Hotel Cancellation Analysis

INSY 695: Enterprise Data Science and Machine Learning in Production I

Financial Implication: ROI Estimation

Final Project

Master of Management Analytics

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1 Problem Description

The hospitality industry frequently grapples with the twin challenges of overbooking and stringent cancellation policies, which, while designed to mitigate losses from cancellations, can inadvertently tarnish a hotel's reputation and diminish future revenue streams. In addressing the delicate balance of maximizing occupancy and maintaining customer goodwill, the implementation of a data-driven predictive model and a causal analysis emerge as pivotal solutions. Our project leverages these models, offering a sophisticated method to evaluate the specific impact of management strategies on cancellation rates. **In this report, we will conduct an ROI estimation to evaluate the financial implications of the causal inference drawn from our data analysis.**[1]

2 General Framework: ROI Estimation

In hospitality management, developing a comprehensive framework for strategic decision-making is essential to address the complexities of guest booking dynamics. This step-by-step framework, rooted in a combination of literature insights and industry best practices, provides a structured approach to evaluate the impact of deposit requirements on customers. It encompasses both the financial outcomes and operational aspects, offering a holistic view of intervention effects. Through an illustrative case study where we analyze first-time guests, we explore how a data-driven approach like this not only aids in understanding the immediate effects of policy changes but also illuminates the broader implications for revenue management and guest satisfaction. By bridging theoretical concepts with practical applications, we aim to demonstrate the utility of a systematic approach in enhancing the financial health and competitive edge of hospitality businesses.

- **Step 1: Customer Segmentation and Price Sensitivity Analysis**
  - *Customer Segmentation:* Divide the customer base into distinct groups using insights derived from Conditional Average Treatment Effect (CATE) estimates.
  - *Price Sensitivity Analysis:* Evaluate the elasticity of demand in terms of deposit requirements and cancellation rates across each customer segment.
- **Step 2: Development of Deposit Policies**
  - *Tailored Deposit Strategies:* Formulate deposit policies based on the price sensitivity analysis to encourage bookings from stable customer segments while protecting revenue from those with a higher likelihood of cancellation.

[1] Please refer to the Causal Model for more.

  - *Dynamic Deposit Approaches:* Explore the adoption of flexible deposit policies that can be adjusted in real-time, responding to fluctuations in demand and customer behavior patterns.

- **Step 3: Evaluation of Revenue Implications**
  - *Revenue Preservation:* Calculate the expected revenue retention by minimizing cancellations within each segment.
  - *Revenue Growth Opportunities:* Project the potential revenue uplift through enhanced customer satisfaction and increased repeat bookings.

- **Step 4: Financial Implications Analysis**
  - *Cost of Implementation:* Estimate the financial outlay required for the development and implementation of the new deposit strategies.
  - *Opportunity Cost Considerations:* Assess the potential revenue that may be foregone due to the adoption of more flexible deposit requirements for certain segments.

- **Step 5: Return on Investment (ROI) Calculation**
  - Calculate the ROI by dividing the net revenue impact (Revenue Preservation + Revenue Enhancement - Implementation and Opportunity Costs) by the total costs associated with the policy changes.

3 Case Study: First-Time Guests

Drawing on insights from our analysis and industry research, we apply this framework through a case study focused on first-time guests. The strategic implementation of deposit requirements for first-time guests stands as an important decision with significant implications for revenue optimization (Falk and Vieru, 2018). Through the lens of causal inference and the nuanced understanding provided by Conditional Average Treatment Effects (CATE), we have employed a methodical exploration of the potential impacts such a policy may have on a hotel's operations.

Based on the causal model results[2], first-time guests exhibit a higher sensitivity to deposit requirements, as indicated by a higher CATE estimate. The reasons for this heightened sensitivity may include:

[2]Refer to causal analysis for more

1. **Lack of Brand Loyalty:** Without prior positive experiences with the hotel, first-time guests do not have established trust or brand loyalty that might mitigate the inconvenience of a deposit requirement. (Source: Article on Loyalty Programs)

2. **Comparison Shopping:** New guests are often comparing multiple accommodations. A mandatory deposit could serve as a critical factor in their decision-making process, possibly favoring alternatives without such requirements. (Source: Article on Loyalty Programs)

3. **Perceived Risk:** First-time guests may perceive a higher risk in committing to a non-refundable deposit due to the lack of previous stays, leading them to opt for bookings with greater flexibility. (Source: Article on Loyalty Programs)

These factors contribute to the potential for a higher rate of cancellations among new guests when faced with a deposit condition, as they carefully consider the associated risks and benefits.

3.0.1 ROI Estimation

Since an exact financial data is not available, to estimate the ROI for implementing a deposit requirement for first-time guests, we will follow these steps:

1. **Determine the Average Revenue Per Booking (ARB):** This is the average revenue generated from each non-cancelled booking by a first-time guest.

    - Let's assume an ARB of $200. (Source: Marriott International 2022 Annual Report)

2. **Incorporate the Conditional Average Treatment Effect (CATE):** The CATE estimate reflects the change in cancellation rates due to requiring a deposit.

    - CATE estimate of -0.56 implies a 56% reduction in the cancellation rate among first-time guests when a deposit is required.

3. **Calculate the Average Deposit Amount (ADA):** This is the average deposit required from first-time guests.

    - Let's use an ADA of $50. (Source: Article on Hotel Deposit)

4. **Estimate the Number of First-Time Bookings (NFB):** The total number of bookings by first-time guests in a given period.

    - Suppose we have 1000 NFB.

5. **Estimate the Reduced Number of Cancellations (RNC):** Using the CATE, estimate the number of cancellations prevented.

$$\begin{aligned} RNC &= NFB \times CATE \\ &= 1000 \times 0.56 = 560 \end{aligned}$$

6. **Calculate the Increased Revenue from Reduced Cancellations (IRRC):**

$$\begin{aligned} IRRC &= ARB \times RNC \\ &= \$200 \times 560 = \$112,000 \end{aligned}$$

7. **Calculate the Total Deposit Amount Collected (TDAC):**

$$\begin{aligned} TDAC &= ADA \times NFB \\ &= \$50 \times 1000 = \$50,000 \end{aligned}$$

8. **Estimate Costs Associated with Deposits (CAD):** Additional costs due to the deposit policy, such as processing fees. Assuming it's 10% of the collected deposits.

$$\begin{aligned} CAD &= 0.10 \times TDAC \\ &= 0.10 \times \$50,000 = \$5,000 \end{aligned}$$

9. **Calculate Net Gain from Deposits (NGD):**

$$\begin{aligned} NGD &= TDAC - CAD \\ &= \$50,000 - \$5,000 = \$45,000 \end{aligned}$$

10. **Estimate ROI:** Considering both the increased revenue from reduced cancellations and the net gain from deposits.

$$\begin{aligned} ROI &= \frac{IRRC + NGD}{CAD} \\ &= \frac{\$112,000 + \$45,000}{\$5,000} = 31.4 \end{aligned}$$

The ROI of 31.4 indicates that for every dollar spent on managing the deposit process, the hotel earns back \$31.40 in increased revenue and net gains from deposits. This calculation is an estimate and should be refined with more detailed data for precise planning. Assumptions and final values are also described in Tables 1 and 2.

Table 1: Assumptions

Parameter	**Value**	**Source**
Average Revenue Per Booking (ARB)	$200	Marriott 2022 Annual Report
Conditional Average Treatment Effect (CATE)	-0.56	
Average Deposit Amount (ADA)	$50	Article on Hotel Deposit
Number of First-Time Bookings (NFB)	1000	Hypothetical
Costs Associated with Deposits (CAD) % of TDAC	10%	Industry benchmarks

Table 2: Final Calculations

Metric	**Value**
Reduced Number of Cancellations (RNC)	560
Increased Revenue from Reduced Cancellations (IRRC)	$112,000
Total Deposit Amount Collected (TDAC)	$50,000
Costs Associated with Deposits (CAD)	$5,000
Net Gain from Deposits (NGD)	$45,000
ROI	**31.4**

3.0.2 Scenario Analysis: Optimistic vs Conservative

Table 3: ROI Estimation for Deposit Requirement: Optimistic vs. Conservative Scenarios

Metric	**Optimistic Scenario**	**Conservative Scenario**
Average Revenue Per Booking (ARB)	\$250	\$180
Conditional Average Treatment Effect (CATE)	-70%	-40%
Average Deposit Amount (ADA)	\$75	\$40
Number of First-Time Bookings (NFB)	1200	800
Costs Associated with Deposits (CAD)	5% of TDAC	15% of TDAC
Reduced Number of Cancellations (RNC)	840	320
Increased Revenue from Reduced Cancellations (IRRC)	\$210,000	\$57,600
Total Deposit Amount Collected (TDAC)	\$90,000	\$32,000
Net Gain from Deposits (NGD)	\$85,500	\$27,200
Return on Investment (ROI)	**65.7**	**17.7**

Using a similar approach, Table 3 presents ROI estimates in optimistic and conservative situations. The optimistic scenario envisages a more favorable outcome with higher average revenue per booking, a greater reduction in cancellation rates, increased deposits, and lower associated costs, leading to a significantly higher ROI, whereas the conservative scenario assumes more modest improvements and higher costs, resulting in a lower but still positive ROI.

- The optimistic scenario underlines the potential for significant financial gains, aiding in strategic financial planning and investment in other areas of the business from the surplus revenue generated.
- The conservative scenario highlights the importance of planning for less-than-ideal conditions, suggesting that even with lower benefits, the policy can still be financially viable, helping in risk management by providing a safety net.

It is important to note that while directly applying CATE to estimate the impact of deposit policies on cancellation rates offers a straightforward quantification, it simplifies the complex interplay of guest behavior, market dynamics, and operational strategies. This approach overlooks variability in guest sensitivity, competitive responses, psychological factors like loss aversion, operational adjustments, and long-term behavioral shifts. A comprehensive evaluation should thus incorporate these multifaceted aspects to accurately assess the strategic viability of deposit policies.

Despite the limitations, our analysis has adeptly demonstrated the utility of CATE in tailoring deposit policies to manage cancellations more effectively. By simulating a scenario grounded in research and industry benchmarks, we have showcased the capability of this analytical approach to not only anticipate the likely behavioral shifts among first-time guests but also to quantify the financial implications. The deployment of a deposit requirement, informed by the insights of causal inference, can serve as a lever to mitigate the risk of cancellations, ensuring a steadier and more predictable revenue stream.

4 Conclusion

In conclusion, the judicious application of causal inference techniques, particularly CATE, provides a robust framework for decision-makers in the hospitality industry. Our successful illustration of this approach, using a simplified yet research-based scenario, underscores the profound potential for such data-driven strategies to enhance profitability and operational efficiency. Future endeavors may build upon this foundation, incorporating more granular data to refine and personalize deposit strategies, thus further fortifying the financial resilience of hotels against the perennial challenge of booking cancellations.

5 References

Falk, Martin, and Markku Vieru. “Modelling the cancellation behaviour of hotel guests.” International Journal of Contemporary Hospitality Management, vol. 30, no. 10, 3 Aug. 2018, pp. 3100–3116, https://doi.org/10.1108/ijchm-08-2017-0509