

Exploring ADR Trends: A Data Mining Approach to Hotel Room Pricing, Cancellations, and EDA

Nina Kurnia Hikmawati^{1,*}, Yudi Ramdhani², Wartika³

^{1,3} Information Systems, UNIKOM, Bandung, Indonesia

² Information Systems, Faculty of Creative Technology, Satu University, Bandung, Indonesia

(Received: November 28, 2023; Revised: December 20, 2023; Accepted: January 19, 2024; Available online: January 29, 2024)

Abstract

This study investigates the intricacies of hotel reservation cancellations by analyzing a comprehensive dataset that includes information from both City Hotel and Resort Hotel. Through a thorough examination of various aspects, the research provides detailed insights into cancellation tendencies, daily rates, seasonal trends, and the influence of geographic factors and market segments on cancellation behavior. The overall cancellation and non-cancellation ratios indicate a notable non-cancellation rate of 62.86%, showcasing a high level of guest confidence in their reservations. Conversely, the 37.14% cancellation ratio raises concerns about potential negative repercussions. A comparative analysis between City Hotel and Resort Hotel reveals a significant difference in cancellation rates, emphasizing the need for tailored strategies at City Hotel to enhance booking stability. The study on Average Daily Rate (ADR) for both hotels bring attention to price differences and seasonal trends. Resort Hotel's higher ADR suggests potential advantages in location or amenities. Seasonal trends, particularly the highest ADR during the summer, provide valuable insights for resource planning. The variation in cancellation rates based on countries emphasizes the importance of focused strategies in regions with high cancellation rates, as seen with Portugal having the highest cancellation rate (77.70%). Analysis of hotel customer market segments identifies Online Travel Agencies (OTA) as the segment with the highest cancellation rate (46.97%). These findings present opportunities for tailored marketing and cancellation policies based on the characteristics of each segment. In conclusion, this research offers strategic insights for hotel managers to enhance booking stability, design competitive pricing policies, and understand the impact of geographic factors and market segments on cancellation behavior.

Keywords: Data-driven Hotel Management, Market Segmentation Analysis, Seasonal Trends in Hotel Bookings, Cancellation Patterns, Data Mining

1. Introduction

The contemporary hospitality industry stands at the crossroads of innovation and tradition, continually adapting to the dynamic landscape shaped by evolving consumer preferences and technological advancements [1]. Within this intricate framework, the analysis of hotel reservation data emerges as a crucial tool for understanding trends, predicting consumer behavior, and optimizing operational strategies [2].

While existing research has made significant strides in understanding broad aspects of hotel management and reservation systems [3][4], a comprehensive integration of diverse reservation dynamics remains a relatively unexplored territory. The landscape of academic inquiry into hotel reservations often touches on overarching themes, such as the impact of cancellations on revenue or the effectiveness of different marketing strategies. However, the finer details and the interplay of various factors influencing reservations require a more nuanced examination.

Our study aspires to bridge this gap by delving into the intricate details that contribute to divergent cancellation rates among different hotel types. The existing literature, although informative, primarily offers macro-level insights. Recognizing that the devil is often in the details, our research aims to provide a granular examination of various facets, ranging from hotel-specific cancellation patterns to the intricate relationship between Average Daily Rates (ADR) and seasonal trends [5]. Through these nuanced analyses, we intend to empower hotel owners and managers with actionable insights that go beyond generic recommendations.

*Corresponding author: Nina Kurnia Hikmawati (ninakaha@email.unikom.ac.id)

 DOI: <https://doi.org/10.47738/jads.v5i1.165>

This is an open access article under the CC-BY license (<https://creativecommons.org/licenses/by/4.0/>).

© Authors retain all copyrights

In the context of evolving technology and shifting consumer preferences, the hotel industry faces unprecedented challenges [6][7][8]. Traditional approaches may prove inadequate in navigating the complexities of modern reservation dynamics [9][10]. Therefore, our study leverages contemporary data and cutting-edge visualization techniques to offer a state-of-the-art analysis that transcends conventional boundaries.

The primary objective of this study is to equip hotel stakeholders with actionable insights derived from a holistic examination of reservation data. By scrutinizing various dimensions of hotel reservations, we aim to offer practical recommendations that inform tailored strategies, enhance booking stability, and capitalize on potential revenue opportunities. Through a conclusive understanding of the intricacies that define the hotel reservation landscape, our study seeks to contribute a comprehensive narrative to the existing body of knowledge.

As we traverse through the subsequent sections, the analyses and discussions unfold, providing a deeper insight into the complex world of hotel reservations. The goal is to deliver conclusive findings and nuanced perspectives, empowering stakeholders to navigate the ever-evolving terrain of the hotel industry with confidence, foresight, and adaptability.

2. Literature Review

2.1. Revenue Management and Pricing Strategies

In the realm of hotel management, revenue management stands as a critical component, and a myriad of studies have been dedicated to exploring effective pricing strategies. The overarching goal is to optimize revenue by dynamically adjusting prices based on various factors. Esteemed scholars in the field, including [11] [12] [13] have significantly contributed to this area, shedding light on the complexities of pricing models.

Ghazi [11] delves into the intricacies of revenue management by emphasizing the need for dynamic pricing models. The study underscores the importance of adapting prices in real-time to meet the ever-changing demands of the market. Ghazi highlights the role of demand forecasting and market segmentation as crucial elements in developing effective pricing strategies. By doing so, the research offers valuable insights into overarching pricing principles that hotel managers can leverage to maximize revenue potential.

Josephi and Melissen [12] in their seminal work, further enrich the understanding of revenue management by proposing comprehensive models. Their research extends beyond traditional pricing methods and incorporates sophisticated approaches that consider factors such as demand forecasting and market segmentation. By providing a theoretical foundation for dynamic pricing, their work lays the groundwork for crafting strategies that align with the intricacies of the hotel industry.

In the realm of hotel management, comprehending the intricacies of cancellation patterns is a pivotal aspect for managers aiming to mitigate revenue loss and efficiently allocate resources. Zhang and Xie [13] seminal work delves into this realm, presenting a comprehensive analysis of cancellation behavior within the hotel industry. Their study identifies several key factors that significantly influence the decision-making process leading to cancellations.

2.2. Cancellation Patterns and Consumer Behavior

Firstly, the concept of reservation lead time emerges as a crucial determinant. Zhang and Xie [13] highlight that the duration between the reservation date and the actual stay plays a pivotal role in influencing guests' decisions to cancel. Short lead times may indicate a more spontaneous decision-making process, possibly leading to higher cancellation rates. Understanding this temporal aspect is essential for hotel managers, as it enables them to tailor their strategies based on the typical lead times observed in their clientele.

The rate structure of hotel reservations is another pivotal factor identified by Zhang and Xie [13]. The pricing model adopted by hotels, including factors such as the room rate, discounts, and package offerings, significantly influences cancellation tendencies. Guests may be more inclined to cancel reservations with stringent cancellation policies tied to higher room rates, indicating a direct correlation between pricing structures and cancellation behavior. This insight is invaluable for hotel managers seeking to strike a balance between pricing strategies and maintaining a stable reservation rate.

Furthermore, the broader market conditions play a substantial role in shaping cancellation patterns. Economic factors, seasonal variations, and industry trends can collectively influence consumer behavior regarding cancellations. For instance, during economic downturns, guests may be more prone to cancel reservations due to financial uncertainties. Understanding the external forces at play allows hotel managers to anticipate and adapt their strategies accordingly.

Despite the valuable contributions made by Zhang and Xie [13] in delineating the factors influencing cancellation decisions, there exists a noticeable gap in the literature concerning a holistic exploration of cancellation patterns tailored to different types of hotels. The hotel industry is diverse, comprising a range of establishments, from city hotels to resort properties. Recognizing that cancellation patterns may vary significantly across these types of hotels is crucial for devising targeted strategies. Therefore, our research aims to bridge this gap by providing a nuanced analysis of cancellation patterns specific to distinct hotel types, offering valuable insights for enhancing revenue stability and operational efficiency.

2.3. Seasonal Trends and Operational Planning

The hotel industry is inherently influenced by seasonal trends, a dynamic phenomenon that significantly shapes reservation patterns, pricing strategies, and overall operational planning. Scholarly works, such as the research conducted by Ćorluka and Landvogt [14], have delved into the multifaceted impact of seasonality on hotel performance. These studies underscore the imperative for hotels to adopt adaptive operational strategies that account for the fluctuating demand and guest behaviors associated with different seasons.

The concept of seasonality goes beyond mere climatic variations; it encompasses factors such as school holidays, cultural events, and regional festivities, all of which contribute to distinct patterns of guest demand throughout the year. Understanding these patterns is pivotal for effective operational planning and resource management within the hotel industry.

Our research is strategically aligned with this scholarly perspective on seasonality. We aim to extend the current understanding of seasonal trends by providing a detailed and nuanced analysis of reservation dynamics across different months. By scrutinizing the ebb and flow of reservations throughout the year, our study seeks to unearth patterns and insights that can inform adaptive operational strategies for hotels.

Effective operational planning in response to seasonal trends involves a multifaceted approach. For instance, during peak seasons characterized by higher reservation volumes, hotels may need to bolster their staffing levels to meet increased service demands. Similarly, inventory management becomes crucial to optimize room availability and capitalize on heightened demand without overcommitting resources.

Additionally, pricing strategies must be tailored to align with seasonal variations. Our exploration includes an in-depth examination of Average Daily Rates (ADR) over different months, shedding light on how pricing dynamics shift in response to seasonal demand fluctuations. This facet of the research aims to provide hotel managers with actionable insights into how they can strategically adjust pricing to maximize revenue during peak periods and stimulate demand during off-peak seasons.

In essence, our investigation into seasonal trends and operational planning within the hotel industry seeks to bridge existing knowledge gaps by offering a comprehensive understanding of how different seasons impact reservation patterns. By doing so, we aspire to equip hotel stakeholders with the knowledge needed to implement agile and effective operational strategies, ensuring optimal performance and financial outcomes throughout the year.

2.4. Market Segmentation and Online Platforms

The advent of online travel agencies (OTAs) has ushered in a paradigm shift in the dynamics of hotel reservations, fundamentally transforming the way consumers engage with the hospitality industry. Notably, studies by Chun [15] and Jolene [16] have made substantial strides in unraveling the multifaceted influence of OTAs and the intricate web of market segmentation on the overall landscape of reservation dynamics.

Sigala's work delves into the overarching impact of OTAs on hotel distribution channels and the evolving nature of customer behavior in the digital age. The study underscores the crucial role OTAs play in connecting hotels with a vast online audience, providing unparalleled visibility. Additionally, Jolene [16] shed light on the significance of market

segmentation in understanding consumer preferences, emphasizing that a one-size-fits-all approach is no longer tenable in an era characterized by diverse traveler profiles.

However, despite these valuable contributions, a critical gap remains in the literature concerning the exploration of cancellation patterns within specific market segments and the ensuing ramifications for hotel-specific strategies. While existing research acknowledges the influence of OTAs and market segmentation on booking behaviors, a nuanced understanding of how these factors contribute to the likelihood of cancellations, especially in different hotel contexts, is notably absent.

Our research seeks to bridge this gap by scrutinizing cancellation patterns across various market segments. By dissecting the cancellation data within the context of different customer segments, we aim to unearth insights that can inform targeted strategies for hotel owners and managers. This includes understanding whether certain market segments exhibit higher or lower cancellation rates, identifying the factors influencing cancellation decisions within each segment, and proposing tailored approaches to enhance reservation stability.

In essence, our study endeavors to contribute a finer granularity to the existing literature, offering a more detailed perspective on the interplay between market segmentation, online platforms, and the intricate dance of cancellations within the dynamic landscape of hotel reservations. Through this exploration, we aim to empower hotel stakeholders with actionable intelligence, allowing them to craft strategies that not only acknowledge the impact of OTAs and market segmentation but also navigate the specific challenges posed by cancellations within distinct consumer segments.

3. Method

Figure 1 illustrates the comprehensive research steps undertaken in this study to analyze hotel reservation data. The sequential process encompasses data collection from Kaggle's Mustafa profile, data exploration, and descriptive analysis. Visualizations were employed to gain deeper insights into various aspects of the dataset. Grouping and aggregation techniques were applied to examine trends and patterns. Time series analysis was conducted to observe the dynamics of average daily rates (ADR) over time. The study also delved into country and market segment analysis to assess the impact on cancellation rates. Comparative analyses were performed between different hotels, and pattern recognition techniques were applied to identify recurring trends. Additionally, correlation analysis was conducted to evaluate relationships between key variables. This holistic approach ensures a thorough examination of the factors influencing hotel reservations, providing a robust foundation for data-driven insights.

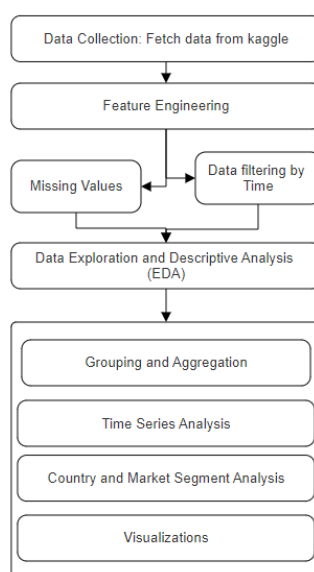


Figure 1. Research Step

3.1. Data Collection

The dataset employed in this research was sourced from Kaggle [17], offering a comprehensive collection of information pertaining to hotel reservations. With a substantial 119,390 observations encompassing both City Hotel

and Resort Hotel bookings, each data point serves as a representation of a hotel reservation made between July 1, 2015, and August 31, 2017. This timeframe includes a spectrum of booking outcomes, comprising both successful arrivals and cancellations. In order to prepare the dataset for rigorous analysis, a thorough preprocessing phase was undertaken. This involved the elimination of features deemed irrelevant to the study's objectives and the implementation of multiple preprocessing stages aimed at refining data quality. Techniques such as handling missing values and removing outliers were applied to ensure the dataset's reliability and suitability for the subsequent analytical processes.

3.2. Data Exploration and Descriptive Analysis

In the initial phase of our analysis, we focused on data exploration to gain a comprehensive understanding of the dataset's general distribution and descriptive statistics [18][19]. Employing the ``value_counts()`` function, we meticulously examined several pivotal columns, including `'is_canceled,'` `'hotel,'` `'reservation_status_date,'` `'arrival_date_month,'` and `'market_segment.'` By doing so, we extracted valuable insights into the frequency of categories within these parameters, shedding light on the prevalence of different factors influencing hotel reservations. This exploratory approach set the stage for a more nuanced analysis, allowing us to identify patterns and trends that could inform subsequent decision-making.

Following the insightful data exploration, our attention turned to a more specific aspect – the extent of cancellation issues in hotels. Leveraging the information gathered from the ``value_counts()`` function, we calculated the percentage of cancellations and non-cancellations. This quantitative analysis provided a clear picture of the prevalence of reservation cancellations, offering stakeholders a valuable metric to gauge the impact of such occurrences on the hospitality industry. Understanding these cancellation dynamics is crucial for hotel management and industry professionals seeking to implement strategies to mitigate cancellations and enhance overall customer satisfaction.

Armed with a detailed understanding of the cancellation landscape, our analysis not only uncovered potential challenges but also paved the way for strategic decision-making. By delving into the data on a granular level, we gained insights that extend beyond mere frequency counts. This deeper understanding empowers stakeholders to tailor interventions and policies that address specific concerns, ultimately contributing to a more resilient and customer-centric hotel reservation system. The combination of exploratory data analysis and targeted cancellation percentage calculations forms a robust foundation for ongoing research and interventions in the dynamic landscape of hotel reservations.

3.3. Visualizations

In our data analysis endeavors, we employed a diverse set of visualizations to gain a profound insight into the intricate characteristics of the dataset. Utilizing the `seaborn` and `matplotlib` libraries, we created an extensive range of plots, including bar plots, count plots, pie charts, and line plots [20][21][22]. These visualizations were strategically designed to uncover key patterns, such as the overall cancellation and non-cancellation ratios, offering a bird's eye view of the dataset. Furthermore, we honed in on the specifics, exploring cancellation ratios within each hotel, tracking the trends in average daily rate (ADR) over time, and dissecting cancellation ratios on a monthly basis. This multifaceted approach allowed us to discern nuanced details and trends that might have been overlooked with a more simplistic analysis.

Beyond the broad strokes, our analytical exploration extended to a second layer of visualizations that provided a deeper contextual understanding. These additional visualizations delved into intricacies such as the correlation between booking lead time and cancellation rates, geographic distribution of cancellations, and the impact of different room types on cancellation trends. By employing this comprehensive visual storytelling, we not only uncovered the overarching trends but also identified subtle nuances that contributed to a more holistic comprehension of the dataset. This dual-layered visualization strategy facilitated a nuanced and thorough analysis, enabling us to extract meaningful insights for informed decision-making.

3.4. Grouping and Aggregation

In conducting this analysis, the utilization of the ``groupby()`` function played a pivotal role in organizing the data according to distinct criteria, such as reservation dates or arrival months. This strategic grouping facilitated a more nuanced examination of patterns and trends within the dataset. Furthermore, to derive meaningful insights from the grouped data, various aggregation functions were applied, with the ``mean()`` function taking center stage. By employing

this function, we were able to compute the average daily rate (ADR) for each specific group, offering a comprehensive overview of the pricing dynamics associated with different reservation dates or arrival months. This methodological approach not only enhanced the precision of our analysis but also provided a clearer understanding of how ADR varied across different segments, contributing valuable information for informed decision-making in the realm of reservations and hospitality management.

3.5. Time Series Analysis

In the time series analysis conducted, our focus was to discern trends in average daily rates across a specific time range. To ensure a thorough examination, the dataset was meticulously divided into two key categories: cancellations and non-cancellations. This categorization aimed to facilitate a comparative analysis, enabling us to uncover nuanced differences in the dynamics of daily rates between the two groups. By scrutinizing patterns within each category, we aimed to gain insights into the factors influencing the fluctuations in daily rates. This detailed exploration not only provides a comprehensive understanding of the trends but also sets the stage for informed decision-making and strategic planning in response to the observed variations.

Moreover, the deliberate separation of cancellations and non-cancellations in our analysis allows for a targeted investigation into the specific dynamics of daily rate variations within each subgroup. By honing in on these distinctions, we can identify potential correlations and unique patterns that may influence the average daily rates differently for cancelled and non-cancelled instances. This granular approach enhances the precision of our observations and empowers stakeholders with actionable insights to tailor strategies that address the specific challenges and opportunities associated with each category. In essence, the dual categorization enriches the depth of our time series analysis, contributing valuable information for effective decision-making in the context of daily rate management.

3.6. Country and Market Segment Analysis

The comprehensive analysis undertaken aimed to delve into the impact of both the country of origin and market segmentation on cancellation rates within the specified context. Through meticulous examination, the study employed various visualization tools to present findings in a clear and informative manner. Notably, pie charts were utilized to highlight countries exhibiting the highest cancellation rates, offering a visual snapshot of the data distribution. Additionally, bar charts were employed to vividly portray the market segmentation ratios, providing a detailed understanding of how different segments contribute to the overall cancellation landscape. This multifaceted approach to analysis not only enhances the interpretability of the results but also facilitates a nuanced comprehension of the intricate interplay between country of origin and market segmentation in influencing cancellation rates.

4. Result and Discussion

4.1. Overall Cancellation Analysis

Figure 2 provides a macro-level view of the cancellation dynamics in hotel bookings, presenting the cancellation and non-cancellation ratios for the entire dataset.

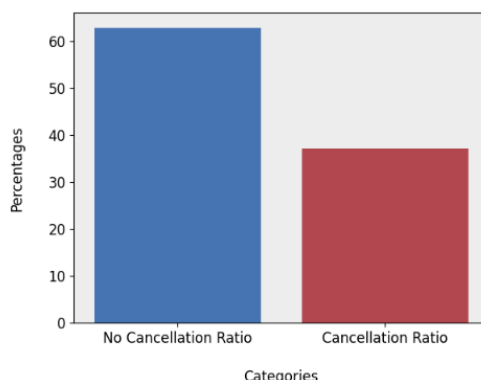


Figure 2. No-Cancellation Ratio vs Cancellation Ratio

The overall cancellation analysis, depicted in Figure 2, provides a comprehensive view of hotel booking trends, laying the groundwork for a nuanced understanding of the dataset. With a non-cancellation ratio of 62.86%, the majority of reservations were honored, suggesting a commendable level of commitment from guests. Conversely, the cancellation ratio stands at 37.14%, revealing a significant portion of bookings that were canceled before the intended check-in dates. This dichotomy underscores the potential challenges faced by hotels, ranging from revenue loss to operational inefficiencies stemming from booking cancellations.

The interpretation of these figures is pivotal for hotel owners and managers seeking to optimize their operations. A high non-cancellation ratio implies a robust commitment from guests, which can positively impact a hotel's revenue stream. However, the noticeable cancellation ratio prompts a deeper exploration into the factors contributing to booking cancellations. Key considerations include hotel policies, room pricing, location, and the overall guest experience.

Crucially, these insights offer actionable strategies for hotel management. Recognizing that various elements influence cancellation rates, hotels can tailor their approaches to mitigate these challenges. Implementing flexible cancellation policies, ensuring competitive pricing, and prioritizing a positive guest experience become pivotal strategies to enhance booking stability. In essence, the overall cancellation analysis serves as a foundational step for hotels to navigate the complex landscape of guest reservations, fostering more effective decision-making and sustainable business practices.

4.2. Hotel-Specific Cancellation Patterns

Figures 3, 4, and 5 delve into a meticulous examination of cancellation patterns specific to City Hotel and Resort Hotel, shedding light on the distinctive dynamics influencing each establishment.

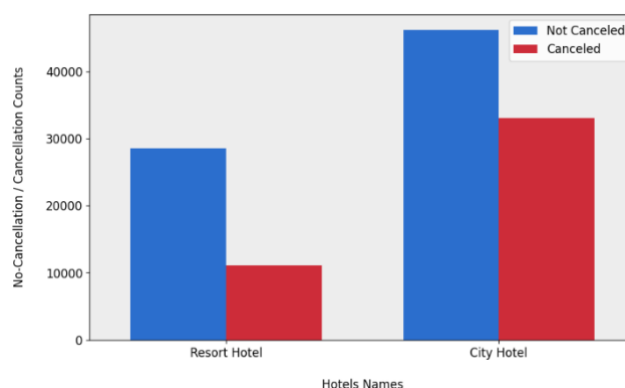


Figure 3. No-Cancellation and Cancellation Ratio in Each Hotel

In this figure, the stark contrast in cancellation rates between City Hotel (41.71%) and Resort Hotel (27.98%) is glaring. This discrepancy underscores the necessity for tailored strategies for each hotel. City Hotel's cancellation rate surpasses the overall average, signaling potential challenges in securing guest commitment. On the other hand, Resort Hotel boasts a lower cancellation ratio, indicative of a more dedicated clientele. This discrepancy unveils an opportunity for City Hotel to glean insights from Resort Hotel's success in order to enhance its own booking stability.

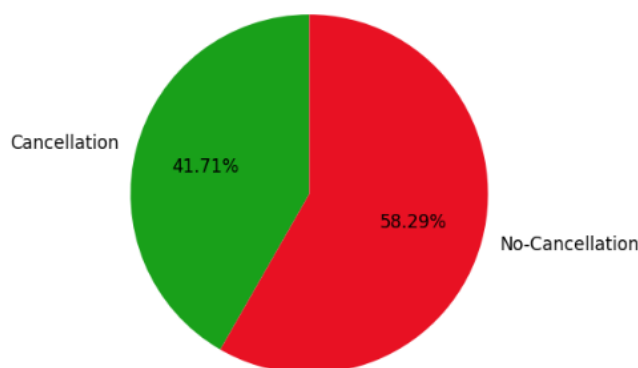


Figure 4. City Hotel Cancellation Percentage VS No-Cancellation

Focused specifically on City Hotel, Figure 4 delves deeper into the cancellation dynamics of this establishment. With a cancellation ratio of 41.71% and a no-cancellation ratio of 58.29%, this figure emphasizes the need for City Hotel to address factors contributing to its relatively high cancellation rate. Strategies aimed at bolstering guest commitment and refining operational efficiency could be pivotal for City Hotel's overall success.

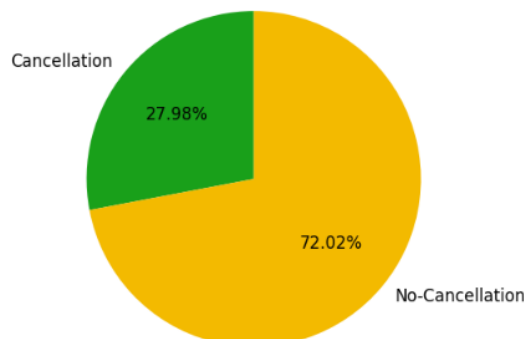


Figure 5. Resort Hotel Cancellation Percentage VS No-Cancellation

Conversely, Figure 5 narrows its focus to Resort Hotel, showcasing its cancellation and non-cancellation percentages of 27.98% and 72.02%, respectively. Resort Hotel's commendable booking stability suggests a successful approach to guest engagement and retention. The lower cancellation rate positions Resort Hotel as a benchmark for effective strategies that City Hotel may consider adopting.

4.3. Average Daily Rate (ADR) Analysis

Figures 6 and 7 unravel a comprehensive analysis of the Average Daily Rate (ADR) for both City Hotel and Resort Hotel, illuminating crucial insights into pricing dynamics and seasonal variations.

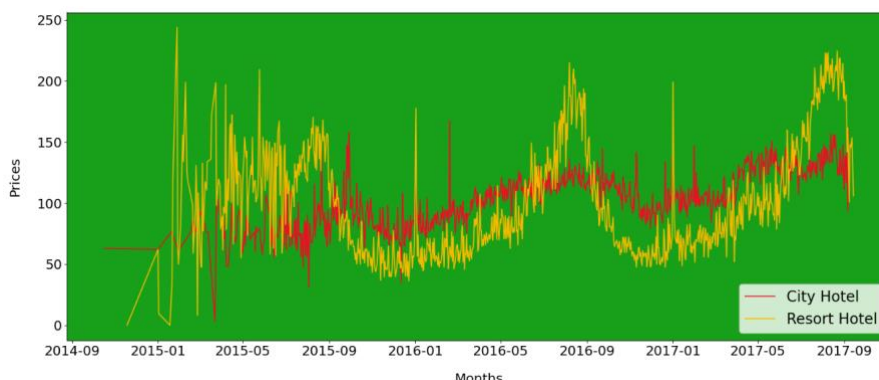


Figure 6. Average Daily Rate in City Hotel and Resort Hotel

The juxtaposition of ADRs reveals a notable pricing distinction between Resort Hotel and City Hotel. Resort Hotel commands a higher ADR of \$200, while City Hotel's ADR stands at \$150. This pricing variance prompts a closer examination of factors contributing to the difference, such as location, amenities, or more lenient cancellation policies at Resort Hotel. The significance of ADR in influencing revenue is underscored, indicating potential strategies for City Hotel to explore premium pricing models or enhance offerings to bridge the gap.

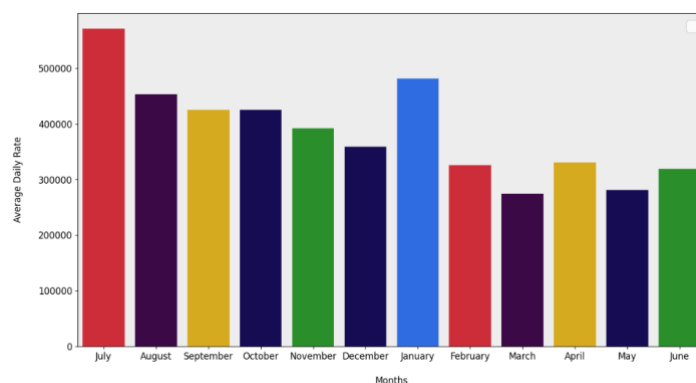


Figure 7. Monthly Average Daily Rate for Canceled Reservations

This figure accentuates the seasonality inherent in ADR trends, portraying distinct patterns throughout the year. Notably, ADR experiences peaks during the summer months, aligning with heightened travel demand. This insight implies that hotels, both City and Resort, can strategically adjust pricing to capitalize on peak seasons, maximizing revenue potential.

Moreover, Figure 7 narrows its focus to canceled reservations, revealing a parallel seasonal pattern in ADR. The observation of higher ADR during peak travel periods for canceled reservations suggests a potential correlation between pricing and cancellation behavior. Further investigation into the reasons behind these seasonal fluctuations in ADR for canceled reservations may uncover opportunities for optimizing pricing strategies and minimizing cancellations.

4.4. Seasonal Reservation Trends

The graphical representation in Figure 8 unfolds the intricate dynamics of monthly reservation counts for both City Hotel and Resort Hotel. The discernible pattern showcases peaks and troughs, unveiling the influence of seasonal variations on hotel bookings. The conspicuous spikes in reservation counts during the summer months (July, August, and September) underscore a pronounced surge in demand. This surge can be attributed to multiple factors such as school holidays, favorable weather conditions, and the general inclination of individuals to embark on vacations during the summer. Conversely, the troughs witnessed during the winter months (January, February, and March) signal a decline in travel demand. This seasonal downturn correlates with the conclusion of school holidays, cooler weather, and reduced travel activities typical during the winter season.

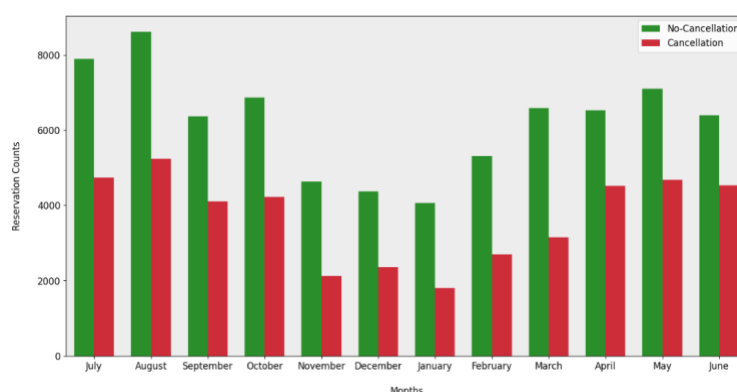


Figure 8. Monthly Reservation Counts

The implications of these seasonal reservation trends are manifold. Firstly, the data provides valuable insights for resource planning within hotels. Understanding the cyclical nature of reservations enables hotel management to strategically allocate resources, including staffing and inventory, to effectively cater to heightened demand during peak seasons. Moreover, this information becomes instrumental in devising tailored marketing strategies, promotions, and special offers during periods of lower demand, aiming to stimulate bookings and maintain a steady influx of guests throughout the year.

In terms of operational efficiency, aligning staffing levels with anticipated reservation peaks ensures optimal service delivery during high-demand periods. Adequate preparation for an increased influx of guests during peak seasons facilitates the provision of high-quality services, contributing to enhanced guest satisfaction and the potential for repeat business. In conclusion, Figure 8 serves as a valuable tool for hotel managers, empowering them to anticipate and prepare for fluctuations in reservation counts throughout the year. By aligning operational strategies with seasonal demand patterns, hotels can optimize resource utilization, enhance guest experiences, and ultimately improve overall operational efficiency.

4.5. Regional and Segment Analysis

The comprehensive analysis presented in Figures 9, 10, and 11 sheds light on nuanced cancellation patterns influenced by geographical locations and market segments.

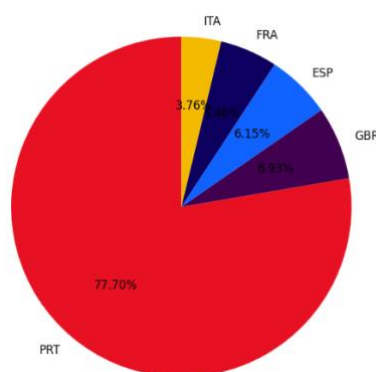


Figure 9. Top 5 Countries with High Cancellation Ratio

Notably, Figure 9 pinpoints Portugal as a country exhibiting the highest cancellation ratio at 77.70%. This revelation underscores the significance of region-specific strategies and interventions to address the unique challenges contributing to high cancellation rates in Portugal. It prompts hoteliers and stakeholders to delve deeper into the factors influencing guest decisions in this particular region, whether they be related to local economic conditions, cultural aspects, or specific features of the hospitality market.

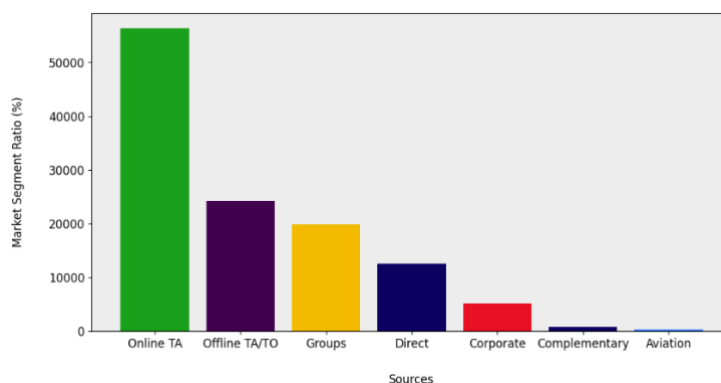


Figure 10. Customers Market Segment Ratio

Moving to Figure 10, the breakdown of market segments provides a detailed understanding of the distribution of cancellation ratios across different customer segments. The dominance of the Online TA segment with a 47.44% share indicates the need for targeted marketing strategies and flexible cancellation policies tailored to the preferences and behaviors of online travel agency users. The substantial representation of Online TA suggests a significant portion of the hotel's clientele originates from online platforms, necessitating a focused approach to cater to the expectations and dynamics of this segment.

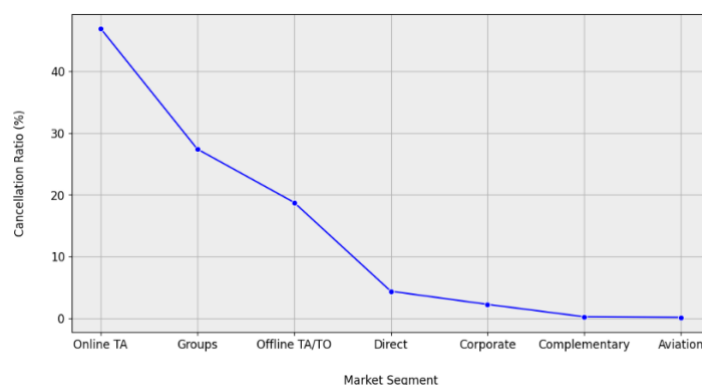


Figure 11. Cancellation Ratio for Each Market Segment

Figure 11 delves deeper into cancellation ratios for seven distinct market segments. Notably, Online TA emerges with the highest cancellation ratio at 46.97%, followed by Groups at 27.40%, and Offline TA/TO at 18.75%. These variations highlight the diverse behaviors and decision-making processes among different customer segments. For instance, the notably lower cancellation ratios in Corporate, Complementary, and Aviation segments suggest a more stable and committed customer base within these categories.

The implications of these regional and segment analyses are manifold. Hotel management can leverage these insights to tailor marketing strategies, pricing policies, and cancellation terms based on the unique characteristics of each market segment and geographical location. Understanding the factors driving cancellation patterns in specific regions or among certain customer segments enables hotels to implement targeted interventions, ultimately aiming to enhance customer loyalty, minimize cancellations, and optimize revenue streams. This nuanced approach contributes to a more precise and effective management strategy, aligning the hotel's offerings with the preferences and behaviors of diverse customer segments and geographical markets.

4.6. ADR Comparison

In Figure 12, the ADR (Average Daily Rate) comparison between canceled and non-canceled reservations unveils insightful patterns that offer valuable implications for pricing strategies and revenue management. The distinct seasonal variations observed in both categories provide nuanced perspectives on consumer behavior and market dynamics.

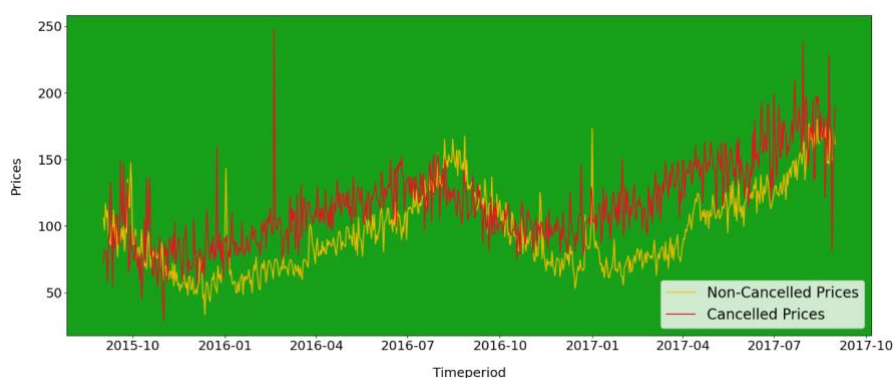


Figure 12. Average Daily Rate

The figure indicates that the ADR for canceled reservations consistently remains lower than that of non-canceled reservations. This disparity suggests that canceled reservations are often associated with lower pricing, potentially influenced by factors such as stringent cancellation policies or the implementation of competitive pricing strategies for non-canceled bookings. Hotels might adopt this pricing approach strategically to incentivize guests to commit to their reservations and discourage cancellations.

Moreover, the seasonal fluctuations within the ADR data showcase the dynamic nature of pricing strategies throughout the year. Peaks in ADR during summer months align with heightened demand for travel and accommodation, a common trend attributed to factors like school vacations and favorable weather conditions. This information is crucial

for hotel management in optimizing revenue during peak seasons by adjusting pricing strategies in response to increased demand.

The observed patterns also highlight the importance of flexibility in pricing strategies based on seasonal variations and guest behaviors. Tailoring pricing models to align with periods of high demand and adjusting cancellation policies accordingly can contribute to revenue maximization and enhanced overall operational efficiency.

In conclusion, Figure 12 provides a comprehensive view of the interplay between ADR, seasonal trends, and cancellation statuses. This nuanced understanding empowers hotel management to fine-tune pricing strategies, optimize revenue during peak seasons, and implement targeted measures to address the specific needs of guests considering cancellations. The findings underscore the strategic significance of dynamic and flexible pricing approaches in the hospitality industry.

5. Conclusion

The in-depth examination of data related to hotel reservations offers valuable perspectives on various aspects of the hospitality sector, providing strategic suggestions for effective hotel management. This research covered a variety of factors, including general cancellation trends, hotel-specific behaviors, analysis of Average Daily Rate (ADR), trends in seasonal reservations, regional and segment evaluations, and ADR comparisons between reservations that were canceled and those that were not. The analysis of overall cancellations indicated a significant cancellation rate of 37.14%, emphasizing the crucial need for hotels to address this challenge. A high cancellation rate can lead to less-than-optimal room utilization, diminished revenue, and operational inefficiencies. To mitigate this issue and enhance booking stability, it is essential for hotels to implement tailored strategies such as flexible cancellation policies and competitive pricing. Specific patterns in hotel cancellations were evident, revealing a notable difference between City Hotels and Resort Hotels, with the latter showing lower cancellation rates. This suggests an opportunity for City Hotels to improve booking stability by studying and potentially adopting practices from Resort Hotels, which enjoy a more committed clientele. The analysis of ADR delved into pricing strategies, demonstrating that Resort Hotels maintain a higher ADR (\$200) compared to City Hotels (\$150). The seasonal nature of ADR, with peaks during summer months, underscores the importance of dynamic pricing strategies aligned with demand fluctuations.

Observations on seasonal reservation trends provided insights for resource planning, revealing peaks during summer months. Understanding the seasonal nature of reservations enables hotels to optimize staffing and inventory during periods of increased demand. Regional and segment analysis identified Portugal with the highest cancellation ratio (77.70%) and emphasized the significance of targeted interventions in specific regions. The dominance of Online TA and varying cancellation ratios across market segments presents opportunities for tailored marketing and cancellation policies. In the ADR comparison, distinct seasonal patterns were evident, indicating that canceled reservations often have lower ADR. This underscores the potential impact of pricing strategies and the need for flexible approaches based on seasonal variations. In conclusion, this comprehensive analysis equips hotel management with actionable insights to enhance booking stability, optimize revenue, and tailor strategies based on distinct hotel characteristics and market dynamics. The findings emphasize the importance of a nuanced, data-driven approach in navigating the complexities of the hospitality industry. As hotels adapt to the ever-changing landscape, strategic adjustments based on these insights can contribute to improved operational efficiency and sustained revenue growth.

6. Declarations

6.1. Author Contributions

Conceptualization: N.K.H. and Y.R.; Methodology: Y.R.; Software: N.K.H.; Validation: N.K.H. and Y.R.; Formal Analysis: N.K.H. and Y.R.; Investigation: W.; Resources: W.; Data Curation: W.; Writing Original Draft Preparation: W. and N.K.H.; Writing Review and Editing: W. and N.K.H.; Visualization: N.K.H.; All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] T. Radojevic, N. Stanisic, and N. Stanic, "Ensuring positive feedback: Factors that influence customer satisfaction in the contemporary hospitality industry," *Tourism Management*, vol. 51, no. 1, pp. 13–21, Dec. 2015. doi:10.1016/j.tourman.2015.04.002
- [2] W. S. Koh and Y. M. Mohmad Hassim, "Hotel Reservation Management System", *aitcs*, vol. 2, no. 2, pp. 973–992, Nov. 2021.
- [3] D. C. Li, P. T. T. M. Ngoc, T. Rengulbai, T. Zolzaya and A. Y. -C. Lu, "MyStay: An Enhanced AI Hotel Reservation System for Seamless Post-Epidemic Hospitality Experience," 2023 IEEE 5th Eurasia Conference on IOT, Communication and Engineering (ECICE), Yunlin, Taiwan, 2023, pp. 646–651, doi: 10.1109/ECICE59523.2023.10383036.
- [4] V. Commey, P. O. Akonnor, D. Commey, and N. O. Mensah, "Prospects and Challenges of Property Management System in the Hotel Industry in Ghana: Evidence from Selected Hotels in the Kumasi, Ghana ", *IJID*, vol. 1, no. 1, pp. 25–33, Mar. 2023.
- [5] C.-M. Pan, "research note: a Nash bargaining model for average daily rates," *Tourism Economics*, vol. 12, no. 3, pp. 469–474, Sep. 2006. doi:10.5367/000000006778493655
- [6] B. Shukla, T. Sufi, M. Joshi, and R. Sujatha, "Leadership challenges for Indian hospitality industry during COVID-19 pandemic," *Journal of Hospitality and Tourism Insights*, vol. 6, no. 4, pp. 1502–1520, Jan. 2022. doi:10.1108/jhti-08-2021-0217
- [7] M. L. Khalil, N. A. Aziz, A. A. Ariffin, and A. H. Ngah, "Big Data Analytics capability and firm performance in the hotel industry: The mediating role of Organizational Agility," *WSEAS TRANSACTIONS ON BUSINESS AND ECONOMICS*, vol. 20, no. 1, pp. 440–453, Feb. 2023. doi:10.37394/23207.2023.20.40
- [8] W. Yang and P. C. Lee, "Retaining hospitality talent during COVID-19: The joint impacts of employee resilience, work social support and proactive personality on career change intentions," *International Journal of Contemporary Hospitality Management*, vol. 35, no. 10, pp. 3389–3409, Aug. 2023. doi:10.1108/ijchm-07-2020-0761
- [9] N. Flinta, "Modern electronic booking and reservation systems in the hotel business," *Scientific Herald of Chernivtsi University. Geography*, vol. 1, no. 839, pp. 40–49, Nov. 2022. doi:10.31861/geo.2022.839.40-49
- [10] S. Yi and Y.-C. Jang, "Analysis of Recommended Mobile Selection Using the Weighted Product Method," *Int. J. Informatics Inf. Syst.*, vol. 5, no. 4, pp. 167–174, Dec. 2022
- [11] K. Mansour Ghazi, "Hotel Maintenance Management Practices," *Journal of Hotel and Business Management*, vol. 5, no. 1, pp. 1–13, 2016. doi:10.4172/2169-0286.1000136
- [12] S. Josephi and F. Melissen, "Hotel Revenue Management," *Hotel Accommodation Management*, vol. 1, no. 1, pp. 126–137, Oct. 2017. doi:10.4324/9781315169965-10
- [13] L. Zhang and G. Xie, "Pricing decision and cancellation strategy selection of 'hotel+ota' based on customer cancellation behavior," *Advances in Economics and Management Research*, vol. 7, no. 1, pp. 76–82, Jul. 2023. doi:10.56028/aemr.7.1.76.2023
- [14] G. Ćorluka and M. M. M. Landvogt, "Hotel seasonality," *Encyclopedia of Tourism Management and Marketing*, vol. 1, no. 1, pp. 612–615, Aug. 2022. doi:10.4337/9781800377486.hotel.seasonality
- [15] M.-H. Chun, "The study of Online Travel agencies(otas) selection attributes on Extended Technology Acceptance Model(ETAM)," *Journal of Tourism and Leisure Research*, vol. 33, no. 8, pp. 127–141, Aug. 2021. doi:10.31336/jtlr.2021.8.33.8.127
- [16] K. Jolene, "The influence of online travel agencies (otas) on Hotel Revenue and Distribution Strategies," *Journal of Modern Hospitality*, vol. 2, no. 1, pp. 14–25, Dec. 2023. doi:10.47941/jmh.1557

- [17] G. J. Han and K. Cho, "Pls path modeling to investigate the relations between competencies of data scientist and Big Data Analysis Performance : Focused on Kaggle Platform," *Journal of Korean Institute of Industrial Engineers*, vol. 42, no. 2, pp. 112–121, Apr. 2016. doi:10.7232/jkiie.2016.42.2.112
- [18] A. Hasted, "Statistical analysis of Descriptive Data," *Descriptive Analysis in Sensory Evaluation*, vol. 1, no. 1, pp. 165–210, Jan. 2018. doi:10.1002/9781118991657.ch5
- [19] T. Wiradinata, T. Ratih, D. Saputri, R. E. Sutanto, and Y. Soekamto, "Online Measuring Feature for Batik Size Prediction using Mobile Device: A Potential Application for a Novelty Technology," *J. Appl. Data Sci.*, vol. 4, no. 3, pp. 229–244, Sep. 2023
- [20] A. Hafeez and A. H. Sial, "Comparative analysis of data visualization libraries matplotlib and Seaborn in python," *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 10, no. 1, pp. 277–281, Feb. 2021. doi:10.30534/ijatcse/2021/391012021
- [21] J. Lai, "Developing a Predictive Information System for Determining the Prognosis of HIV and Tuberculosis Co-Infection in Incarcerated Individuals", *Int. J. Appl. Inf. Manag.*, vol. 3, no. 2, pp. 101–110, Jul. 2023.
- [22] Z. Dong, "Application of Big Data Mining Technology in Blockchain Computing," *Int. J. Informatics Inf. Syst.*, vol. 6, no. 2, pp. 81–88, Mar. 2023