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PRACTICE ARTICLE

Yield management for the cinema industry

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Abstract

Cinema operators have so far behaved more conservatively in terms of their price management. In the course of the digital transformation, there are many opportunities for price innovations. The implementation of yield management strategies in the cinema industry would have a positive impact on revenue and capacity utilization and can both strengthen the competitive situation of cinemas and contribute to increasing profitability. It is essential to determine what the number or proportion of discounted tickets should be and how many tickets can be sold at the regular price. This can be calculated using the critical fractile method, which assumes that the demand follows the normal distribution in a certain period and the distribution parameters are known. In this paper, the number of tickets to be offered at the regular price is calculated based on the evaluation of statistical data on visitor numbers, occupancy rates and prices of the German cinema industry and a leading German cinema chain.

Keywords Yield management · Cinema industry · Critical fractile · Revenue management · Dynamic pricing

What's hot at the movies? Yield management for the cinema industry using the critical fractile method

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Introduction

In recent years, there have been few innovations in price management in the cinema industry. Cinema operators usually differentiate their prices depending on the day of the week by lowering ticket prices on so-called "cinema days" to increase demand on those days. Furthermore, they use the instrument of personal price differentiation, so that different persons pay different prices for the basically identical product from each other. In this socially accepted form of "price discrimination", for example, students, retirees or students can buy movie tickets at significantly lower prices. In addition, the price bundling—the package sale of several cinema

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productions at a total price that is lower than the sum of the individual prices (e.g. as a subscription)—and the multi-person pricing—special offers for groups of people (e.g. "Family Day" or "Ladies' Night"), which will allow children, partners or escorts to have a cheaper or free admission to the cinema show—established strategies of price differentiation. However, these typical price policy strategies for the cinema industry do not refer to fluctuations in demand, nor do they take account of fixed capacities and thus the possibilities of managing capacity utilization. Thus, the existing potential of the cinema industry for the application of strategies of dynamic pricing and yield management, also referred to as revenue management, as it is operated in particular by airlines, railway companies or hotel chains (Abrate et al. 2012; Deksnyte and Lydeka 2012), largely unused. In ticketing for events, various models of price differentiation and channel management, based on demand forecasts for the respective productions, are already being used, so that the need to catch up in the cinema industry is evident.

Etymology and development of dynamic pricing and yield management

Dynamic pricing can probably be traced back to the research of the French mathematic Henri Poincaré on temporal changes in dynamic systems at the end of the nineteenth century (Poincaré 1892). Griffith Conrad Evans became a pioneer of dynamic pricing in 1924, formulating a mathematical model for a monopolistic vendor in two different time periods (Evans 1924) to determine the optimal price. The assumption was that demand is dependent on both price and time (den Boer 2015).

The exploration of yield management, which aims to maximize yields, began in the 1970s. Yield Management strives for optimal price management under the condition of fixed capacity. Given the low variable costs (often zero), this corresponds to maximizing profit when the marginal costs are zero. Yield management is a powerful profit driver. The implementation of yield management resulted in a 2–5% increase in revenues for companies (Smith et al. 1992; O'Connor and Murphy 2008). According to Yeoman and Watson 1997), yield management is a process based on forecasts, strategies and people, with the human aspect being the cornerstone of successful yield management practices and yield management being understood as a human activity system.

The development of Littlewood's Rule in 1972 (Littlewood 1972) provided the starting point for predicting load factors based on advance bookings (Littlewood 2005). The algorithm developed by Littlewood enabled the creation of a forecasting system based on a seat inventory problem for a single route with two fare classes. Littlewood first proposed grouping flights from low-demand origin and destination airports into broader categories, establishing the first static revenue management model based on a single resource (Weatherford 2016). Revenue management has experienced a number of turning points in its development (Yeoman and McMahon-Beattie 2017). The Expected Marginal Seat Revenue (EMSR) concept, introduced by Belobaba in 1987, expanded on Littlewood's Rule and became the basis of most airline revenue management systems. EMSR is of great importance and even today most revenue management systems are based on it (Belobaba 1987; Yeoman 2016). It uses heuristic decision rules for nested bookings by adding protective limits calculated by applying Littlewood's rule to consecutive classes. EMSR was further refined and became EMSRb, improving optimal solutions by 0.5 percent (Belobaba 2016).

The digital transformation has already resulted in price changes that can now be calculated and performed almost automatically at very low cost. The permanent availability of digital devices and the location-independent access to apps and websites of cinema platforms or operators ensure almost complete market transparency and create the conditions for digital pricing (Oh and Lucas 2006). However, users' behavior is also becoming ever more transparent, as they largely provide the required data base themselves because time, location, frequency of their access to an app or website and their previous purchase activities are largely problem-free to grasp and analyze. The evaluation of the data leads to a perfect personal price differentiation on the basis of the user profiles created with it and for each potential customer the individual price can be calculated algorithmically (Borgesius and Poort 2017). In addition to the opportunity to increase sales, cinema chains can also appeal to attractive customer segments, differentiate themselves from competitors and improve their own market position.

In the following, we will examine the extent to which dynamic pricing and yield management can be implemented in the cinema industry and which such strategies and instruments of price differentiation are recommended for cinema operators.

Requirements for the application of yield management

Yield Management is a complex form of price differentiation over time (Simon 2015), where simultaneous and dynamic price and capacity control is used to maximize maximum fixed capacity utilization (Simon and Fassnacht 2019; Kahneman et al. 1986). The aim is to assign differentiated price categories to different market segments according to their respective willingness to pay in order to increase their earnings. It is fundamentally differentiated between price-elastic and price inelastic reacting segments of buyers. This results in the idea that price-insensitive consumers with high willingness to pay should pay premium prices and price-sensitive customers discount prices (Tellis 1986; Desiraju and Shugan 1999; Kimes 2000). This leads to an increase in sales and a better capacity utilization (Kimes 1989a). Yield management techniques were originally used by international airlines in the mid-1970s, with American Airlines as a pioneer (Simon and Fassnacht 2019). Through a system of price adjustments, high occupancy of aircraft seats should be achieved. Meanwhile, hotel chains, rail companies, cruise lines, car rental companies, travel and transport companies as well as similar service providers also practice yield management successfully (Jallat and Ancarani 2008). For cinema operators too, the application seems sensible, since the characteristic conditions with regard to supply (points 1—3) and demand (points 4—6) are fulfilled (Kimes 1989b; Fitzsimmons et al. 2014; Simon and Fassnacht 2019; Heo and Lee 2009):

1. The offered seating capacity in cinemas is fixed. In a sold-out cinema, additional customers can be served due to the rigid capacity cap later at a later date.

2. There are low variable costs for service provision, whereas an increase in capacity (for example, through construction) would require high fixed costs.

3. Unused capacity expires so that unsold tickets for a movie show result in irrecoverable revenue losses.

4. The purchase of the service takes place before the service provision or consumption. With the purchase or reservation of a movie ticket, a performance promise is acquired. There is uncertainty for the buyers if the film will meet their expectations.

5. Among the moviegoers, different price-elastic customer groups or differentiated willingness to pay can be identified.

6. The demand for cinema tickets is subject to fluctuations, e.g. on different weekdays, times of day and different movies, and is uncertain.

A (simplified) segmentation of the cinema market leads on the one hand to a distinction between price-sensitive or price-elastic and price-insensitive or price-inelastic buyers and on the other to a differentiation between time-flexible and time-inflexible customers (Desiraju and Shugan 1999; Tellis 1986). For example, some customers may only go to the weekend for a movie because they do not have time for leisure activities during the week (Table 1).

Yield Management counters fluctuations in demand due to lower prices in times of low-demand and price increases in times of high demand (Kimes 1989b). Desirable are therefore forecasts of the time course and the price elasticity of demand.

Favoring early ticket bookings

Preventing early ticket bookings motivates price-sensitive moviegoers to buy their tickets at a very early stage. The sooner the movie tickets are bought, the lower is their price. However, it is important to precisely calculate what proportion of tickets can be sold at reduced prices and what number of tickets must be withheld for price inelastic buyers. Through the use of reservation systems, the time interval between booking or purchase decision and consumption can be made variable. In yield management, the decision must be made as to whether early bookings should be preferred or confirmed at a reduced price, or whether it would be better to retain capacities in order to later be able to absorb higher willingness to pay (Sviokla 2003) from other customer segments (Cross 1997; Pfeiffer 1989).

In a quantitative study on decision-making strategies and film selection criteria of the cinema audience, 702 cinemagoers were interviewed directly in the film theater. 447 of the interviewees (63.68%) stated that they had to decide which film to watch before the visit or at the latest on the way to the cinema, while 186 respondents (26.50%) spontaneously decided on the day of the planned screening to meet. 69 subjects (9.83%) first decide to go to the cinema, and then decide which movie they want to watch (Ranné 2004). The clear majority of the interviewed Moviegoers already knows in advance or on the way to the cinema, for which film they are interested. Thus, the promotion of early bookings for cinema operators is worthwhile.

Table 1 Segmentation of the Cinema Market

High Time sensitiveness low	Low opportunity customers Most inflexible moviegoers	Medium opportunity customers Weekenders
	Medium opportunity customers Cinema day moviegoers	High opportunity customers Most flexible moviegoers
	Low willingness to pay high	
	Low-yield customers	High-yield customers

Own illustration

Implementation of the pricing model

Discounting early ticket purchases

Discounting early ticket purchases is a strategy for attracting price-sensitive customers buying their tickets as early as possible. A new cinema program which is valid for one week starts every Thursday. This new cinema schedule is published on Mondays. So, every customer has the chance to plan a cinema visit a few days in advance. But it is important to limit the number of discounted tickets. This motivates the customer to buy a ticket as early as possible because it is likely that these tickets will be sold-out at a later time.

Customers need to decide in advance which movie they want to watch. The decision has to be made at the box office at least. Thus, it can be assumed that the decision point varies between customers. There are some who decide very early which movie they want to watch and others decide spontaneously. To apply this pricing model, it is essential to have customers who are willing to make the film decision very early. Otherwise this pricing model would not be attractive for customers. The major movie theaters chains publish their new cinema schedule on Mondays and this then applies from Thursday—on this day the new films are in the cinemas—until the Wednesday of the following week. This would give cinema-goers the opportunity to reserve tickets for a film a maximum of nine days in advance. The model follows the principle that the discount granted on the ticket price should be higher the earlier the booking is made. The sample calculation is based on the price of € 7.50 for a 2D film on a Wednesday (Table 2).

Demand is influenced by various factors, such as weather, holidays, and the quality of the movies. Therefore, it makes sense to adjust the discount rate to the expected demand.

Table 2 Discount for early purchase

Booking days in advance	Day of the week	Discount%	Discounted price
9	Monday	50	€ 3.75
8	Tuesday	45	€ 4.13
7	Wednesday	40	€ 4.50
6	Thursday	35	€ 4.88
5	Friday	30	€ 5.25
4	Saturday	25	€ 5.63
3	Sunday	20	€ 6.00
2	Monday	15	€ 6.38
1	Tuesday	10	€ 6.75
0	Wednesday	0	€ 7.50

Own illustration and own calculations

Calculation of the optimal number of discounted tickets using the critical fractile method

It is essential to determine what the number or proportion of discounted tickets should be and how many tickets can be sold at the normal price. This can be calculated using the critical fractile method, which assumes that the demand (e.g. for cinema tickets) follows the normal distribution in a certain period and the distribution parameters are known.

The calculations are based on two types of tariffs: in the airline industry, consumers with a high willingness to pay are referred to as high-yield passengers and those with a low willingness to pay are referred to as low-yield passengers. Low-yield passengers tend to book earlier to get cheaper rates, while high-yield passengers book later.

If you didn't hold tickets at the regular price, it would very likely be that all tickets would be sold to low-yield passengers, while the high-yield passengers would have to be rejected due to their late reservation. This would lead to significant earnings losses. It is therefore important to calculate the number of tickets at the regular price that must be held back in order to meet the demand of high-yield passengers (Littlewood 2005).

Overbooking, which is common in yield management, is also a critical element for very attractive films and prime time show times. Overbooking is used as a compensation procedure to protect against utilization risks through no-shows (short-term no shows) or go-shows (unexpected additional appearances). Statistics for no shows and cancellations in the past are required for the use of overbooking (Kimes 1989b), which have not yet existed in the cinema industry.

If cinema-goers have to be rejected despite a reservation, this is perceived as unfair and inevitably leads to disappointment and very likely to emigration to a competing cinema (Campbell 1999). An inaccurate forecast can also potentially result in a loss of revenue if the company incorrectly expects too little overcapacity and therefore not sufficiently overbooked (von Wangenheim and Bayon 2007).

The four-step model of calculation

Step 1: Estimating the percentage of price-sensitive and price-insensitive customers

To estimate the percentage of price-sensitive and price-insensitive customers, the average ticket prices of each day of the week will be analyzed. The following chart illustrates the average ticket prices of one week in October 2015. These average prices are based on prices of all cinemas in Germany.

Generally, price fluctuations in the cinema industry have little impact on the demand (Castendyk et al. 2014). It follows that most cinema visitors are price-insensitive. The figure illustrates the average prices paid and the number of visitors each day of the week.

It will be assumed that from Monday to Thursday price sensitive customers visit the cinemas in Germany because the average price is lower than the average prices from Wednesday to Sunday. A total of 26.27% of all cinema visitors in Germany are price-sensitive and 73.73% of them are price-insensitive (Friday-Sunday).

The first step is to calculate the demand for tickets at the regular price. To do this, it is necessary to determine the percentages of customers who react price-elastic (-sensitive) and price-inelastic (-insensitive). Price changes usually have little impact on demand in the cinema industry (Castendyk et al. 2014). The majority of cinema-goers react inelastic to price changes. Possible resistance to price changes cannot be considered in the context of this article.

The following illustration shows the average ticket prices and the number of visitors in the week from October 1st to October 7th, 2015 in Germany. It is assumed that customers who react to price changes will visit the cinemas from Monday to Thursday, since the arithmetic mean of ticket prices increases these days is considerably less than from Friday to Sunday. From this it can be deduced that 26.27% of German cinema-goers react elastically to price changes, while 73.73% are rather inelastic (Table 3).

Step 2: Calculation of the probability that the demand for regular tickets is lower than the number of regular tickets offered

The basic form of the critical fractile model is as follows:

$$\boldsymbol{P(d < x) \leq \frac{C_u}{C_u + C_o}}$$

P: Likelihood of demand.

d: Demand for regular tickets

x: Number of regular tickets offered

C_u: Lost profit due to an underestimated demand for regular tickets

c_o: costs due to an overestimated demand for regular tickets.

From the basic model, the formula suited for the present case is developed:

$$P(d < x) \leq \frac{(F - D)}{(F - D) + p * D - (1 - p) * (F - D)}$$

F: Price of regular tickets.

D: Price of discounted tickets

p: Percentage of price-sensitive customers.

This results in:

$$P(d < x) \leq \frac{(F - D)}{F - D + p * D - F + D + p * F - p * D}$$

The formula can be simplified:

$$P(d < x) \leq \frac{F - D}{p * F}$$

In the calculation, the price F = € 7.50 of regular tickets for a 2D movie on a Wednesday was used, whereas the price of discounted tickets D = € 6.75 results from a discount of 10% on a ticket reservation on the previous Tuesday.

The percentage of price-sensitive customers going to the cinema from Monday to Tuesday is p = 0.2627 (26.27%).

$$p(d < x) \leq \frac{€7.50 - €6.75}{0.2627 * €7.50}$$

$$\boldsymbol{P(d < x) \leq 0.3807}$$

This results in a probability of 0.3807 (38.07%).

Table 3 Percentage of price-sensitive and price-insensitive moviegoers

Day of the week	Number of visitors	Average price	Price-sensitive/-unsensitive customers	Percentage%
Monday	188.123	€ 7.58	707.127	26.27
Tuesday	286.370	€ 7.35		
Wednesday	232.634	€ 7.94		
Thursday	195.264	€ 8.54		
Friday	394.231	€ 9.14	1.984.806	73.73
Saturday	794.833	€ 9.21		
Sunday	600.478	€ 8.49		
Total	2.691.933		2.691.933	100.00

Own calculations using data of the FFA Berlin 2015 and qlikview of the week 01/10/15 – 07/10/15

Step 3: Taking the corresponding (one-sided) z value from the normal distribution table

For the calculated probability of P = 0.3807, the corresponding (one-sided) z value can be taken from the normal distribution table: **z = −0.6480**.

Step 4: Calculation of the amount of reserved full fare seats

For the calculation of the amount of reserved full fare seats that should be withheld, the following formula is appropriate:

$$x = \mu + z * \sigma$$

μ: Normal capacity utilization

σ: Standard deviation.

In Germany, an average degree of capacity utilization of 13.6% was achieved in 2013.

There were clear differences between the federal states: While the utilization in Baden-Wuerttemberg and Hessen averaged 16.1%, followed by Hamburg and Mecklenburg-Vorpommern with 15.5%, Saxony-Anhalt only achieved 6.9%.

Within the federal states, there were considerable fluctuations: The capacity utilization in Mecklenburg-Vorpommern fluctuated between 7.8% und 23.2%. The standard deviation was 7.7 percentage points (Castendyk et al. 2014).

For the calculation of the amount of reserved regular tickets, the federal state Mecklenburg-Vorpommern is used as an example.

Assuming a cinema has 500 seats, the (average) capacity utilization will be 0.155 * 500 = 77.5 seats.

The standard deviation is 0.077. Multiplied by 500 seats, this results in 0.077 * 500 = 38.5 seats.

Using the z value, this results in:

x = 77.5 + (-0.6480 * 38.5)

x = 52.55.

Thus, 53 Tickets should be withheld and sold at the regular price.

Unattractive starting times and films with low visitor numbers

The attractiveness of a film screening depends to a considerable extent on the time the film began. If prime time films start at 8:00 p.m., they usually record significantly higher attendance, especially on weekdays, than performances that take place in the early afternoon or at midnight (Castendyk et al. 2014). However, this difference in attractiveness has so far not been considered in pricing, because all prices are subject to a standard price. It makes sense to offer reduced-priced tickets for screenings starting at an unofficial time of day in order to reduce the number of unsold tickets and increase sales. Such a temporal price differentiation depending on the start of the presentation would primarily address the market segment of time-flexible and elastic price responding (price-sensitive) demand for which there are hardly any special offers.

To illustrate the model, it is assumed that a cinema operator offers four performances on weekdays for one and the same movie, which take place at 2:00 p.m., 5:00 p.m., 8:00 p.m. and 11:00 p.m. The performance at 8:00 p.m. is the most popular and most attractive, because it is a normal time for a visit to the cinema, where the highest ratings are also achieved on (linear) television. The other three times are less attractive. The performance at 2:00 p.m. is within, at 5:00 p.m. at the edge of the usual core working time, while the beginning at 11:00 p.m. is too late for many employees who have to return to work the next morning. In order to increase the traction of these periods, another yield management strategy would make sense, staggering prices depending on the attractiveness of the start of the presentation. The performances at 2:00 p.m. and 11:00 p.m. could be offered at a reduced price of 25%, whereas for tickets at 5:00 p.m. the discount would be 10%. At a regular price of, for example, € 8.50 for the 8:00 p.m. performance of a 2D movie on a working day, the ticket prices fell to € 6.38 for performances at 2:00 p.m. and 11:00 p.m. and on € 7.65 for the 5:00 p.m. performance.

This pricing strategy would be tailor-made for the price-sensitive, but temporally flexible target group, which could in principle fulfill each of the four presentation times (Jerath et al. 2010). This would opt for the cheapest ideas. Similarly, discounts could be granted for unattractive films with low visitor numbers or for films that have been running for several weeks and have absorbed most of the demand. This would tend to result in more stable capacity utilization and higher revenues.

Queue management

On Fridays or Saturdays, the number of visitors to the cinema is significantly higher than on other weekdays. The increased demand on these days leads to longer waiting times at ticket counters. However, time is precious for a large number of consumers. It is therefore recommended to classify cinema visitors in terms of their willingness to wait longer in two market segments. One group accepts the longer waiting times while the other is willing to pay a premium to avoid them (Friedman and Friedman 1997). It is therefore a decision or a trade-off between time and money. In view of the willingness to pay for shorter waiting periods, higher premiums can be generated by means of the surcharges. Efficiency is increased by reducing waiting times, which can rise customer satisfaction for some of the visitors (Larson et al. 1991).

It is a strategy known by airlines and amusement parks. The airline “easyJet” offers “Speedy Boarding”. Passengers can book it in addition to their flight ticket, using the Priority Check-in counter and saving time. This allows them to take the "fast lane" in the safety review and get into the plane first (easyJet 2017). The Universal studios offer "Express Plus Pass", which allows guests to refuse to follow the prescribed procedures and to attend the various stations within the theme park without waiting (Heo and Lee 2009).

The introduction of queue management by cinema operators requires the installation of ticket counters, which allow moviegoers to avoid waiting times to buy tickets, snacks and drinks by paying a surcharge (Wirtz and Kimes 2007). The opening of such ticket counter would be worthwhile, especially on days of high capacity utilization.

This price strategy addresses the target group, which is characterized by an inelastic reaction to price changes or a high willingness to pay but little time flexibility. The challenge is to determine the amount of the surcharge on the regular ticket price. If the additional price is too low, many customers would choose this option, which would not produce the desired effect of shortening the waiting times. On the other hand, if the premium is too high, it would discourage visitors from buying and lead to reactance (Horowitz and McConnell 2003). A reasonable premium could be 20% of the regular price. This form of queue management could increase the yield per moviegoer as well as shorten waiting times. Digital Pricing allows a dynamic individual parameterization of queues.

Conclusions

The German cinema operators have so far behaved more conservatively in terms of their price management. In the course of the technology leaps associated with the digital transformation, there are many opportunities for price innovations. The implementation of yield management strategies in the cinema industry would have a positive impact on revenue and capacity utilization. In addition, the industry competition would receive new impetus. Cinema operators who adopt strategies such as yield management first face the risk of uncertainty among consumers, but could gain a competitive advantage and benefit from the communication impact because consumers follow the trends very quickly if they offer them benefits.

At launch, priority should first be given to policies and instruments that require the least amount of investment and time. This is especially true for the discounting of tickets for performances at unattractive times of day and less catchy films as well as the queue management.

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