determine the best strategies that can increase profits or reduce losses for each party.The results show that a saddle point is reached at a value of 4.57, where PT A achieves a profit increase from 4 to 4.57, while PT B reduces its loss from 6 to 4.57. This optimal strategy can be achieved if PT A prioritizes improving product quality and setting competitive prices, while PT B A prioritizes setting competitive prices and service quality enhancement. The implementation of these strategies has proven effective in strengthening the competitiveness of Kelom Geulis in the market. This study is expected to serve as a practical reference for Kelom Geulis producers to continuously adapt their marketing strategies, ensuring their relevance in the market and appealing to consumers

Keywords: Game Theory, Kelom Geulis, Marketing, Strategy

1. Introduction

Kelom Geulis is one of Indonesia's traditional art products, valued for its high aesthetic and cultural significance. As part of the nation's cultural heritage, this product serves not only as footwear but also as a symbol of the creativity of local artisans (Rahadi et al, 2022). In recent years, the demand for Kelom Geulis has steadily increased, both in local and international markets, driven by growing public appreciation for culturally significant products. However, this rising demand has also intensified competition among producers. Local artisans face challenges from similar products and various modern footwear alternatives, which are often more practical and have broader market appeal (Sufyan, 2018).

The competition in the Kelom Geulis market drives producers to develop more innovative and effective marketing strategies (Febrianti, 2024). These strategies must consider various factors, such as improving product quality, setting competitive prices, and enhancing service quality. In this context, a deep understanding of the interactions between market players becomes crucial to maximizing profits and minimizing potential losses.

Game Theory is a mathematical approach used to analyze strategic interactions between two or more competing parties. This theory provides tools to model strategic decision-making and assists producers in determining optimal strategies to face competition (Patel, 2021). Through this approach, producers can identify the best steps to enhance their competitiveness in the market.

This study aims to apply game theory to determine the optimal marketing strategies for two primary producers of Kelom Geulis. The research instrument consists of questionnaires designed to gather data on consumer perceptions and the effectiveness of marketing strategies. The collected data are analyzed to construct a payoff matrix, which is used to identify the best-mixed strategies for each producer. This study is expected to provide practical guidance for Kelom Geulis producers in developing effective marketing strategies while strengthening their market position. Additionally, the research is anticipated to support preserving this traditional art product as part of Indonesia's cultural identity.

2. Literatur Review

Game Theory is a mathematical approach used to analyze conflicts or competition between parties with opposing interests (Brams, 2011). This concept is highly relevant in competitive situations where each party needs to formulate strategies to achieve optimal outcomes. In game theory, players act rationally to maximize their gains or minimize their losses while considering the possible responses of their opponents (Colman, 2013). Key elements forming the foundation of game theory include the number of players, payoffs, game strategies, game matrix, and saddle points. These elements provide an analytical framework to understand strategic interactions in various competitive contexts.

Two types of strategies commonly applied by players in game theory are pure strategies and mixed strategies (Fang et al, 2021). A pure strategy is a single course of action deemed optimal for each player. In the case of pure strategies, the solution in game theory is determined using the minimax and maximin criteria (Musah et al, 2020). The column player, aiming to minimize losses, applies the minimax criterion by selecting the smallest value among the maximum values in each column. Conversely, the row player, aiming to maximize gains, uses the maximin criterion by choosing the largest value among the minimum values in each row. The optimal solution in a pure strategy is achieved when the maximum of the row minima equals the minimum of the column maxima, forming a point of equilibrium called the saddle point (Williams, 2012).

However, not all games can be resolved using pure strategies. In cases where there is no saddle point or deterministic solution, players must adopt mixed strategies. A mixed strategy is a probabilistic combination of several strategies, allowing players to adjust their responses based on the actions of their opponents (Ganzfried and Sandholm, 2011). By employing mixed strategies, players can mitigate risks and increase the likelihood of achieving outcomes that are close to optimal. Analyzing mixed strategies involves calculating the probabilities of each possible strategy, resulting in an outcome that reflects the expected gains or losses under uncertain competitive conditions. This approach enables players to navigate more complex scenarios where deterministic solutions are not feasible, providing a balanced and adaptive framework for decision-making.

Game theory, utilizing both pure and mixed strategy approaches, has been applied in various scenarios, including business competition, marketing strategy planning, and policy analysis (Varadarajan & Jayachandran, 1999). The game matrix, a key tool in this analysis, encapsulates the payoffs for each combination of player strategies. By leveraging this theory, decision-makers can model conflict scenarios and identify the best steps to achieve their objectives. Game theory thus provides an effective framework for analyzing strategic interactions in different competitive contexts. Whether through pure or mixed strategies, the theory helps players determine actions that maximize benefits while minimizing potential losses (Abapour et al, 2020). Its implementation not only offers deeper insights into the dynamics of competition but also enables more informed and strategic decision-making. This makes game theory a valuable tool for navigating complex competitive situations and optimizing outcomes.

3. Materials and Method

This study was conducted over one months in Tasikmalaya, West Java, a region known as the center of Kelom Geulis production. A survey method was employed to collect data, with questionnaires serving as the primary instrument. A total of 20 respondents were selected, consisting of consumers and business practitioners with deep knowledge of Kelom Geulis and experience in the traditional craft industry. The objective of this study is to analyze the marketing strategies implemented by two major producers. In navigating market competition, these producers have adopted several key strategies, which are summarized as follows:

a. Product Quality Improvement
   Producers focus on enhancing product quality by using the finest raw materials, introducing innovative designs, and improving production processes. These efforts aim to ensure that Kelom Geulis continues to meet the aesthetic and functional standards expected by consumers.
b. Competitive Pricing
   Pricing is carefully determined to maintain a balance between consumer purchasing power and production costs. This process involves market surveys and direct dialogues with consumers to achieve prices that are both competitive and mutually beneficial for both parties.
c. Service Quality Enhancement
   Producers provide training to sales personnel to improve customer service. The primary focus is to deliver quick, friendly, and professional responses to customers, creating a satisfying shopping experience and fostering customer loyalty.

The variables in the questionnaire cover three main aspects: product quality, pricing, and service. These variables are structured as follows:

- A_1, B_1: Product Quality Improvement
- A_2, B_2: Competitive Pricing
- A_3, B_3: Service Quality Enhancement

The survey results from the questionnaire were then summarized into a payoff matrix, which was analyzed using game theory. This analysis helps determine the best strategies that each producer can adopt. Through this approach, optimal strategies in either pure or mixed forms can be identified, enabling producers to maximize their profits or minimize potential losses. This study is expected to serve as a practical guide for Kelom Geulis producers to enhance their competitiveness in both local and international markets.

4. Results and Discussion

Based on the results of the distributed questionnaires regarding the competition between PT A and PT B, the collected data include evaluations of three main variables: product quality, pricing, and service. Each variable reflects the effectiveness of the strategies implemented by each company in attracting consumers and meeting market demands. The values derived from the questionnaire analysis are systematically summarized in Table 1 for PT A and Table 2 for PT B, enabling a direct comparison of the performance of both companies. This data serves as a critical foundation for analyzing their strategic interactions using the payoff matrix to determine the best strategies for addressing competition.

Table 1: Questionnaire Scores of PT A

Strategy	B_1	B_2	B_3
A_1	8	10	10
A_2	12	9	10
A_3	10	8	10

Table 2: Questionnaire Scores of PT B

Strategy	B_1	B_2	B_3
A_1	12	10	15
A_2	10	11	10
A_3	15	12	15

Based on Table 1 and Table 2, the competitive values between the two companies can be determined. These values are obtained by subtracting the scores of the row company from the scores of the column company, representing the variables of each company, namely PT A and PT B. The calculation results are presented in Table 3.

To ensure that all values in the matrix are positive, each element in the payoff matrix is adjusted by adding the absolute value of the smallest element. In this study, all elements in the matrices of PT A and PT B were increased by 6, resulting in a new matrix presented in Table 4.

Table 3: Matrix of Competitive Values for PT A and PT B

Strategy	B_1	B_2	B_3	Row Maximum
A_1	-4	0	-5	-5
A_2	2	-2	0	-2
A_3	-5	-4	-5	-5
Column Minimax	2	0	0	

Table 4: Perubahan Matriks Nilai Persaiangan PT A dan PT B

Strategy	B_1	B_2	B_3	Row Maximum
A_1	2	6	1	1
A_2	8	4	6	4
A_3	1	2	1	1
Column Minimax	8	6	6	

Based on Table 4, a game theory analysis using pure strategies was conducted. PT A, as the row player, applied the maximum rule, while PT B, as the column player, applied the minimax rule. For PT A, the smallest value in each row was selected (the smallest value in row one is 1, in row two is 4, and in row three is 1). Among these, the largest value (maximum) was chosen, which is 4. Meanwhile, for PT B, the largest value in each column was selected (the largest value in column one is 8, in column two is 6, and in column three is 6). The smallest value among these (minimax)

was then chosen, which is 6. In this case, the maximum value for PT A and the minimax value for PT B do not match, as PT A selects 4, and PT B selects 6. Therefore, the game has not yet reached an optimal point, or saddle point. To achieve a more optimal outcome, the analysis proceeds with a mixed strategy approach.

The next step involves applying the dominance rule, where each player eliminates strategies that present the worst potential losses or gains. Based on Table 4, strategy A_3 for PT A is deemed the worst because it poses a high risk of significant losses for PT A. Similarly, for PT B, strategy B_1 is considered the worst because it has the potential to cause substantial losses for PT B. Consequently, these strategies are excluded from the analysis as they do not provide optimal outcomes for either player.

Table 5: Earnings of PT A and PT B After Applying the Dominance Rule

Strategy	B_1	B_2	B_3	Row Maximum
A_1	-	6	1	1
A_2	-	4	6	4
A_3	-	-	-	-
Column Minimax	-	6	6	

Based on Table 5, the probability values for each potential strategy can be determined. For PT A, the probability of using strategy A_1 is p, while the probability of using strategy A_2 is (1-p). Meanwhile, for PT B, the probability of using strategy B_2 is q, and the probability of using strategy B_3 is (1-q). To achieve a saddle point and reach an optimal value, the probability values for each strategy are utilized. These probabilities are calculated to balance the payoffs for both players, ensuring that neither PT A nor PT B has an incentive to deviate from their chosen mixed strategy. This approach ensures that the game reaches equilibrium under the given conditions.

- For PT A, if PT B responds to any strategy used by PT A with strategies B_2 and B_3, the following equations can be derived:

$$6p + 4(1-p) = 4 + 2p \quad (1)$$
$$1p + 6(1-p) = 6 - 5p \quad (2)$$

From equations (1) and (2), the probabilities can be derived as follows:

$$4 + 2p = 6 - 5p$$
$$7p = 2$$
$$p = \frac{2}{7} \rightarrow (1-p) = \frac{5}{7}$$

If the values $p = \frac{2}{7}$ and $(1-p) = \frac{5}{7}$ are substituted into equation (1), the following is obtained:

$$6p + 4(1-p) = 6\left(\frac{2}{7}\right) + 4\left(\frac{5}{7}\right) = \frac{32}{7} = 4.57$$

The result represents the optimal profit for PT A, which is 4.57, meaning PT A's profit increased from 4 to 4.57 by using a mixed strategy. This outcome can be achieved if PT A applies strategy A_1, focusing on improving product quality, and strategy A_2, focusing on competitive pricing.

- For PT B, if PT A responds to any strategy used by PT B with strategies A_1 dan A_2, the following equations can be derived:

$$6q + 1(1-q) = 1 + 5q \quad (3)$$
$$4q + 6(1-q) = 6 - 2q \quad (4)$$

From equations (3) and (4), the probabilities can be derived as follows:

$$1 + 5q = 6 - 2q$$
$$7q = 5$$
$$q = \frac{5}{7} \rightarrow (1-q) = \frac{2}{7}$$

If the values $q = \frac{5}{7}$ and $(1-q) = \frac{2}{7}$ are substituted into equation (3), the following is obtained:

$$6q + 1(1-q) = 6\left(\frac{5}{7}\right) + 1\left(\frac{2}{7}\right) = \frac{32}{7} = 4.57$$

The result represents the optimal loss for PT B, which is 4.57, meaning PT B's loss decreased from 46 to 4.57 by using a mixed strategy. This outcome can be achieved if PT B applies strategy B_2, focusing on competitive pricing, and strategy B_3 focusing on service quality enhancement.

5. Conclusion

Based on the analysis results, it can be concluded that the competition between PT A and PT B reached a saddle point at a value of 4.57. Under this condition, PT A experienced an increase in profit from 4 to 4.57, while PT B successfully reduced its loss from 6 to 4.57. This achievement indicates that both companies have optimized their strategies to create a competitive balance. This success can be achieved if PT A prioritizes the implementation of strategy A_1, focusing on improving product quality, and strategy A_2, emphasizing competitive pricing. Meanwhile, PT B can minimize its losses by focusing on strategy B_2, targeting competitive pricing, and strategy B_3, focusing on service quality enhancement. These strategies have proven to be the best choices for enhancing the competitiveness of Kelom Geulis in the market. The analysis demonstrates that, by utilizing the right combination of strategies, both companies can improve their respective competitive positions. Strategies focused on improving product quality and setting optimal prices are not only effective in increasing PT A's profits but also in helping PT B minimize its losses. Therefore, this study provides practical guidance for both companies to continuously evaluate and adapt their marketing strategies, ensuring that Kelom Geulis remains relevant in the market and enhances its appeal to consumers.

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