DYNAMIC PRICING FOR SPORTS EVENTS
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Abstract

Dynamic pricing has been a prominent research field, and there have been abundant studies conducted related to it. Even though most of them are conducted for hotel and airline industries, the number of studies in sports has been increasing. Especially, after the San Francisco Giants implemented dynamic pricing strategy to 5% of their stadium and generated $500,000 more revenue as the first professional sports team, the number of studies have expanded. However, most of the studies try to identify factors that affect the model. They mostly handle dynamic pricing from a managerial view and/or consider currently available models having been implemented by Major League of Baseball teams. The number of mathematical models of dynamic pricing is insufficient in this field. Sports games attract many spectators, thus it is believed that pricing tickets of them is worth taking into account. As indicated in the literature, dynamic pricing is appropriate for sports industry, and it should be preferred in practice instead of traditional pricing strategies that underprice tickets. This study mainly intends to contribute dynamic pricing in sports, by proposing a mathematical model for tickets of football games. The model is based on a reference price and price multipliers, thus the approach can be customized for clubs. This feature increases chance for success of the approach in practice. The number of assumptions is limited, so the applicability of the model is high. In this study, with the aim of revenue maximization, optimization of the multipliers is the main concern. Since most of the game characteristics of different sports disciplines are in common, the model can be applied to other sports disciplines by making a few changes. According to the results, the revenue is increased compared to the traditional pricing strategies.

Keywords: dynamic pricing, revenue management, optimization

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INTRODUCTION

Increasing expenditures of sports clubs force them to find new ways to cope with their financial obligations. Especially, football clubs face with rising transfer fees. They need to generate more revenue to cover their increasing spending. Football clubs generate their revenues mainly from three sources that are match day including ticket sales, broadcasting and commercial including merchandise and sponsors (Boor et al., 2016). Revenue generated from ticket sales can be controlled by a decent pricing strategy.

Static ticket pricing strategy is adopted dominantly by the football clubs all over the world. In this strategy, ticket prices are set before and remain same in time. Besides, some forms of variable ticket pricing strategy are used as well. Because of these traditional strategies, game tickets are underpriced in some of the football leagues. For instance, German Bundesliga and English Premier Leagues have the highest attendances among European football leagues. Even though English clubs are able to capitalize on ticket sales, German clubs need a more profitable pricing strategy (Nufer & Fischer, 2013). As indicated in the related literature, dynamic pricing is a promising strategy to optimize ticket prices (Stephen L Shapiro & Drayer, 2012). It does not require any cost or investments. Based on studies by Sheryl E Kimes (1989) and Sheryl E. Kimes, Chase, Choi, Lee, and Ngonzi (1998), it can be concluded that dynamic pricing strategy is appropriate for sports industry. Some of the reasons based on these studies can be explained as follows:

1. **Perishable inventory**: As sports tickets are perishable, they have to be sold before the game is over. Otherwise, it is worth nothing.
2. **Product sold in advance**: Tickets are sold months before a season starts, so there is an abundant time to sell tickets.
3. **Fluctuating demand**: Demand for tickets fluctuates depending on different factors such as performance of home and away teams, weather on the game day, and injury of star players.
4. **Low marginal sales cost**: Sports games generally attract many spectators. Hosting an additional spectator in the stadium does not cause a considerable marginal cost since clubs may generate additional revenue from merchandise or food sell.
5. **High marginal production costs**: In case tickets are sold out, it is not practical to add some other seats to the stadium instantaneously. Increasing the capacity of a stadium is generally a long-term plan that requires high production costs.
6. **Ability to segment markets**: The market can be segmented based on some characteristics such as season ticket status (Lee and et al., 2009).
7. **Predictable demand**: Each game has its own importance level. High important games attract more spectators generally. Effective factors on the importance of a game can be determined. Hence, the demand can be predicted to some extent.

Dynamic pricing is defined differently in studies. In some of them, dynamic pricing is accepted as a special form of revenue management that is commonly used in airline and hotel industries (van Ryzin & Talluri, 2005). Hence, they define revenue management as quantity based revenue management and dynamic pricing as price based revenue management. However, Bitran and Caldentey (2003) claim that revenue management is a sub form of dynamic pricing. No matter how they are defined, the ultimate objective of them is to maximize revenue by changing prices according to willingness to pay of customers.

Dynamic pricing studies in sports have been increasing recently. Especially, after the San Francisco Giants implemented dynamic pricing strategy to 5% of their stadium and generated $500,000 more revenue as the first professional sports team (Davenport, 2014). From that time on, dynamic pricing has been used by sports clubs in different disciplines as well. It is mostly...
adopted by MLB (Major League Baseball) and NBA (National Basketball Association) teams (PwC, 2015). However, a few football clubs have been using it such as Derby County. This situation is reflected to the literature. Almost all of the studies focus on MLB and they mostly handle dynamic pricing strategy from managerial view. The lack of mathematical models of dynamic pricing in sports is apparent. This study mainly aims to contribute to this area.
Implementing dynamic pricing strategy to football tickets may have some drawbacks. Since spectators are one of the invaluable sources of clubs in terms of revenue and motivation, discouraging them by offering high prices is pointless. Similarly, as season ticket holders produce upfront revenue for the clubs, dissuading them by offering lower prices than they pay per game is meaningless. Hence, the dynamic pricing model should be designed carefully. A price floor and/or price ceiling should be set in case it is needed even though it may limit the dynamic pricing model. The success of dynamic pricing strategy depends on its model and/or algorithm to some extent. The effective factors should be analyzed in detail and included in the model.
Dynamic pricing models are implemented in various industries from airline to entertainment. Models may have some characteristics in common. However, there may be some differences. For instance, dynamic price patterns may differ based on area in which it is applied to.
This study is organized as follows. In the following section, the dynamic pricing studies in sports are presented. Then, the details of the model are explained. An application is illustrated to clarify the model and to make comparisons in terms of revenue. The simulation results are presented. At the end, the study is concluded. The limitations of the model are illustrated and some suggestions towards future research are presented.

LITERATURE REVIEW

Most of the studies on revenue management or dynamic pricing are intended for airline or hotel industries. However, the number of dynamic pricing studies in sports has been increasing thanks to its successful applications in MLB and NBA. The current studies mostly try to determine the factors that form and affect dynamic pricing models rather than introducing a mathematical model. The lack of studies that propose mathematical models of dynamic pricing in sports industry is evident.
Parris, Drayer, and Shapiro (2012) suggest developing a dynamic pricing strategy for Los Angeles Dodgers baseball team. It is claimed that management support, training of workers and effective communication are required for successful implementation of dynamic pricing. Stephen L Shapiro and Drayer (2012) analyze Giants’ ticket prices in 2010 season in order to provide better understanding of dynamic pricing. Prices of static and dynamic pricing strategies and secondary market are considered. Static prices are low, and secondary market prices are high. Additionally, time is found to be significant on ticket prices. Cui, Duenyas, and Sahin (2012) consider pricing strategies in case of consumer resale. The main concern is to explain whether consumer resale boosts or decreases revenue. Sweeting (2012) asserts that dynamic pricing is important and increases revenue by 16%. Drayer, Shapiro, and Lee (2012) claim that sports teams underprice game tickets by adopting a cost based pricing strategy in order to maximize attendance and customer satisfaction. However, as expenses go higher, teams seek to find new pricing strategies instead of traditional strategies. Demand based pricing strategies are the main concern. Nufer and Fischer (2013) assert that even though German football clubs in Bundesliga league have one of the most match attendance numbers in European leagues, their match tickets are the cheapest. According to the findings, Bayern Munich football club has highest attendance, but it cannot monetize it enough because of its inefficient pricing strategy. An appropriate revenue management or dynamic pricing model is necessary for higher incomes. Maxcy and Drayer (2014) present factors such as game day and time, performance of home
team, and performance of players that affect dynamic pricing. It is asserted that captured money in secondary markets requires clubs to adopt dynamic pricing strategy. Lanzavecchia, Fallucca, Labianca, and Stover (2014) define dynamic pricing as changing prices in response to changing demand with the aim of maximizing both revenue and match day attendance. It is affirmed that dynamic ticket prices change based on time of ticket purchase, day of game, weather, and seat position in stadium. Stephen L. Shapiro and Drayer (2014) consider price determinants in both primary and secondary markets. Time and ticket related factors and performance factors of team and players are found to be significant. Zhu (2014) considers both primary and secondary markets in terms of dynamic pricing strategy. In case customers are not strategic, the revenue of the franchise can be increased by 6.93% in both markets. However, if customers are strategic, the revenue increase will be 3.67%. Phumchusri and Swann (2014) claim that sports and entertainment ticket industry may benefit from revenue management thanks to its selling products in a certain time characteristic. However, it has received less attention in the literature. They propose a dynamic pricing model in which demand depends on both ticket prices and time remaining to the event time. As a result, a revenue increase by 8.15% is achieved compared to the static pricing. Dwyer, Drayer, and Shapiro (2013) claim that customers expect to find cheaper tickets as starting time of game approaches. Moe, Fader, and Kahn (2011) try to determine factors that affect ticket prices. As home team wins, games become more important.

**DYNAMIC PRICING MODEL**

As indicated previously, one of the main objectives of this study is to propose a mathematical model of dynamic pricing model for football tickets. Similar dynamic pricing model was offered by Dorgham, Saleh, and Atiya (2015) for telecommunication industry. It is believed that similar logic can be applied to the football ticket pricing because price changes depending on time and inventory on hand are in common. Likewise, selling perishable inventory in a certain time period is mutual. However, there are some subtle differences. The timing slot of the call in telecommunication matters most. But, the characteristics of a football game are determinant for ticket prices. The mathematical models also differ from each other. First, there should be a price floor on football tickets because of season ticket holders. There should be a price ceiling as well in order to avoid discouraging potential spectators. The form and characteristics of multipliers are also different. The structure of the multipliers are more complex that make calculations elaborate.

In order to clarify the model, the models are implemented to an exemplary case. With the aim of simplifying calculations and shortening the optimization time, the features of the game and model are assumed to be as follows:

- The weather on the game day is 18 °C.
- The game will be played on Sunday at 19:00.
- Number of tickets is 1800.
- Means season ticket price is $45.
- The game tickets are offered for sale 30 days in advance.
- The home team collected 10 points in total in the last 5 games.
- Calculated prestige of the visitor team is 0.96.
- The ticket price is $65 for static pricing strategy.
- 100 customers arrive at the system daily.
RESULTS

The simulation results are given on Table 1 and Table 2. Maximum revenue is obtained after 4 iterations and 117 fitness function evaluations.

Table 1. Expected total revenue for the proposed model

| Iteration | Total Revenue ($) |
|-----------|-------------------|
| 0         | 122,453           |
| 1         | 122,913           |
| 2         | 123,049           |
| 3         | 123,049           |
| 4         | 123,447           |

$t_1$, $t_2$, $t_3$, $i_1$, $T_1$, and $T_2$ are the optimization variables and $t_4$ and $i_2$ are dependent variables in the case. According to the simulation results, the values of them are as follows:

Table 2. Optimization variable values of the proposed model

| Variables | Values |
|-----------|--------|
| $t_1$     | 0.8502 |
| $t_2$     | 0.9608 |
| $t_3$     | 1.1497 |
| $t_4$     | 1.3023 |
| $i_1$     | 1.0997 |
| $i_2$     | 1.1003 |
| $T_1$     | 8.7456 |
| $T_2$     | 0.1080 |

The ticket prices of the static pricing strategy are same for 30 days. The comparison of total revenues is shown on Table 3. The revenue difference compared to the static pricing is also shown. Based on the results, the proposed dynamic pricing model generates more revenue than static pricing strategy.

Table 3. Total revenue comparisons of the dynamic and static pricing strategies

| Pricing Strategy   | Revenue  | Difference |
|--------------------|----------|------------|
| Static             | $117,000 | -          |
| Dynamic Pricing    | $123,447 | %5.51      |

CONCLUSION

A dynamic ticket pricing model for football clubs is proposed in this study. Dynamic ticket prices are determined based on the multipliers. According to the results, the dynamic ticket pricing model generated more revenue than the static pricing strategy. The proposed model is expected to contribute to the sports literature in terms of mathematical models of dynamic pricing. Almost all of the dynamic pricing studies in sports try to explain effective factors on dynamic pricing models and/or try to handle dynamic pricing model from a managerial perspective. This approach may be enhanced by using real data. In this way, the model will be more realistic and applicable to the football clubs. By making few changes, the model can be implemented to
other sports disciplines either. Besides, considering strategic customers might enhance the applicability of the model. Additionally, considering consumer resale effects might also improve the quality of the model.

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