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Determination of e-commerce application marketing strategies using game Theory

Syifa Fijri Arrofilah [1], Herlinda Nur'afwa Sofhya [2]
[1,2] Tadris Mathematics, Faculty of Tarbiyah and Teacher Training, UIN Siber Syekh Nurjati Cirebon Jl. Perjuangan By Pass Sunyaragi, Cirebon City, 45132, Indonesia

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ABSTRACT

Online shopping activities have recently increased significantly, resulting in consumers who initially shopped at offline stores switching to online stores through e-commerce applications, which are currently experiencing intense competition. In the face of fierce competition in the global business world, every company needs to develop a strategic marketing plan to enhance business quality and achieve its goals. This study aims to identify the attributes that are most important to consumers in each e-commerce application, determine the value of the game, and identify the optimal e-commerce marketing strategy using game Theory. This study utilises two e-commerce applications, namely Tokopedia and Shopee, and employs eight strategies: product, place, price, delivery speed, promotion, practicality, website appearance, and security. The marketing strategy used is a mixed approach, utilising POM QM Software for Windows V4 for support. The results obtained from the competition between Tokopedia and Shopee indicate that the optimal strategy for Tokopedia is a combination of price and promotion. In contrast, the optimal strategy for Shopee is a combination of promotion and security. According to the research results above, the attribute that is emphasised in each e-commerce application is the promotion strategy.

Corresponding Author:

Syifa Fijri Arrofilah
Tadris Mathematics, Faculty of Tarbiyah and Teacher Training, UIN Siber Syekh Nurjati Cirebon
Jl. Perjuangan By Pass Sunyaragi, Cirebon City, 45132, Indonesia
Email: *syifafijri@mail.syekhnurjati.ac.id[1],

1. INTRODUCTION

Applying matrices to solving problems can make it easier, such as in business and economics. Growing companies need to know how to manage marketing effectively. In this era of globalisation, numerous competitors vie to sell their products or goods to various countries. For a business to achieve its goals, effective marketing management must be

implemented and actively involved [1]. According to Saleh and Said [2], marketing is about satisfying and meeting customer wants and needs.

Information technology is currently not difficult to obtain, as it has become an integral part of social life. Information technology continues to grow and become more sophisticated. Due to its sophistication, it has the potential to offer various conveniences to enhance people's lives. The ease of doing business or trading can also be felt in economic life, especially in trade or business. Today's business and information technology are inextricably linked. The term e-commerce was coined due to the synergy between business and information technology [3]. E-commerce, or Electronic Commerce, refers to the marketing, distribution, sale, and purchase of products using the internet or other networks [4].

In Indonesia, various e-commerce applications are available, including Shopee, Lazada, Tokopedia, Blibli, Ralali, and JD.ID, and other e-commerce applications. The Indonesian e-commerce market remains dominated by Tokopedia and Shopee. Based on the average number of visitors each month, both are becoming more competitive. Tokopedia has an average of 158.3 million monthly visitors in the second quarter of 2022, according to iPrice data. Tokopedia's achievements have increased compared to the first quarter of 2022, which saw an average of 157.2 million visitors. At the same time, Shopee is in second place with an average of 131.3 million monthly visitors in the second quarter of 2022. This figure is down compared to the first quarter, which reached 132.7 million visitors. In the next order are Lazada, Bukalapak, Blibli, Ralali, Klik Indomaret, JD.ID, Bhinneka, and Matahari with the number of visitors as shown in Figure 1.

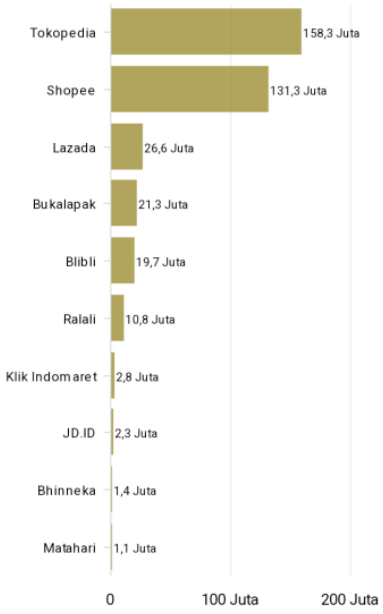

Figure 1. Most Average Visitors in the Second Quarter of 2022

Online shopping activities have increased significantly in recent years, particularly after the onset of isolation measures during the COVID-19 pandemic, leading to consumers who initially shopped at offline stores transitioning to online shopping through e-commerce applications [5]. As shown in Figure 1, it is stated that e-commerce applications experience stiff competition. In the face of intense competition in the business world, every company needs to develop a comprehensive marketing strategy to enhance business quality and achieve its objectives. Marketing strategy involves planning marketing efforts based on the target market. There are five components of the marketing strategy, including product, price,

promotion, process, and service, as well as marketing personnel and location [6]. Because the purpose of a marketing strategy is to attract customer interest, market conditions and customer needs must be considered, which is why marketing strategy is closely related to customer perceptions and preferences [7].

In this case, by applying knowledge from research operations, specifically game Theory, a method can be obtained to analyse competitive strategies using optimal marketing strategies with mathematical approaches. Game Theory is a mathematical model of competitive situations, the focus is on the choices made by rivals to win as much as possible (maximising profits) or lose as little as possible (minimising losses) [8]. There are rules in the game that can directly lead to competitive situations and help determine the best strategy, giving each player the most significant advantage. Meanwhile, consumers must be cautious when selecting products, considering factors such as the price of goods, their advantages and disadvantages, and the ease of transactions. This allows consumers to evaluate the product after use [9].

Numerous studies have been conducted to determine marketing strategies by applying game Theory. One of the studies undertaken by Debora Exaudi Sirait, entitled "Application of Game Theory in Determining Optimum Marketing Strategies for Beauty Products," was published in 2021. This research aims to determine the best course of action in various competitive situations by examining the decision-making process. The following five constraints were selected as problem boundaries, namely Product, Cost, Place, Promotion, and Service, using SPSS 19.0; the preliminary questionnaire reliability test yielded a Cronbach's alpha value of 0.820. Since the maximin and minimax values are the same in a pure strategy, a saddle point can be reached. Thus, the pure strategy is the optimal strategy. As a result, the optimal strategy for Jafra and Oriflame is 10 on (X1, Y2), with Jafra players employing a product strategy and Oriflame using a price strategy, utilising a pure strategy [10].

Each e-commerce service provider company has advantages that differentiate it from others, for example, focusing solely on the choice of products sold, payments, or website appearance. Even though consumers also have their preferences regarding e-commerce platforms [11]. Thus, consumers in e-commerce applications must pay attention to the advantages and disadvantages of each e-commerce application, for example, from the aspects of price, promotion, product, place, security, and practical considerations. Consumers can also determine whether e-commerce applications work as expected after using them [12]. Game Theory can be used to interpret the uncertainty in consumer judgments about e-commerce applications. Assessments will be given to consumers who have used products from e-commerce applications.

Based on the explanation above, a study titled "Determination of Marketing Strategy for E-commerce Applications Using Game Theory" will be conducted. Research using game Theory aims to determine the attributes that are important to consumers in each e-commerce application, determine the value of the game in e-commerce applications, and determine optimal marketing strategies.

2. METHOD

This type of research method includes quantitative research types. Quantitative research is a systematic, scientific investigation of parts and phenomena, as well as their relationships. The purpose of quantitative research is to develop and use mathematical models, theories, and/or hypotheses related to natural phenomena [13]. This study employs game Theory, which is the Theory that underlies the concept of a game and involves rules within the game.

2.1 Population and Sample

The population is a group of individuals or objects that are in an area with distinctive characteristics that are of concern in a study (observation) [14]. The population in this study consisted of students from the Tarbiyah and Teacher Training Faculty of IAIN Syekh Nurjati, specifically the 2019 class, who used e-commerce applications, totalling 1,620 students. Researchers took the 2019 Batch of students because they are consumers of e-commerce applications.

The sample is part of the population to be studied [14]. To determine the sample size, you can search for the Slovin formula, as follows:

$$n = \frac{N}{1 + Ne^2}$$

Information:
n = sample size
N = population size
e = percentage of inaccuracy due to sampling errors that can still be tolerated or used, 10%.

In the Slovin formula, there are provisions, among others. The value of e = 0.1 (10%) for a large population. The value of e = 0.2 (20%) for a small population. For this study, the measurements that can be taken based on the formula above are as follows.

$$n = \frac{1620}{1 + 1620(0{,}1)^2} = \frac{1620}{1 + 1620(0{,}01)} = \frac{1620}{17{,}2} = 94{,}1860465116$$

Based on the calculation using the Slovin formula, the minimum number of samples required is 94 people, rounded up to 100 respondents. Sampling is conducted using a non-probability sampling technique, specifically purposive sampling. Sampling is done according to the sample requirements needed. Sampling is intentionally done by taking only certain samples that possess specific characteristics, such as those using the Tokopedia and Shopee e-commerce applications. Thus, sampling is not done randomly [15].

2.2 Data Collection Techniques

Data collection techniques are the most strategic steps in research, as obtaining data that adheres to established data standards is the primary goal of a study [13]. The data collection technique in this study employs game Theory, which is conducted using a closed questionnaire where responses are provided by selecting from available answer options. This study utilises primary data, specifically a questionnaire that contains questions relevant to the research.

2.3 Data Testing Techniques

Data testing is used to ensure that data can be processed. In this study, we test the validity and reliability using Microsoft Excel.

2.4 Processing Data Using Game Theory

The following are the stages in processing data using game Theory, namely:

1. Create a payoff matrix (game matrix) as the first step in applying game Theory. In this study, the most widely used e-commerce applications were identified, and a game matrix

was created, specifically focusing on users of the e-commerce applications Tokopedia and Shopee.
2. Determine the competitive value of each game matrix.
3. After that, determine the acquisition value by subtracting the number of row players from the number of column acquisitions.
4. Then look for the smallest value of each row.
5. Next, look for the most significant value from each column.
6. Look for the maximum value, which is the most significant value in the minimum row after the smallest value.
7. Look for the minimum value, which is the smallest value in the maximum row after the most significant value.
8. Finally, conclude the optimisation test by checking whether the maximum and minimum values are the same and whether the optimal strategy is found at the saddle point [16].

2.5 Data analysis

At this stage it is done by analysing the results of the analysis using game Theory that has been produced by knowing the attributes that are important to consumers in each e-commerce application, determining the value of the game (estimated average how many games using the best strategy) in the application e-commerce, and determining the optimal marketing strategy using game Theory.

3. RESULTS AND DISCUSSION

3.1 Research Description

This research on determining the marketing strategy of e-commerce applications is based on consumer evaluations of e-commerce applications. The respondents in this study, who were students of the Tarbiyah and Teacher Training Faculty at IAIN Syekh Nurjati Cirebon, class of 2019, were the consumers of e-commerce applications. This research was conducted in two stages: a preliminary questionnaire and a formal questionnaire. An initial questionnaire was distributed to 50 respondents to test for validity and reliability using Microsoft Excel. Then, the formal questionnaire was distributed to 100 respondents to compare the Tokopedia and Shopee e-commerce applications. The following are some of the attributes that are important to consumers in choosing e-commerce applications, namely:

Table 1. Attributes and Explanations

No	*Attributes*	*Explanations*
1	*Product*	*Good app quality, service features, and app brand name.*
2	*Place*	*Numerous merchants, various balance-filling channels, and easy access to applications from anywhere.*
3	*Price*	*Administrative fees and discounted prices.*
4	*Delivery Speed*	*Providing offers in terms of delivery speed, Products ordered now are then sent directly to consumers at that time.*
5	*Promotion*	*Informative advertising, promos, and cashback, as well as the ability to attract consumers.*
6	*Practical*	*Ease of transactions with barcode scanning and others has a visual design to facilitate transactions.*
7	*Website display*	*Attractive website design, product advertisements displayed on the website, and an innovative website layout.*

8	*Security*	*Log in with verification, and transactions are protected with a PIN or fingerprint. Refunds can also be made.*

3.2 Validity Test and Reliability Test

Validity test

A questionnaire is said to be valid if the results of $r_{count} > r_{table}$. Determining the number of preliminary questionnaires in this study is assumed to be close to a normal distribution, as the sample size typically used in research is between 30 and 500 [14]. The results of the preliminary questionnaire were obtained from a sample of N = 50 respondents. With a significance level of 5%, N = 50 (df = 50 – 2 = 48), then the value of r_{table} is 0.235. The validity test in this study is as follows:

Table 2. Validity Test Results I

No	*Attributes*	r_{count}	r_{table}	*Valid/Invalid*
1	*Product*	*0,710*	*0,235*	*Valid*
2	*Place*	*0,218*	*0,235*	*Invalid*
3	*Price*	*0,642*	*0,235*	*Valid*
4	*Delivery Speed*	*0,222*	*0,235*	*Invalid*
5	*Promotion*	*0,569*	*0,235*	*Valid*
6	*Practical*	*0,658*	*0,235*	*Valid*
7	*Website display*	*0,217*	*0,235*	*Invalid*
8	*Security*	*0,642*	*0,235*	*Valid*

The results of the validity test for the questionnaire, as shown in the table above, indicate that the r count is greater than the r table value. Therefore, the items are declared valid, except for the attributes of place, speed of delivery, and website appearance, which are discarded.

Table 3. Validity Test Results II

No	*Attributes*	r_{count}	r_{table}	*Valid/Invalid*
1	*Product*	*0,757*	*0,235*	*Valid*
2	*Price*	*0,652*	*0,235*	*Valid*
3	*Promotion*	*0,629*	*0,235*	*Valid*
4	*Practical*	*0,768*	*0,235*	*Valid*
5	*Security*	*0,674*	*0,235*	*Valid*

Of the eight attributes, five are valid: Product, Price, Promotion, Practicality, and Security.

Reliability Test

A questionnaire is considered reliable if the value α is greater than 0.6. The results of the reliability test in this study are as follows:

Table 4. Reliability Test Results

Attributes	*Number of Item Variances*	*Total Variance*	$r_{xy} = \alpha$
Product	*3,014286*	*7,233061*	*0,729078*
Price			
Promotion			

Practical			
Security			

The results of the reliability test for the questionnaire, as shown in the table above, were calculated using Microsoft Excel and yielded a value of α = 0.729078, which exceeds 0.6. Therefore, the results of the reliability test for the questionnaire fell into the high category.

3.3 Research variable

The following variables were used in this study, based on attributes that underwent validity and reliability tests as outlined below.

Table 5. Attribute Variables

Game Attributes	*Variables used*	
	Tokopedia	*Shopee*
Product	V_1	W_1
Price	V_2	W_2
Promotion	V_3	W_3
Practical	V_4	W_4
Security	V_5	W_5

3.4 Game Theory Data Processing

Game Theory data processing is done by first creating the game matrix. The game matrix is constructed based on the results of the research questionnaire, taking into account the difference or deduction from the competition between P_1, namely Player I (the row player), and P_2, namely Player II (the column player). After that, to obtain the optimal solution, the game is solved using a pure strategy to achieve a saddle point. If the pure strategy does not yield a saddle point, the game is then solved using a mixed approach. If the mixed strategy also does not produce a saddle point, it will be solved by one of the alternative methods.

Recapitulation of Competition Value

Based on the questionnaire data obtained, the competition results are presented in this competition value recapitulation. Tokopedia is represented as P_1, namely Player I (row player), and Shopee is represented as P_2, Player II (column player).

Table 6. Recapitulation of Tokopedia and Shopee Competition Value

P_1 \ P_2		*Shopee*				
		W_1	W_2	W_3	W_4	W_5
Tokopedia	V_1	18 / 82	18 / 82	21 / 79	21 / 79	15 / 85
	V_2	23 / 77	17 / 83	22 / 78	20 / 80	19 / 81
	V_3	22 / 78	24 / 76	19 / 81	23 / 77	20 / 80
	V_4	19 / 81	18 / 82	20 / 80	20 / 80	19 / 81
	V_5	18	19	14	17	17

		82	81	86	83	83

Creating a Game (Pay-Off) Matrix.

After the value recapitulation is carried out, the next step is to create a pay-off matrix based on the data by calculating the difference value between each competitor. Thus, the form of the pay-off matrix is obtained as follows.

Table 7. Tokopedia and Shopee Pay-Off Matrix

P_1 \ P_2		Shopee				
		W_1	W_2	W_3	W_4	W_5
Tokopedia	V_1	- 64	- 64	- 58	- 58	- 70
	V_2	- 54	- 66	- 56	- 60	- 62
	V_3	- 56	- 52	- 62	- 54	- 60
	V_4	- 62	- 64	- 60	- 60	- 62
	V_5	- 64	- 62	- 72	- 66	- 66

The payoff matrix obtained then completes game Theory calculations using pure strategies, mixed strategies, and alternative methods to obtain saddle points. The alternative method employed in this research is a linear programming model.

Game Theory Solution Using Pure Strategy

The use of pure strategy involves identifying the smallest value in each row and the most significant value in each column. Then, from the row value (maximin) obtained, determine the most essential value, and from the value of each column (minimax), choose the smallest value.

Table 8. Tokopedia and Shopee Pure Strategy Solution

P_1 \ P_2		Shopee					Maximin
		W_1	W_2	W_3	W_4	W_5	
Tokopedia	V_1	- 64	- 64	- 58	- 58	- 70	- 70
	V_2	- 54	- 66	- 56	- 60	- 62	- 66
	V_3	- 56	- 52	- 62	- 54	- 60	- 62
	V_4	- 62	- 64	- 60	- 60	- 62	- 64
	V_5	- 64	- 62	- 72	- 66	- 66	- 72
Minimax		- 54	- 52	- 56	- 54	- 60	

From the Tokopedia and Shopee game matrix in the table above, it is observed that the maximum value and the minimum value are not the same, indicating that the saddle point has not been reached and the optimal strategy has not been identified. This game matrix between Tokopedia and Shopee employs a mixed strategy rather than a pure one.

Game Theory Solution Using Mixed Strategy

The mixed strategy is implemented by iterating through the rows and columns using the domination principle, and then determining the maximin and minimax values based on the pure strategy.

Table 9. Completion of Mixed Strategy with the Domination Principle of Tokopedia and Shopee

P_1 \ P_2		*Shopee*		*Maximin*
		W_3	W_5	
Tokopedia	V_2	- 56	- 62	- 62
	V_3	- 62	- 60	- 62
	V_4	- 60	- 62	- 62
Minimax		- 56	- 60	

From the Tokopedia and Shopee game matrix in the table above, it is observed that after the domination rule is applied, the maximal value and the minimum value are still not the same, namely -60 and -62. As an alternative to obtaining the optimal solution, the saddle point value can be solved using a mixed strategy with the simplex method, a linear programming application.

Application of Linear Programming

In the simplex method, if there are harmful elements in the acquisition matrix, then each matrix element is summed absolutely from the component with the smallest value. Sum each aspect to guarantee the value of the game (V) to be positive [17]. The table below is a modification payment matrix, starting with the smallest element, namely, -72. Each component of the Tokopedia and Shopee payment value matrix is then added to a constant equal to the absolute value of -72, which equals the absolute value of -72. The minus 72, which equals the absolute value of -72, equals the absolute value of 2.

Table 10. Tokopedia and Shopee Game Modification Payment Matrix

P_1 \ P_2		*Shopee*				
		W_1	W_2	W_3	W_4	W_5
Tokopedia	V_1	8	8	14	14	2
	V_2	18	6	16	12	10
	V_3	16	20	10	18	12
	V_4	10	8	12	12	10
	V_5	8	10	0	6	12

For the Row Player (Tokopedia)

In game Theory, row players are maximising players, so they must be able to maximise profits by maximising V or minimising one over cap V. The row player can be formulated as a linear program.

Minimise

$$Z = \frac{1}{V} = \sum_{i=1}^{5} V_i = V_1 + V_2 + V_3 + V_4 + V_5$$

With Limits

$$\begin{aligned}
8V_1 + 18V_2 + 16V_3 + 10V_4 + 8V_5 &\geq 1 \\
8V_1 + 6V_2 + 20V_3 + 8V_4 + 10V_5 &\geq 1 \\
14V_1 + 16V_2 + 10V_3 + 12V_4 &\geq 1 \\
14V_1 + 12V_2 + 18V_3 + 12V_4 + 6V_5 &\geq 1 \\
2V_1 + 10V_2 + 12V_3 + 10V_4 + 12V_5 &\geq 1 \\
V_1, V_2, V_3, V_4, V_5 &\geq 1
\end{aligned}$$

After operating on POM QM For Windows, the optimal solution is obtained as follows:

Table 11. Optimal Solution for Row Players

Minimize	V_1	V_2	V_3	V_4	V_5		*RHS*	*Dual*
	1	*1*	*1*	*1*	*1*			
Const 1	*8*	*18*	*16*	*10*	*8*	≥	*1*	*0*
Const 2	*8*	*6*	*20*	*8*	*10*	≥	*1*	*0*
Const 3	*14*	*16*	*10*	*12*	*0*	≥	*1*	*0,0217*
Const 4	*14*	*12*	*18*	*12*	*6*	≥	*1*	*0*
Const 5	*2*	*10*	*12*	*10*	*12*	≥	*1*	*0,0652*
Solution	*0*	*0,0217*	*0,0652*	*0*	*0*		*0,087*	

From the table above, the optimal solution is obtained as follows:

$V_2 = 0{,}0217,\ \ V_3 = 0{,}0652$
$V_1 = V_4 = V_5 = 0$
$Z = 0{,}087$

Because $Z = \frac{1}{V}$ and $V_i = \frac{V_i}{V}$ so

$$V = \frac{1}{Z} = \frac{1}{0{,}087} = 11{,}4942$$

$\bar{V_1} = V_1\ x\ V = 0\ x\ 11{,}4942 = 0$
$\bar{V_2} = V_2\ x\ V = 0{,}0217\ x\ 11{,}4942 = 0{,}2494$
$\bar{V_3} = V_3\ x\ V = 0{,}0652\ x\ 11{,}4942 = 0{,}7494$
$\bar{V_4} = V_4\ x\ V = 0\ x\ 11{,}4942 = 0$
$\bar{V_5} = V_5\ x\ V = 0\ x\ 11{,}4942 = 0$

In the previous payment matrix, each element has been added to $k = 72$, so: $V = 11{,}4942 - 72 = -60{,}5058$. Thus, the result of the row player game is $-60{,}5058$ with the V_2 strategy, namely price $(0{,}2494)$ and V_3, namely promotion $(0{,}7494)$.

For the Column Player (Shopee)

In game Theory, column players are minimax players, so they must be able to minimise losses by minimising V or maximising $\frac{1}{V}$. The column player can be formulated as a linear program.
Maximise

$$Z = \frac{1}{V} = \sum_{i=1}^{5} W_i = W_1 + W_2 + W_3 + W_4 + W_5$$

With Limits

$$\begin{aligned}
8W_1 + 8W_2 + 14W_3 + 14W_4 + 2W_5 &\le 1\\
18W_1 + 6W_2 + 16W_3 + 12W_4 + 10W_5 &\le 1\\
16W_1 + 20W_2 + 10W_3 + 18W_4 + 12W_5 &\le 1\\
10W_1 + 8W_2 + 12W_3 + 12W_4 + 10W_5 &\le 1\\
8W_1 + 10W_2 + 6W_4 + 12W_5 &\le 1\\
W_1, W_2, W_3, W_4, W_5 &\le 1
\end{aligned}$$

After operating on POM QM For Windows, the optimal solution is obtained as follows:

Table 12. Optimal Solution for Column Player

Maximize	W_1	W_2	W_3	W_4	W_5		*RHS*	*Dual*
	1	*1*	*1*	*1*	*1*			
Const 1	*8*	*8*	*14*	*14*	*2*	≤	*1*	*0*
Const 2	*18*	*6*	*16*	*12*	*10*	≤	*1*	*0,0217*
Const 3	*16*	*20*	*10*	*18*	*12*	≤	*1*	*0,0652*
Const 4	*10*	*8*	*12*	*12*	*10*	≤	*1*	*0*
Const 5	*8*	*10*	*0*	*6*	*12*	≤	*1*	*0*
Solution	*0*	*0*	*0,0217*	*0*	*0,0652*		*0,087*	

From the table above, the optimal solution is obtained as follows:

$W_3 = 0{,}0217,\ \ W_5 = 0{,}0652$

$W_1 = W_2 = W_4 = 0$

$Z = 0{,}087$

Because $Z = \frac{1}{V}$ and $W_i = \frac{W_i}{V}$ so

$$V = \frac{1}{Z} = \frac{1}{0{,}087} = 11{,}4942$$

$\overline{W_1} = W_1\, x\, V = 0\, x\, 11{,}4942 = 0$

$\overline{W_2} = W_2\, x\, V = 0\, x\, 11{,}4942 = 0$

$\overline{W_3} = W_3\, x\, V = 0{,}0217\, x\, 11{,}4942 = 0{,}2494$

$\overline{W_4} = W_4\, x\, V = 0\, x\, 11{,}4942 = 0$

$\overline{W_5} = W_5\, x\, V = 0{,}0652\, x\, 11{,}4942 = 0{,}7494$

In the previous payment matrix, each element has been added to $k = 72$, so: $V = 11{,}4942 - 72 = -60{,}5058$. Thus, the results obtained for column players are $-60{,}5058$ with the W_3 strategy, namely promotion $(0{,}2494)$ and W_5, namely security $(0{,}7494)$.

So by using the Mixed Strategy, we get a game value of $V_{maks} = V_{\min} = -60{,}5058$, which means that with this method a saddle point has been reached, so row players (Tokopedia) can maximise their profits with a pricing strategy of 24.94% and a promotion strategy of 74.94% and column players (Shopee) can also minimise their losses with a promotion strategy of 24.94% and a security strategy of 74.94 %. Shopee won this competition as the second player by employing a mixed strategy, which involves implementing a linear program—a strategy that utilises more than one approach. This indicates that maximising Tokopedia wins with a value of –60.5058 and minimising Shopee losses with a value of 60.5058. So that when the two of them are added together, it produces zero, because the game Theory used is a game of two zero-sum players.

4. CONCLUSION

Based on the research results obtained regarding e-commerce applications, it can be concluded that the attributes most important to consumers in each e-commerce application are promotional strategies. From the results of data processing using game Theory between Tokopedia and Shopee, the optimal game value is -60.5058, achieved through a mixed strategy with the application of linear programming. The optimal strategy for Tokopedia is to employ a pricing and promotion strategy, whereas the optimal strategy for Shopee is to utilise a promotion and security strategy.

The researcher can suggest several avenues for further research. This research is based on customer perceptions, so periodic research must be carried out, as customer

perceptions can change over time. For companies, it is recommended that each division of the marketing department pay more attention to determining the optimal marketing strategy renewal to compete with other companies.

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