

APPLICATION OF GAME THEORY IN THE PHOTOGRAPHY SECTOR

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Abstract

Just like everyone, governments and business circles are liable to make decisions by evaluating choices in terms of alternative loss and profit. The game theory is a mathematical approach. The aim is to obtain optimum results from economic activities by taking into account the prevalent competition in the light of the various outputs of contingent strategies that can be implemented. The games played and the number of players is characterized by the amount of total profit and contingent strategies. In two-player games, the success of one competing party implies loss for the other; this is very similar to the negotiations that take place between workers and trade unions. This implies that the game may result with a zero sum. Each move to be made during the game gives rise to a countermove from the competition. In other words, there is unification in the game field among the opponents who are keen on preserving their interests. Competitors – who are bound to actualize some sort of competitive action in an era of free competition – must be able to at least predict each other's activities in terms of the earnings they pursue. This article examines, on the basis of game theory, the series of activities of two truly prominent establishments – serving in the field of photography equipment – aimed at increasing their market share.

(Key Words: game theory, optimal decision making, competing players, minimax criterion, dominance, zero sum, arts management, photography sector.)

1. The game

Mankind has always made use of numerical means to solve problems encountered in the business world. Governments as well as corporations choose to solve their problems by mathematical means instead of relying on their intuitions. The input in a factory is raw material. The raw material undergoes certain processes in order to obtain the desired product. People who are responsible for decision-making use specific data as raw material. Similar to the raw material used for manufacturing certain products, this data also undergoes certain processes in order to reach a final decision – which is expected to be a successful one.

When faced with mathematical models, a recurrent expression coming from managers of small-scale companies, or those of larger companies who have not yet adapted themselves to 'thinking big', is "... we can't apply this in our country and in our sector." We all know that the primary remedy for a person with the flu is bed rest – and the fact that the person lives in America or in Turkey does not change the circumstances. Similarly, the same solutions proposed by management scholars abroad may just as well be applied in our country.

Just like the competing players found in every game, companies compete in their own game aimed at obtaining a larger market share. Naturally, the success of one company implies the failure of another. Each competing company must aim for success in this game.

In short we can say that governments as well as corporations play certain games, just like all of us.

The game theory defines the profit and loss of competing players in terms of mathematical information. It is this information that becomes the guiding factor for decision makers.

2. Can the game theory be applied in the photography sector?

Today, competition is the essential determining factor for managerial decisions. The activities of competing parties operating in the same sector have an inevitable effect on the decisions we make. The same holds true for the photography sector. For example, Kenan Akkaya – a senior salesman from the Hayyam Mall – expresses the difference between his former and latter attitude toward digital photography equipment as follows: "...At first I was opposed to selling digital cameras. But later I found that I could no longer deny it. I was compelled to sell digital equipment if I was to survive. The

popularity and high sales rate of digital cameras has created a 60-70% decrease in the sales of manual cameras.”

Kenan Akkaya’s experiences will gain their true value when he will be able to express them numerically. For example, at what rate can a salesman who makes proper use of the original manuals (written in English) increase his market share compared to his competitors? Do salesmen who have gained a reputation for being reliable make a differentiating profit compared to those having no such reputation?

The “eminent” firms of the photography sector should view their problems through a similar vision and should acknowledge the necessity to become truly corporate establishments. Industrial engineering and Business Administration graduates working in large-scale photography firms are unable to implement their knowledge due to the heavy burdens of daily routines. Unfortunately they end up working like technicians. The top management in these firms should be able to recognize these employees and the potential benefit that can be derived from placing them in the research departments of their firms. It is through this kind of effort that haphazard applications can be diminished and hereby the sector can be upheld on stronger grounds.

3. The rules of the game

Let us examine some preliminary examples involving the application of game theory:

Example 1:

Let us consider two competing firms. Naturally, as is the case for all business firms, these two are also competing to increase their market share. Both firms try to benefit from competitive tools such as discount campaigns, advertisements, promotions, attempts to sell high quality products for low prices; improvement of customer satisfaction, providing good service for sold products and whatever else you can think of.

Let us label the competitive tools, which the two firms apply, as campaigns A, B, C, and D. Let’s assume that Company X is implementing the Advertisement and Discount campaigns (Strategy A and Strategy B respectively); while Company Y is implementing Warranty Service for Sold Products and Promotion (Strategy C and Strategy D respectively). Although in this example the two companies are applying different strategies it is possible to examine another example where they both apply the same strategies.

| Company X | Company Y | |
|------------|------------|------------|
| | Strategy C | Strategy D |
| Strategy A | 15 | 25 |
| Strategy B | - 10 | - 12 |

The positive (+) values in our matrix indicate profit for Company X and the negative (-) values indicate a loss for Company X (meaning a profit for Company Y).

If Company X applies Strategy A while Company Y is applying Strategy C, Company X will win 15 points – which means that either its market share will increase by 15% or that it will obtain 15 million dollar revenue. The decrease in the market share of Company Y has led to a 15% increase in market share, or has produced 15 million dollar revenue for Company X.

If Company X applies Strategy A while Company Y is applying Strategy D, Company X will win 25 points.

If Company X applies Strategy B while Company Y is applying strategy C, Company X will lose 10 points. This loss incurred by Company X will become a profit for Company Y. A 10% loss of market share for Company X will turn into a profit for Company Y, which in turn will increase its market share by 10%.

If Company X applies Strategy B while Company Y is applying Strategy D, Company Y will win 12 points.

Example 2:

There are some cases where, to the benefit of the company, certain strategies should not be applied.

| | | Company Y | |
|-----------|------------|------------|------------|
| | | Strategy C | Strategy D |
| Company X | Strategy A | 16 | 20 |
| | Strategy B | 9 | - 12 |

The management of Company Y can clearly identify that their only chance for making a profit is by means of having Company X apply Strategy B. Presuming that the management of Company X will act rationally we can guess that they will not choose to apply Strategy B.

The outcome will be that Company X will apply Strategy A while Company Y applies Strategy C.

Example 3:

| | | Strategy C | Company Y | |
|-----------|------------|------------|------------|------------|
| | | | Strategy D | Strategy E |
| Company X | Strategy A | 10 | 0 | 20 |
| | Strategy B | 6 | - 13 | 9 |

The managers of Company X will choose not to apply Strategy B, hereby making it impossible for Company Y to benefit from its only chance of making any profit. So, under these circumstances Company X will apply only Strategy A. In this case Company Y will have to apply Strategy D in order not to incur any loss. Since Company X will apply Strategy A and Company Y will apply Strategy D, both will be able to maintain their present market shares. However, neither of them will gain any additional market share.

Example 4:

| | | Company Y | |
|-----------|-------------|------------|------------|
| | | Strategy C | Strategy D |
| Company X | Strategy A | 8 | - 12 |
| | Strategy A' | 10 | 15 |
| | Strategy B | - 10 | 20 |

Since the management of Company X observes that there is a possibility for Company Y to win if X plays Strategies A and B, it persistently stays at the A' level. In this case Company Y should apply column C in order to minimize its loss. The optimal strategies are Strategy A for Company X and Strategy C for Company Y.

Example 5:

| | | Strategy C | Company Y | |
|-----------|-------------|------------|------------|------------|
| | | | Strategy D | Strategy E |
| Company X | Strategy A | 5 | 4 | - 2 |
| | Strategy A' | 4 | - 5 | - 6 |
| | Strategy B | 0 | 3 | - 3 |

If Company Y is successful in applying Strategy E, Company X will have no chance to win. In this case Company X will apply Strategy A in order to minimize its loss.

What we have done so far is to analyze certain data from real life examples in terms of the benefit they provide to the companies.

The modern and cunning competitive conditions of today require companies to undertake certain measures. The calculation of the various outcomes resulting in profit or loss is a must whether it is done through estimation, past experiences or information obtained from employees of competing firms. For example, a manager who has no idea what kind of revenue can be obtained from an advertisement campaign and who acts with a "let's just run the campaign and leave the rest to God"

disposition cannot possibly be considered as a contemporary manager. Every managerial step should be taken with a specific purpose and full awareness of its possible outcomes.

Managers must have some sort of insight about their competitors' behavior while they are taking certain measures to gain a larger market share.

4. Nick-On and Caneo-On

Professionals and amateurs around the world prefer Nick-On and Caneo-On cameras because of their following features:

- a) The image quality created by their objectives
- b) The diversity of their products
- c) Their reliability, even under hard conditions.

Importers situated in different countries represent these two brands.

The representative firm of Nick-On in the country we will examine wishes, during the second half of year 2004, to promote certain activities aimed at increasing its market share. The primary initiatives the firm is considering will be the following:

- a) Apply certain discount rates on products,
- b) Make use of promotional sales,
- c) Offer payment by installments.

The management is naturally expecting that each activity will pay itself off and result with a certain increase of market share.

The managers of Nick-On Firm are also investigating what activities Caneo-On will be undertaking. It turns out that similarly, the representative firm of Caneo-on is planning to apply the following methods:

- a) Discount,
- b) Promotional sales,
- c) Installments.

Also, the representative firm of Nick-On has found out that Caneo-On is planning to run a TV advertisement.

The Nick-On representative prepares the following matrix according to both its own expectations and its competitor's expectations:

| | | Caneo - On | | | |
|-----------|-------------|------------|-----------|-------------|-------|
| | | Discount | Promotion | Installment | TV Ad |
| Nick - On | Discount | 15 | 8 | - 5 | 5 |
| | Promotion | 5 | 12 | 5 | - 5 |
| | Installment | 5 | 10 | 10 | 8 |

We can make out the meaning of the profit rates above by recalling the structure of game matrices previously described. But here, there is something else we must do. Upon careful examination of our matrix, a specific condition regarding Caneo-On should catch our attention. When the Promotion and Installment strategies of both firms are compared in a descending order it can be clearly detected that the Installment option is more beneficial for Caneo-On. The same holds true for the comparison of Promotion and TV Ad strategies of both firms. So, it will make no sense for the Caneo-On representative to implement the Promotion strategy and undergo the burden of promotional sales. The Installment and TV Ad strategies are under all circumstances – i.e. disregarding which strategy Nick-On chooses to implement – more beneficial.

Our matrix then changes as shown below:

| | | Caneo - On | | |
|-----------|-------------|------------|-------------|-------|
| | | Discount | Installment | TV Ad |
| Nick - On | Discount | 15 | - 5 | 5 |
| | Promotion | 5 | 5 | - 5 |
| | Installment | 5 | 10 | 8 |

In this step we must determine the initial behavior of the two firms who are in fact uninformed of one another and can only try to make sound predictions about what actions its counterpart will undertake.

If Nick-On decides to apply the Discount strategy it will at worst lose 5 points. If it decides to apply the Promotion strategy it will at worst again lose 5 points. On the other hand, the Installment option provides a profit for Nick-On. The lowest profit of this option is 5 points (meaning for example a 5% increase in market share). The best choice among the most unfavorable options is the application of the Installment strategy. This choice is labeled as MaxMin (determining the maximum outcome among the minimum values).

After the MaxMin choice with regard to the rows in the matrix, we can determine the MiniMax criterion for the Caneo-On firm with regard to the columns.

| Nick - On | Caneo - On | | | Minimum |
|-------------|------------|-------------|-------------|------------|
| | Discount | Installment | TV Ad | |
| Discount | 15 | - 5 | 5 | - 5 |
| Promotion | 5 | 5 | - 5 | - 5 |
| Installment | 5 | 10 | 8 | 5 (MaxMin) |
| Maximum | 15 | 10 | 8 (MiniMax) | |

Hereby Nick-On, in order to increase its market share by 5% at worst, and Caneo-On in order not to lose more than 8% of its own market share will have to choose as their initial strategies Installment and TV Ad respectively.

In the first instance Nick-On is willing to be contented with a 5% increase in market share. Yet, Caneo-On's choice of the TV Ad strategy, which minimizes Caneo-On's loss, actually provides an 8% increase instead of 5% for Nick-On's market share.

In the following time period during which these activities are continued, both firms will need to make new decisions to create more favorable outcomes for themselves.

Since Caneo-On will be applying the TV Ad strategy it will make no sense for Nick-On to choose to apply the Discount (providing a 5% increase in market share) or Promotion (incurring a 5% loss of market share) strategies. But the circumstances for the other firm Caneo-On are different. For example, while Nick-On sustains the Installment strategy, Caneo-On can withdraw the TV Ad (not willing to content with the 8% loss any more) and move on to the Discount strategy, incurring only a 5% loss of market share, which in fact is more favorable than the initial 8% loss of market share. So, in the second phase Caneo-On will apply the Discount strategy in order to diminish its loss of market share from 8% to 5%.

Likewise, Nick-On will also move on to the Discount strategy. The fact that both firms apply discount will result in a 15% increase in market share for Nick-On. Since a profit for Nick-On means a loss for Caneo-On, the latter will lose 15% of its market share.

In the following period Caneo-On will again change its strategy in order to improve its situation. While Nick-On applies Discount, Caneo-On will start an Installment campaign, through which it will provide a 5% increase in market share. Keeping a close watch over its competitor Nick-On will also undertake the Installment strategy, hereby increasing its market share by 10%.

While Nick-On sustains the Installment strategy, Caneo-On may implement the Discount strategy in order to improve its situation even further. In this case Caneo-On will have pulled back its loss of market share down to 5%. When Nick-On realizes that Caneo-On is applying discount, it will move on to the same strategy aiming to increase its own market share from 5% to 15% again.

In the long term, in order to determine the rate at which the players (Nick-On and Caneo-On) choose to play by the varying strategies and to find out the result of the game, conversions for x_i in rows and y_i in columns are performed, and the result of the game is found by means of algebra.

$$\begin{aligned}
 X_1 + X_2 + X_3 &= 1 \\
 15 X_1 + 5 X_2 + 5 X_3 &\geq k \\
 - 5 X_1 + 5 X_2 + 10 X_3 &\geq k \\
 5 X_1 - 5 X_2 + 8 X_3 &\geq k \\
 X_i &\geq 0, i = 1, 2, 3
 \end{aligned}$$

$$\begin{aligned}
 Y_1 + Y_3 + Y_4 &= 1 \\
 15 Y_1 - 5 Y_3 + 5 Y_4 &\leq k \\
 5 Y_1 + 5 Y_3 - 5 Y_4 &\leq k \\
 5 Y_1 + 10 Y_3 + 8 Y_4 &\leq k \\
 Y_i &\geq 0, i = 1, 2, 3
 \end{aligned}$$

For the solution of the equations obtained

$$\begin{aligned}X_1 + X_2 + X_3 &= 1 \\15 X_1 + 5 X_2 + 5 X_3 &= k \\- 5 X_1 + 5 X_2 + 10 X_3 &= k \\5 X_1 - 5 X_2 + 8 X_3 &= k\end{aligned}$$

$$\begin{aligned}Y_1 + Y_3 + Y_4 &= 1 \\15 Y_1 - 5 Y_3 + 5 Y_4 &= k \\5 Y_1 + 5 Y_3 - 5 Y_4 &= k \\5 Y_1 + 10 Y_3 + 8 Y_4 &= k\end{aligned}$$

Using the above equities, you can obtain the following results:

$$\begin{aligned}X_1 &= 1 - X_2 - X_3 \\15 (1 - X_2 - X_3) + 5 X_2 + 5 X_3 &= k \\- 5 (1 - X_2 - X_3) + 5 X_2 + 10 X_3 &= k \\5 (1 - X_2 - X_3) - 5 X_2 + 8 X_3 &= k\end{aligned}$$

Similar equations can be created for Y_i values.

5. Conclusion

Using the two sets consisting of 4 equations having 4 unknown values each solves the problem. The values found are called the frequency values for each of the firms. These values indicate the time period for the application of various strategies for Nick-On and Caneo-On. A negative (-) time value will have no value in practice. Such a value will imply that, for example choosing the TV Ad strategy will provide no profit for the Caneo-On representative firm. Nick-On will choose to apply the Installment option during 77% of the time period. It will also have to apply Discount during 19% of its time period and Promotional sales during the remaining 4%. As for Caneo-On, it will determine its time period for Discount and Installment strategies as 58% and 42% respectively.

The game value is 6.9. The Nick-On firm will increase its market share by 6.9% through the application of different strategies during various time periods. In return, the Caneo-On firm will be faced with a loss of market share at the same rate.

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