Group Coursework Submission Form

Specialist Masters Programme

Please list all names of group members: (Surname, first name) 1. Bakogiannis, Konstantinos 2. Donado Agudelo, Valentina 3. Farina Alcedo, Blanca	4. Kampisioulis, Marinos **GROUP NUMBER:** **2**
MSc in: Business Analytics	
Module Code: SMM641	
Module Title: Revenue Management and Pricing	
Lecturer: Dr Oben Ceryan	**Submission Date:** 12/12/2024

Declaration:

By submitting this work, we declare that this work is entirely our own except those parts duly identified and referenced in my submission. It complies with any specified word limits and the requirements and regulations detailed in the coursework instructions and any other relevant programme and module documentation. In submitting this work we acknowledge that we have read and understood the regulations and code regarding academic misconduct, including that relating to plagiarism, as specified in the Programme Handbook. We also acknowledge that this work will be subject to a variety of checks for academic misconduct.

We acknowledge that work submitted late without a granted extension will be subject to penalties, as outlined in the Programme Handbook. Penalties will be applied for a maximum of five days lateness, after which a mark of zero will be awarded.

Marker's Comments (if not being marked on-line):

Deduction for Late Submission:

Final Mark: **%**

REVENUE OPTIMAZATION FOR PANATHINAIKOS BASKETBALL GAMES

REVENUE MANAGEMENT AND PRICING - SMM641

GROUP 2

Introduction

Panathinaikos Basketball Club, a dominant force in European basketball, recently celebrated its EuroLeague victory and unveiled a renovated home arena designed to be a benchmark for sports facilities. This milestone has not only elevated fan interest but also created an opportunity for the club to maximize its matchday revenue. Ticket pricing, a critical element in this equation, needs to balance financial objectives with fan satisfaction. The overarching goal of this project is to optimize ticket prices for each section and match tier within the arena to maximize revenue while adhering to constraints related to seating capacity and demand.

This analysis focuses on five key seating sections within the arena: General, Family, VIP, Courtside, and Ultras. Each section has distinct characteristics in terms of fan preferences, demand, and capacity. Ticket prices are optimized for three match tiers: Tier 1, representing high-profile matches with strong fan interest, Tier 2, representing mid-level matches, and Tier 3, consisting of matches with lower demand. Additionally, this report compares this year's optimized pricing results to last year's revenue generated from fixed ticket prices. The comparison highlights the financial benefits of implementing data-driven pricing strategies.

Data and Problem Description

The dataset used for this analysis comprises willingness-to-pay (WTP) data for fans across the five seating sections and three match tiers. The WTP data reflects the maximum price fans are willing to pay for tickets based on the attractiveness of the match and the seating section. The sections in the arena have different scaled capacities: 14500 for the General section, 2,000 for the Family section, 7,500 for the VIP section, 2,500 for the Courtside section, and 2,000 for the Ultras section. These scaled capacities were determined to simplify optimization calculations. For most sections, demand was required to meet at least 80% of the scaled capacity, ensuring effective utilization of available seats. However, the Ultras section had a unique constraint where full capacity utilization was mandatory for all match tiers, as they constitute the backbone of the team's fan support.

Last year's ticket prices were gathered from historical data in online platforms and are as follows:

	Sections	Prices
General	101-109, 401-405B, 406-411	30€, 60€, 75€
Family	120-142	25€, 50€, 65€
VIP	123-129	50€ , 100€, 150€
Courtside	103B-107B, 114B-118B, 125B-128B, 124B-138B	150€, 300€, 450€
Ultras	110-122	20€, 40€, 60€

Table 1: Historical data for ticket pricing and gate allocation

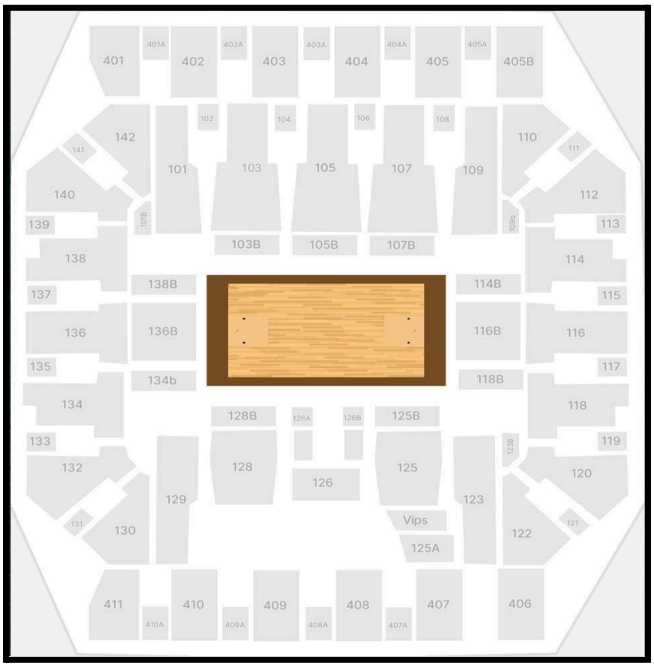

Figure 1: Map of OAKA Basketball Arena

The problem statement involves determining the optimal ticket price for each section and tier that maximizes revenue. Revenue is defined as the product of ticket price and demand, where demand is modeled as the number of fans willing to pay a price greater than or equal to the ticket price. Constraints on minimum and maximum demand were incorporated to ensure both financial and operational objectives were met.

Methodology

This study implemented a non-linear optimization approach to determine the optimal ticket prices for Panathinaikos Basketball Club's matches, focusing on maximizing revenue while adhering to constraints related to capacity and demand. The methodology was divided into key

steps, starting with data preparation and concluding in the evaluation of the optimization results.

The dataset was constructed to model the willingness to pay for match tickets among five fan groups-General, Family, VIP, Courtside, and Ultras- across three match tiers, with Tier 1 being the most attractive and Tier 3 the least. Using a Gaussian distribution, WTP values were generated with means and standard deviations reflecting the affluency and preferences of each group. Affluent groups, like VIP and Courtside fans, exhibited higher WTP and greater variability, while less affluent groups, such as Families and General fans, showed more conservative spending patterns. Ultras remained consistent across tiers, while General fans displayed increasing WTP for higher-quality matches. The 400-sample dataset represents a larger market of 40,000 potential customers, providing a robust basis for optimization. The data was cleaned to ensure all WTP values were numeric, providing a reliable foundation for optimization. Scaled capacities were assigned to each section to simplify calculations, and constraints were defined for both minimum and maximum demand. For most sections, demand was required to meet at least 80% of the scaled capacity, while the Ultras section was uniquely constrained to always achieve full capacity.

The optimization framework used the constraint optimization by linear approximation algorithm, which is well-suited for handling non-linear constraints. The objective function maximized revenue, defined as the product of ticket price and demand, where demand was the number of fans willing to pay at least the ticket price. For each section and tier, the algorithm iteratively determined the price that maximized revenue while respecting the capacity constraints. An initial price guess was set as the mean WTP for each tier, and the algorithm adjusted this iteratively until convergence.

Each section was optimized sequentially. For instance, the General section was analyzed across all tiers, with results showing optimal prices and corresponding demand that met the defined constraints. The same process was applied to the Family, VIP, Courtside, and Ultras sections. While most sections followed similar optimization logic, the Ultras section required a stricter approach to ensure demand equaled capacity for all tiers.

To provide insights into pricing and demand relationships, revenue curves were generated for all sections and tiers. These plots visually represented how revenue changed with varying ticket prices, with the optimal price highlighted using a vertical dotted line. This step was crucial for interpreting the results of the optimization process.

Finally, a comparative analysis was conducted to evaluate the benefits of the optimized pricing strategy. Last year’s fixed ticket prices were applied to the same WTP data, and revenue was

calculated under similar constraints. This allowed for a direct comparison between the revenue generated using fixed prices and that achieved through optimized pricing.

Overall, this methodology combined robust optimization techniques with visualization and comparative analysis, enabling a comprehensive approach to ticket pricing. The results demonstrate the financial potential of data-driven strategies for maximizing matchday revenue.

Results

The optimization process provided actionable insights into pricing strategies, highlighting the potential for significant revenue improvements across all seating sections and match tiers. By leveraging data-driven techniques, the club achieved prices that align with fan willingness-to-pay, maximize revenue, and maintain efficient utilization of arena capacity. The optimized prices, revenues, and demands for each seating section and tier are summarized in Table 2. These results reveal how each section contributes to the overall revenue, with pricing tailored to its capacity and fan behavior.

Section	Tier 1			Tier 2			Tier 3		
	Price (€)	Revenue (€)	Demand	Price (€)	Revenue (€)	Demand	Price (€)	Revenue (€)	Demand
General	78.00	11232.00	144.00	55.00	7975.00	150.00	35.00	4095.00	117.00
Family	59.00	1121.00	19.00	38.00	722.00	19.00	27.00	459.00	17.00
VIP	370.00	2775.00	8.00	281.00	2107.50	10.00	196.00	1470.00	8.00
Courtside	468.00	1170.00	3.00	404.00	1010.00	3.00	250.00	625.00	3.00
Ultras	72.00	1440.00	20.00	54.00	1080.00	20.00	25.00	500.00	20.00

Table 2: Optimized Ticket Prices, Revenues, and Demands (Scaled)

The General section emerged as the largest contributor to revenue, benefiting from its high capacity and broad appeal. For Tier 1 matches, the section generated £11,232, nearly three times the revenue of any other section. The VIP section, with its premium pricing, also performed strongly, generating significant revenues despite lower demand. Courtside's limited capacity yielded steady but modest contributions, while the Ultras section successfully achieved full capacity for all tiers, maintaining consistent revenue levels. The Family section, catering to a specific fan demographic, exhibited moderate revenues across all tiers. However, its demand is closely aligned with constraints, showcasing the effectiveness of targeted pricing in maintaining occupancy.

To further understand the pricing dynamics, revenue curves were generated for all seating sections and match tiers, as shown in Figure 2. These plots illustrate how revenue varies with ticket prices and highlight the optimal price points (indicated by the red dotted lines) for each section and tier. The curves demonstrate distinct patterns based on capacity and willingness-to-pay, with sections like General and VIP showing broader revenue peaks due to their demand flexibility, while Courtside and Family exhibit steeper declines due to capacity limitations. The consistent full-capacity performance of Ultras is also evident. These visualizations provide a clear, data-driven basis for interpreting the optimization outcomes and their alignment with revenue objectives.

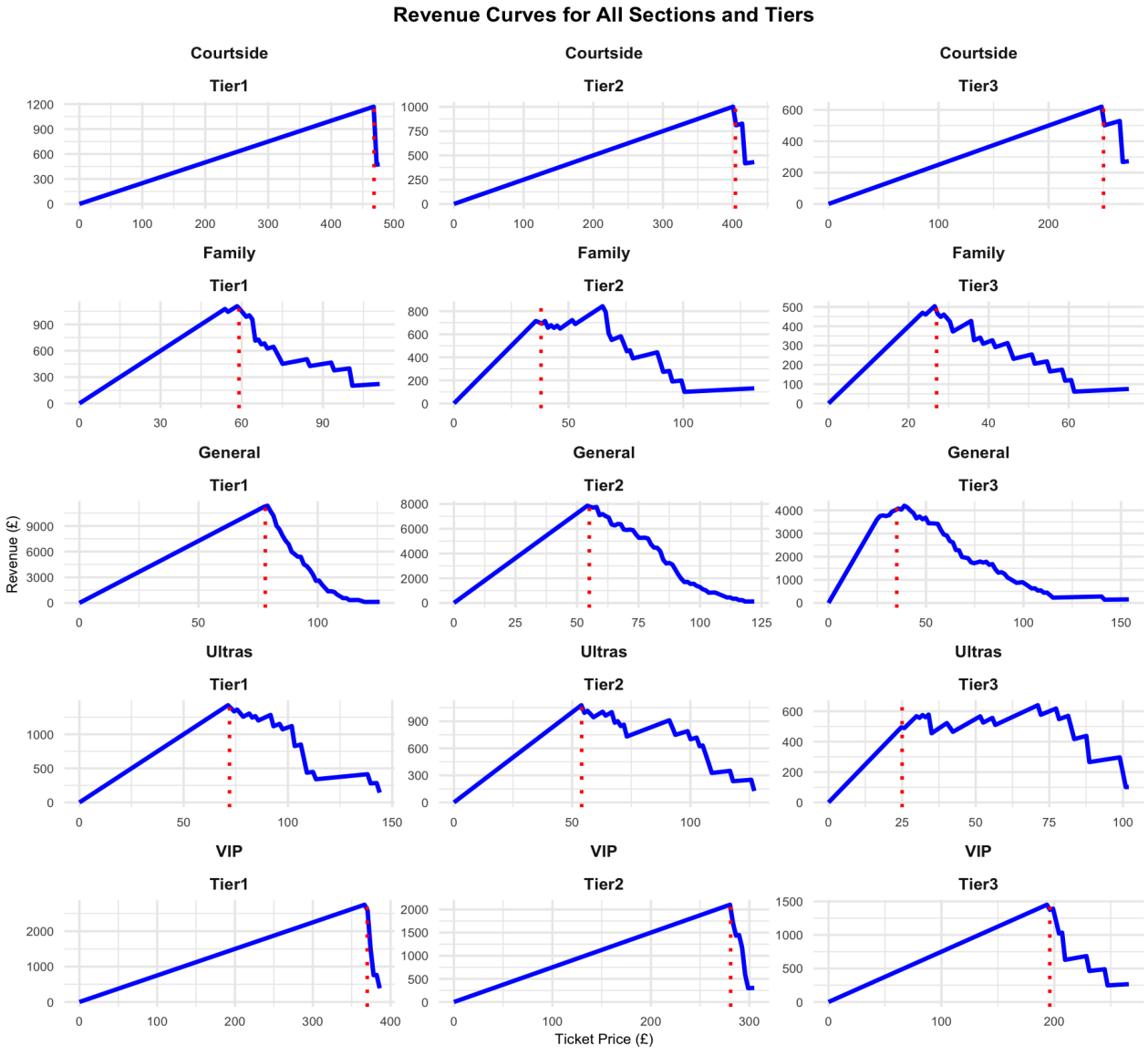

Figure 2: Revenue curves for all sections across all tiers

A comparison between this year's optimized pricing and last year's fixed prices highlights the financial benefits of data-driven optimization. Table 3 summarizes the total revenue per tier and the overall season revenue for both years.

Tier	Total Revenue This Year(€)	Total Season Revenue This Year (€)	Total Revenue Last Year(€)	Total Season Revenue Last Year (€)
Tier 1	17738.00	70952.01	15235.00	60940.00
Tier 2	12894.50	90261.48	10200.00	71400.00
Tier 3	7149.00	42893.96	5435.00	32610.00
Total	**37781.50**	**204107.40**	**30870.00**	**164950.00**

Table 3: Comparison of Total Revenue Between This Year and Last Year

This year's optimized strategy generated a total season revenue of £204,107.40, a 23.74% increase over last year's revenue of £164,950. The improvement was most pronounced for Tier 2 matches, which saw a revenue increase of over £19,000 due to better alignment with fans' WTP. Tier 1 matches also demonstrated a notable increase, driven by premium pricing in high-demand sections like VIP and Courtside.

The results illustrate the critical role of tailored pricing in maximizing revenue. For example, the General section's broad appeal allowed it to sustain higher demand across all tiers, while the VIP section capitalized on its exclusivity through premium pricing. The Ultras section, adhering to its full capacity constraint, contributed steady revenue across all tiers, reinforcing the importance of maintaining fan engagement in this area.

Compared to last year's fixed pricing, the optimized strategy clearly demonstrates the value of leveraging WTP data and incorporating capacity constraints. The 23.74 % revenue increase represents a significant financial gain and sets a strong precedent for implementing similar optimization models in future seasons.

Recommendations

Based on the analysis and findings of the project, the following recommendations are proposed to further enhance the revenue management strategies for Panathinaikos Basketball Club:

1. **Implement the new Pricing Strategy**
   The optimized pricing strategy demonstrates a 23.74% increase in total season revenue compared to last year's fixed pricing. This highlights the importance of aligning ticket prices with fan willingness-to-pay (WTP). The club should adopt optimized ticket prices for each seating section and match tier to maximize revenue while ensuring high levels of fan satisfaction and arena utilization.

2. **Targeted Marketing Campaigns**
   The Family and General sections show strong demand alignment with pricing strategies, presenting an opportunity to further drive ticket sales. Tailored marketing campaigns can amplify this demand. For example, offer family packages and discounts for group purchases to attract more attendees in the family section or emphasize affordability and accessibility to appeal to casual fans and maintain high occupancy rates in the general section.

3. **Monitor and Evaluate the Effectiveness of the Strategy**
   To ensure the long-term success of the pricing strategy, they should establish a robust evaluation framework. Key performance indicators (KPIs) such as revenue per seat, occupancy rates, and fan satisfaction scores should be regularly monitored. Insights from these evaluations can guide adjustments and refinements to the strategy.

By implementing these recommendations, Panathinaikos Basketball Club can sustain its financial growth, strengthen fan engagement, and solidify its position as a leader in revenue management within European sports.

Conclusion

The revenue optimization analysis for Panathinaikos Basketball Club underscores the transformative potential of data-driven pricing strategies in the sports industry. By leveraging willingness-to-pay data, the study successfully identified optimized ticket prices for each seating section and match tier, leading to a substantial 23.74% increase in total season revenue

compared to last year’s fixed pricing. The results reveal the importance of tailored pricing in maximizing revenue while maintaining fan engagement and efficient arena utilization.

Key findings highlight the General section as the primary revenue driver, supported by its high capacity and broad appeal, while the VIP section achieved significant contributions through premium pricing. The Ultras section's consistent full-capacity demand reinforced its critical role in sustaining fan enthusiasm and steady revenue streams. The Family section demonstrated the value of targeted pricing for niche demographics, balancing moderate revenue with high occupancy.

These insights validate the club’s shift toward a data-driven approach, emphasizing its potential for long-term financial sustainability and enhanced fan satisfaction. The recommendations, including implementing optimized pricing, executing targeted marketing campaigns, and establishing an evaluation framework, provide actionable steps to further refine revenue management strategies.

By adopting these practices, Panathinaikos Basketball Club can not only strengthen its financial foundation but also enhance the fan experience, solidifying its status as a leader in European basketball and setting a benchmark for innovation in sports revenue optimization.