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Stress Testing Key Performance Indicators: A Monte Carlo Approach to Hospitality Industry Resilience

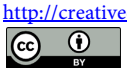
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Abstract

In this study, we analyzed the response of two key performance metrics in the hospitality industry, i.e., Average Daily Rate (ADR) and Revenue Per Available Room (RevPAR) to multiple adverse scenarios. Based on the Fairmont Southampton in Bermuda, which is owned by Gencom, the research uses the operational data from four years (from 2016 to 2019) to establish a Monte Carlo simulation model. The model develops scenarios representing both stable conditions (labeled "Business as Usual") and high-volatility environments ("Turbulent Times"), in which external factors like global economic recessions or supply chain disruptions can sharply curtail demand. The study uses one thousand independent simulations per scenario to assess potential revenue declines both in likelihood and severity of potential revenue declines. While under most market conditions, ADR and RevPAR remain fairly stable, clustering around their historical means, extreme scenarios can generate considerable down-side risk with significant revenue shortfall potential, which is what the key findings reveal. VaR (Value at Risk) and ES (Expected Shortfall) metrics emphasise the probability of these losses as well as the subsequent damage after risk limits have been breached. It can be concluded that proactive strategies including dynamic pricing mechanism, diversifying income sources, and maintaining financial buffers are necessary for hotel resilience. These insights go beyond merely reinforcing the need for strong contingency planning, they also help guide Gencom and investors/partners on how we can develop strategies to withstand sudden market shocks.

Keywords

Monte Carlo Simulation, Hospitality Finance, KPI Stress Testing, RevPAR, Occupancy Rate Volatility, Financial Modeling in Hospitality, Resilience

Modeling, Risk Analysis, Stochastic Modeling in Tourism, Scenario Forecasting, Gross Operating Profit, Quantitative Hospitality Research

1. Introduction

The hospitality industry is one of the most vital sectors in the global economy. Sectors within the industry include restaurant management, hotels, food & beverage, and tourism. This industry is prone to many disruptions, including financial hindrances, guest complaints, and supply chain disruptions. Although there are many economic fluctuations, the hospitality industry has significant ties with technology, providing various tools. Key Performance Indicators are commonly used when assisting businesses in making informed decisions, monitoring their performance, and achieving their goals. Common KPIs include Revenue Per Available Room (RevPAR) and Average Daily Rate (ADR). These indicators assist businesses when adapting to unprecedented changes and tracking progress to measure a business's progress. On the other hand, when faced with adverse scenarios, you can't be entirely reliant on KPIs due to fluctuations in their behavior.

This study explores and investigates how utilizing a Monte Carlo approach can respond to KPIs under adverse scenarios and assess impacts within the industry. The central research question driving this study is: *How do KPIs (Key Performance Indicators) behave under adverse scenarios, and what do these behaviors reveal about the resilience of the hotel sector within the hospitality industry?* This study examines financial hindrances, economic fluctuations, and supply chain disruptions that affect key metrics like ADR and RevPAR. By comprehending all the potential disruptions these scenarios may have within the industry, we can evaluate different recoveries from external shocks.

The main goal of this research paper is to stress-test key KPIs using a Monte Carlo approach, a statistical technique that models a range of uncertain variables. This method will offer better insights into adapting to specific changes, making it less vulnerable to fluctuating conditions during crises. In addition, this study seeks to assess how KPIs effectively capture long-term resilience and sudden vulnerabilities. The paper aims to improve risk management and adapt contingency planning in the hospitality sector, as gathered by the Monte Carlo simulation.

This paper is structured to conduct a literature review on KPIs' behavior during crisis periods. In the methodology section, stress-tested key indicators will be utilized to explain the Monte Carlo simulation. In the results section, the findings will be presented, analyzing the type of impact the different adverse scenarios had on KPIs. Ultimately, the conclusion will highlight specific implications for industry risk management and resilience to ensure better-strengthening strategies based on the behaviors of stress-tested KPIs.

2. Literature Review

2.1. Theoretical Framework

Under adverse scenarios, businesses' performance in the hospitality industry is frequently analyzed through crisis management, risk management frameworks, and resilience theory. First, risk management frameworks mainly prioritize risks to mitigate their risks or avoid them. Hospitality businesses often undergo tragic disasters, economic disturbances or recessions, and even public health crises like COVID-19, significantly impacting their operations and customers. Crisis management sets an infrastructure for risk management by providing strategies to recover and respond to these hindrances. This helps when focusing primarily on minimizing short-term and long-term damage and efficiently maintaining operations. This structure focuses on adaptability and proactive planning during crises. Resilience theory investigates how businesses recover from these unexpected disruptions and evolve and become resilient to future hindrances and can have long-term organizational flexibility (Cutter et al., 2008).

In the hospitality industry, RevPAR and ADR are categorized as Key Performance Indicators (KPIs) utilized to evaluate financial and operational performance. Key metrics can track a business' progress by providing valuable insights into guest demand, financial strategies, and the economic state. On the other hand, during a crisis, KPIs may have significant shifts in socio-economic and market trends, leading to changes in guest behavior, market fluctuations, and supply chain disruptions. For example, in an economic recession, RevPAR and ADR decrease significantly, and businesses in the hotel industry must lower their rates to attract tourists. Traditional KPIs, which are backward-looking, may not fully reflect the sudden risks or the long-term resilience of businesses during these uncertain periods (Sheffi & Rice Jr., 2005).

This limitation highlights the need to stress-test KPIs during adverse circumstances. The Monte Carlo simulations provide a deeper understanding of how these key metrics perform under adverse scenarios, revealing vulnerabilities and weaknesses during normal market conditions (Jüttner & Maklan, 2011).

2.2. Empirical Evidence

Research and empirical studies on how the hospitality sector performs in unexpected conditions provide more insight into how KPIs respond to these external shocks. During the 2008 financial crisis, RevPAR and ADR saw substantial losses and declines as hotel demand decreased and businesses fought over prices to attract a smaller pool of customers (Zervas et al., 2017). Hotels across the world reported a RevPAR decline of approximately 20% during the height of the crisis, demonstrating the vulnerability of hospitality businesses to economic recessions or downturns.

The COVID-19 pandemic was a tragedy for all businesses in the hospitality industry, and it serves as another crucial example of how KPIs fluctuate in response to crises. Traveling restrictions, border closures, and lockdowns are all factors that

led to the decline of sources of revenue and customers for hotels, airplanes, and other businesses within the hospitality sector. Research by Oxford Economics (2021) found that the global hotel industry lost 400 billion in revenue during 2020, with occupancy rates plummeting by over 50% in many regions. Another study from STR Global (2020) showed that some markets saw RevPAR drop by over 80% during the pandemic as travel demand reached very low. This drop in KPIs indicates the decline in key performance metrics and the shortcomings of traditional KPIs in foreshadowing or managing crises.

These empirical examples show the significant fluctuation of KPIs during times of crisis and highlight the significance of different approaches to analyzing performances, such as Monte Carlo simulations. By simulating various adverse conditions, businesses can better comprehend their operations' resilience and develop more efficient strategies for risk management, resilience, and recovery (Wheelwright et al., 1998).

3. Data

The dataset utilized in this research paper comes directly from Gencom, a U.S.-based investment firm that owns, operates, and develops prized real estate around the world, with an emphasis on luxury hotels, resorts, and branded residential properties. Gencom is also an active owner of and investor in hospitality operating platforms. The data spans from 2016 to 2019. It covers detailed performance metrics on one of Gencom's many properties, the Fairmont Southampton in Bermuda. Spanning four years, this dataset provides insight into both the financial and operational metrics of Gencom's hotel property. This rich data allows for constructing and stress-testing the following Key Performance Indicators (KPIs), ensuring a more accurate evaluation of their operational resilience and financial stability.

The different KPIs from the dataset leveraged in this analysis are as follows:

1) Average Daily Rate (Financial Performance Indicator)

Description: Average Daily Rate (ADR) measures a hotel's average revenue for each occupied room during a specific period. This key metric offers insight into a hotel's pricing strategy, indicating the revenue impact of each guest/booking. As metadata, ADR tracks fluctuations in room rate adjustments, helping companies in the hotel industry identify market dynamics, seasonal shifts, and variations in guest demand. Hotels analyze ADR with other metrics to adjust their pricing models, enhance their competitive position, and maximize room revenue.

$$\text{ADR} = \frac{\text{Total Room Revenue}}{\text{Number of Rooms Sold}} \tag{1}$$

- Total Room Revenue: Total revenue generated from room sales over a specific period.
- Number of Rooms Sold: The total number of rooms occupied and sold during a specific period.

2) RevPAR (Financial Performance Indicator)

Description: RevPAR is a crucial performance measure in the hospitality industry. It is calculated by multiplying a hotel's average daily rate (ADR) and occupancy rate. This metric also functions as metadata, synthesizing information about room rates and occupancy trends to evaluate a hotel's revenue capacity and potential properly. Higher RevPAR indicates a more profitable operation, helping maximize their income and maintain a competitive edge in the industry.

$$\text{RevPAR} = \frac{\text{Total Room Revenue}}{\text{Total Available Rooms}} \tag{2}$$

$$\text{RevPAR} = \text{ADR} \times \text{Occupancy Rate} \tag{3}$$

- Total Available Rooms: The total number of rooms available for sale over the period (unsold rooms are still factored into the KPI).
- Occupancy Rate: The proportion of rooms sold relative to the total available rooms (%).

4. Methodology

Limitations of the Data

The data used in this Gencom case study span only from 2016 to 2019. Focusing on a single property, Fairmont Southampton in Bermuda, this dataset provides valuable information. Although we can interpret the hotel's operational and financial performance, the scope is minimal. This brings many challenges:

1) Small Sample Size: With data limited to just four years, fewer observations are available for this analysis. Extensive trends like long-term patterns and economic expansions may pose challenges when analyzing this dataset. In addition, short-term and long-term fluctuations within the hotel industry can be misunderstood during these four years. The small sample size can be less reliable for future possibilities because the time frame of this data collection increases the risk of overfitting the models.

2) Geographic Limitation: This data is based on one location, the Fairmont Southampton in Bermuda. This location contains unique market conditions due to its geographic isolation. Also, Bermuda's hospitality market depends on luxury tourism, especially in the hotel industry. Challenges in this region include hurricanes and tropical storms that can harm its tourism and even this individual hotel. The factors from this study alone make it difficult to compare my findings to other regions with different environmental, political, and economic challenges.

3) Lack of External Variables: This dataset relies primarily on internal vital metrics, including ADR and RevPAR. External factors that are not considered in the data include prominent macroeconomic factors. Consumer confidence, GDP growth, and inflation rates are broader economic indicators that this data lacks. Misunderstanding these more prominent economic factors means this analysis may miss essential trends or forces outside this hotel's control.

4) Limited Crisis Data: The data spans 2016 to 2019, meaning that this period didn't go through significant economic disruptions like the COVID-19 pandemic

or the 2008 financial crisis. Consequently, this data from Gencom may not accurately reflect the hotel's key performance indicators (KPIs) due to different reactions during adverse market conditions. As a result, the lack of crisis data increases the difficulty due to data limitations on Fairmont Southampton's hotel resilience in contrary market conditions, making using Monte Carlo simulations to express potential impacts during hypothetical crises vital.

The Need for Monte Carlo Simulation

Given these limitations from the dataset, we utilize Monte Carlo simulation to comprehend further how KPIs may potentially behave under a wide range of possible future scenarios. Monte Carlo simulations allow us to overcome the constraints of limited historical data by using variances, historical means, and other statistical properties. This will assist in generating numerous potential states based on vital statistical properties. Insights into how critical ADR and RevPAR might behave in certain market conditions can be acquired by running thousands of simulations for future scenarios. This Monte Carlo approach enables us to simulate typical and extreme market conditions that would not otherwise be evident from a narrow historical dataset.

1) Stress Testing: Monte Carlo simulations help us evaluate how ADR and RevPAR perform through market fluctuations and minor or severe economic shocks. We can test the resilience of these metrics by simulating abrupt changes in consumer demand, supply chain disruptions, or economic downturns. Through this stress test process, we can identify potential weaknesses in the hotel's operational model, making it more feasible to implement new risk management strategies.

2) Risk Analysis and Quantification: Beyond identifying the most likely outcomes, Monte Carlo simulations offer essential insights with critical metrics like ADR and RevPAR that allow detailed risk quantification. We can identify the likelihood of underperformance under certain market conditions by assessing the extreme ends of the distribution and central expectations. Large occupancy declines or significant revenue losses can be deciphered from these thousands of possible outcomes, helping us further understand the impact of tail risks, rare but highly disruptive events. This comprehensive risk assessment informs better contingency planning. It provides hotel managers/operators with actionable insights for risk management that will help increase the hotel's resilience in adverse conditions or events.

Simulation Details

To comprehensively evaluate the performance of the average daily rate (ADR) and RevPAR, we performed 1000 independent Monte Carlo simulations. These simulations allow us to replicate both regular business fluctuations and extreme market disturbances by introducing random variations into our KPI calculations. This approach simulates a wide range of possible future outcomes beyond what Gencom's data from 2016 to 2019 can provide. Instead, it gives a more dynamic forecast of the hotel's financial and operational performance during uncertain times.

We utilized and calculated the average and standard deviation for ADR and RevPAR from this dataset, using them as starting points for this Monte Carlo sim-

ulation. By implementing these statistics into our simulation, we could accurately model two critical market conditions: Business as Usual (BAU) and Turbulent Times. The results offer a more feasible and predictive tool for understanding how the hotel could best perform in different market environments, regardless of whether they were stable or turbulent.

Scenario 1: BAU (1 Standard Deviation from the Mean)

In the "BAU" scenario, we simulate a stable operating environment where the hotel performance is modeled. Both ADR and RevPAR fluctuate within one standard deviation (1σ) of their historical means. This scenario captures the most typical variability, including minor changes in the local economy, seasonality, and flexible pricing strategies. Reflects a business environment and serves as a baseline for analyzing the hotel's overall performance under predictable market changes or conditions, excluding volatility in the hospitality industry. Key Parameters:

- Baseline Data: ADR and RevPAR means are calculated from the Fairmont Southampton Hotel in Bermuda from 2016-2019 data.
- Random Variations: Fluctuations within 1σ from the mean, representing the regular dynamics of the market.
- Simulations: 1000 iterations generate potential future outcomes.
- Projection Period: Future projections based on historical trends over several years.

The objective of this scenario is to evaluate the hotel's overall performance under normal business conditions, where the market dynamics are predictable and the market volatility is relatively low. By confining fluctuations to one standard deviation, we simulate an environment where extreme external shocks are limited, and internal operations and minor economic influences primarily drive the hotel's performance.

Rationale for the "BAU" Scenario:

The hospitality sector is susceptible to uncertain fluctuations driven by various factors. These factors include strategic pricing decisions, seasonal consumer demands, and local economic conditions depending on the region. For instance, during peak tourism, ADR typically escalates due to heightened consumer demand, while during off-peak seasons, pricing may decline accordingly to this demand. In addition, operational costs, regional economic trends, and competitive pressures within the market play an important role in a hotel's performance. By restricting fluctuations to within one standard deviation, 'BAU' reflects a stable economic environment where external shocks are marginalized. This controlled approach establishes a benchmark for the hotel's resilience during normal market conditions, setting a reference point for assessing the financial and operational aspects of a hotel's performance during more turbulent times.

Scenario 2: Turbulent Times (3 Standard Deviations from the Mean)

The "Turbulent Times" scenario presents a high volatility model that allows key metrics such as ADR and RevPAR to fluctuate within three standard deviations (3σ) from their average. This scenario is designed to simulate the impact of severe

external economic and operational shocks such as the 2008 financial recession or the COVID-19 pandemic in 2020, as previously mentioned. The extended range of deviation models the hotel's potential performance during periods of substantial economic distress, where there are sharp tourist declines or widespread geopolitical tension. This scenario is critical for providing information on hotel risk management capabilities, liquidity maintenance, and the ability to recover from unexpected external factors of high impact.

Key Parameters:

Baseline Data: This is similar to the "BAU" scenario (2016-2019). However, the degree of fluctuation extends up to three standard deviations from the mean.

- Random Variations: ADR and RevPAR are modeled to experience extreme volatility.
- Simulations: 1000 iterations generate potential future outcomes.
- Extreme Scenarios: The shocks modeled are high-impact events replicating real-world crises affecting the hospitality sector.

This scenario rigorously evaluates the hotel's financial resilience under rare catastrophic events. Some examples include global health pandemics that affect a region's tourism, geopolitical crises that hinder global travel, and economic recessions that substantially affect discrete capital spending during travel. The range of three standard deviations encompasses a wide array of potential outcomes, including worst-case scenarios crucial for assessing the hotel's weaknesses and stress points to extreme external fluctuations.

Rationale for the "Turbulent Times" Scenario:

The hospitality industry, especially the hotel sector, consistently encounters major external disruptions, whether from global pandemics, geopolitical instability, or global financial crises. All of these disruptions lead to rapid occupancy and revenue declines for those in the hospitality industry. This scenario models ADR and RevPAR within three standard deviations to simulate rare high-impact events. By understanding how the hotel performs under these harsh conditions, we can identify stress points and help guide strategic decisions to reinforce these weaknesses that the hotel may have. Implementing strategies to safeguard financial stability by making pricing adjustments and contingency planning efforts can strengthen the hotel's economic resilience.

Value at Risk (VaR) Calculation

To rigorously evaluate the financial risks that the hotel may face, we employ the Value-at-risk (VaR) methodology for two KPIs: ADR and RevPAR. VaR is a cornerstone of financial risk analysis, designed to quantify the maximum potential loss that an asset or performance metric could experience over a specific period, given a specified confidence level. This enables us to identify and measure the most extreme potential losses the hotel could undergo during a given time frame, particularly under extreme market conditions or even significant volatility.

The VaR formula used is:

$$\mathrm{VaR}_{\alpha} = \mu - z_{\alpha} \times \sigma$$

where: μ = mean of the KPI (ADR or RevPAR);

z_α = the z-score corresponding to the chosen confidence level (e.g., 1.645 for 95%, 2.33 for 99%);

σ = standard deviation of the KPI's distribution.

In simpler terms, calculating 95% VaR for ADR is likely to result in ADR dropping below the threshold in any particular period. This calculation is essential because it allows us to gauge the potential severity of revenue fluctuations and how they might affect the hotel. It provides a clear view of the possible downside risks in both stable market environments and more volatile scenarios.

Expected Shortfall (ES) in Our Case

While VaR captures the potential maximum loss under regular market conditions, it presents a vital limitation: VaR fails to identify the extent of losses that exceed the threshold. This is where ES, or Conditional VaR, becomes necessary in times like these. ES calculates the average loss in scenarios where ADR and/or RevPAR fall way below the VaR threshold, providing a deeper understanding of tail risk. Overall, ES provides a more extensive and detailed image of the tail risk, which is vital for measuring the severity of the losses beyond the worst-case scenario or the threshold.

The formula for ES is:

$$\mathrm{ES}_\alpha = E\left[X \mid X \le \mathrm{VaR}_\alpha\right]$$

In this formula:

- X represents the KPI values (e.g., ADR or RevPAR).
- The condition $X \le \mathrm{VaR}_\alpha$ captures scenarios where the KPI falls below the VaR threshold, highlighting the worst possible outcomes or events.

The hospitality industry is susceptible to abrupt disruptions triggered by external factors, such as health crises like the COVID-19 pandemic, natural disasters, and geopolitical conflicts. These incidents can result in significant and unexpected declines in a hotel's financial performance, far beyond what a standard forecasting model can predict. The ES key metric fills this gap by accurately measuring the average losses during these extreme events, enhancing our comprehension of the potential risks.

VaR quantifies the probability of significant losses that arise from these challenging events, while ES evaluates the severity of those losses (financial, economic, etc.) when they occur. By leveraging VaR and ES into our risk evaluation framework, the multidimensional perspective on financial risk with creating more resilient business models can help develop long-term stability and combat adverse financial outcomes in the hotel industry.

5. Findings

Summary Statistics.

Table 1 presents the summary statistics for the key performance indicators (KPIs) used in the study: ADR and RevPAR. The mean ADR is approximately

$314.66, indicating the average revenue earned per occupied room during the study period. Similarly, the mean RevPAR is around $193.33, reflecting average revenue generated per available room, factoring in both occupied and vacant rooms.

Table 1. Summary Statistics for KPIs.

Metric	Mean	Standard Deviation
ADR	314.6600	14.550221
REVPAR	193.3275	11.889596

The standard deviations for ADR ($14.55) and RevPAR ($11.89) indicate moderate variability, suggesting relatively stable revenue performance under typical market conditions. These statistics set a baseline for comparison when assessing risk scenarios, such as economic downturns or crises modeled in the Monte Carlo simulations. This stability during "BAU" scenarios underscores the hotel's strong revenue management and ability to adjust prices to sustain financial performance.

Monte Carlo Results.

Figure 1 illustrates the distribution of ADR values generated through Monte Carlo simulations under the "Business as Usual" scenario. The histogram shows a bell-shaped curve, indicating a relatively normal distribution centered around the mean ADR of approximately $314.66. Most simulated ADR values fall between $290 and $340, suggesting that the hotel's pricing strategy remains stable during typical market conditions. The narrow spread reflects moderate volatility, implying that even with slight demand fluctuations, the hotel can sustain consistent room pricing.

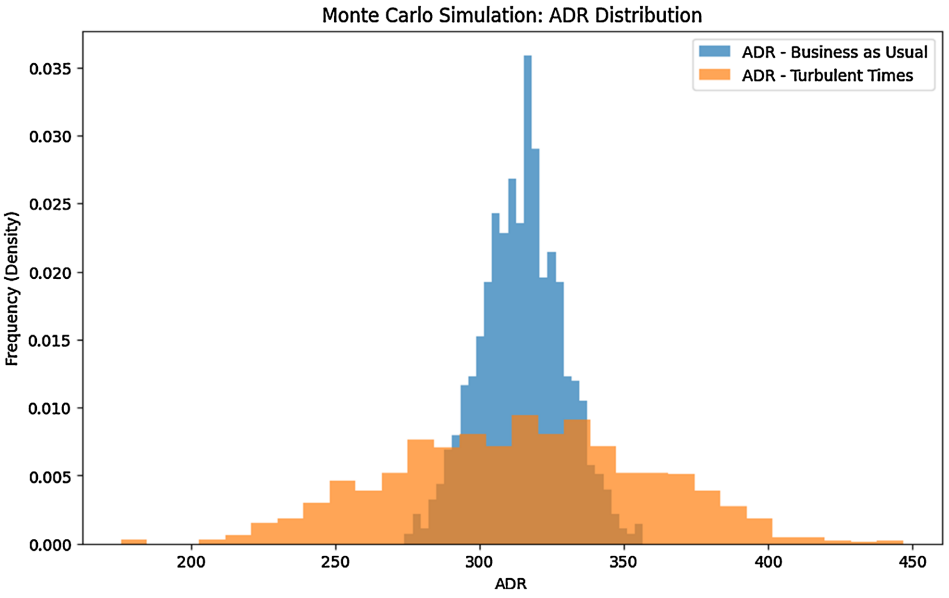


Figure 1. Histograms from Monte Carlo Simulations for ADR.

Additionally, the peak of the histogram near the mean ADR highlights frequent occurrences of revenue outcomes close to the average, underscoring predictability in the hotel's pricing behavior. This concentration near the mean suggests that the hotel's pricing management is effective and resilient under standard operating conditions, minimizing the likelihood of extreme revenue fluctuations during normal business periods.

Figure 2 depicts the distribution of RevPAR values derived from Monte Carlo simulations. The histogram reveals a concentrated range of values near the mean RevPAR of approximately $193.33, with most simulated outcomes lying between $170 and $210. This clustering indicates a steady revenue generation pattern, driven by effective room occupancy management and pricing strategies. The limited variability suggests that the hotel's revenue performance is relatively stable, even when accounting for potential market fluctuations in normal operating environments.

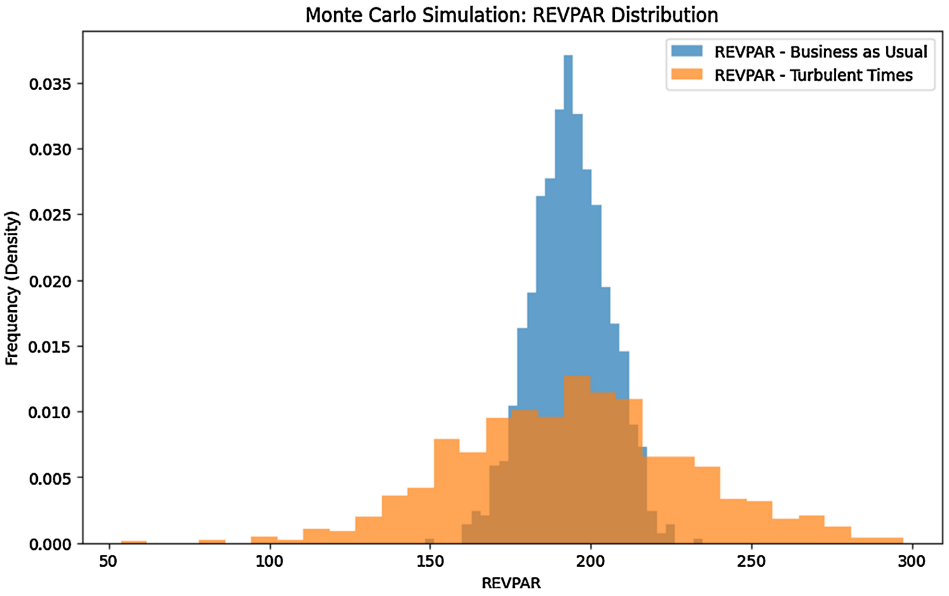


Figure 2. Histograms from Monte Carlo Simulations for RevPAR.

The shape of the histogram reflects a symmetric distribution, reinforcing the reliability of revenue expectations under typical conditions. The reduced presence of extreme values indicates a low probability of significant revenue declines, suggesting that the hotel is well-positioned to maintain financial stability. This stability is likely due to the hotel's ability to adjust pricing dynamically while ensuring a consistent occupancy rate.

VaR and ES Results.

Table 2 displays the VaR and ES for ADR and RevPAR at a 95% confidence level, reflecting potential revenue declines under BAU conditions. The VaR for ADR is approximately $290.72, meaning there is a 5% chance that ADR could drop below this threshold in a given period. Similarly, RevPAR's VaR is about $173.77, demonstrating the minimum expected RevPAR in a worst-case scenario.

Table 2. VaR and ES at 95% confidence level for ADR and REVPAR under BAU.

Metric	VaR (95%)	ES (95%)
ADR	290.72	−103.01
REVPAR	173.77	−147.97

The ES, representing average losses beyond the VaR threshold, shows significantly negative values: - $103.01 for ADR and - $147.97 for RevPAR. These figures suggest that if conditions worsen beyond VaR levels, the hotel could face significant financial setbacks, highlighting the critical need for effective risk management strategies to mitigate such extreme revenue declines.

Under normal conditions, "BAU", the means from the Monte Carlo simulations for ADR and REVPAR were quite stable, with moderate standard deviations. The VaR (95%) thresholds, like $ADR \approx \$290.72$ and $RevPAR \approx \$173.77$, provide evidence that under adversity—common conditions—revenue is expected to decline but does so within manageable bounds. These findings seem to indicate that dynamic pricing strategies coupled with a strong loyalty base will stabilize revenue streams even if mild downturns occur.

However, the "Turbulent Times" scenario (Table 3) shows a significant rise in downside risk, while VaR and ES metrics show considerably worse potential declines—in some cases, $ADR\ ES \approx -\$938.34$ and $RevPAR\ ES \approx -\$830.55$. These extreme outcomes underline the importance of diversifying revenue sources and offering value-added packages to mitigate heavy reliance on room revenues. By tailoring strategies to resist such significant shocks, hotels can maintain resiliency and support sustainable revenue performance.

Table 3. VaR (95%) and ES (95%) for ADR and REVPAR (Turbulent Times).

Metric	VaR (95%) - Turbulent	ES (95%) - Turbulent
ADR	242.85	−938.34
REVPAR	134.65	−830.55

6. Conclusion and Remarks

Focusing on ADR (Average Daily Rate) and REVPAR (Revenue Per Available Room), this research attempts to learn both the disruptiveness and resilience of hotel KPIs in times of crisis through the use of a Monte Carlo simulation model. Based on data from 2016 to 2019 at the Fairmont Southampton in Bermuda, which is owned by Gencom, it provided an analytical perspective on the way that ADR and RevPAR were likely to perform not only in normal ("Business as Usual") but also in very volatile ("Turbulent Times") market environments. While the dataset was constrained by a narrow time frame and was geographically specific, the Monte Carlo approach was able to widen the range of potential outcomes, yielding important insights into operational stability, risk exposures and potential strategies for contingency planning. This focus was driven by a recognition that de-

pendence alone on historical average data can hide vulnerabilities under major external shocks. Case studies from previous hospitality crises, from the 2008 financial crisis to the COVID-19 pandemic, show that even resilient KPIs like ADR and RevPAR can tumble when demand collapses or supply shocks are prolonged. Our review of the literature highlighted the fact that hospitality firms can and need to do more than rely on measures that are retrospective—by exploring the full range of downside risk and stress testing their critical key performance indicators (KPIs), companies can develop a deeper understanding of the downside and activate all potential response capabilities.

This study conducted Monte Carlo simulations to produce thousands of potential states for ADR and RevPAR, based on the property's mean and standard deviations from the past. The two scenarios shown included the "Business as Usual" (BAU) scenario statement which allowed for KPI fluctuations within one standard deviation of historical norms, while "Turbulent Times" posited up to three standard deviations to fulfill conditions such as global recessions or severe supply chain disruptions. Under BAU conditions, Fairmont Southampton's ADR and RevPAR metrics converged around their historical averages of approximately $314.66 and $193.33, respectively, indicating fairly steady sources of revenue. The VaR and ES calculations indicated that despite 5% chance of lows below these thresholds, losses were largely contained and within normal ranges of industry volatility. In contrast, the "Turbulent Times" scenario revealed much more severe downside risks. In light of wider potential swings in ADR and RevPAR, the VaR values fell to levels that suggest occupancy and pricing strategies could be massively undermined in extreme market scenarios. The ES calculations showed that the average losses could also be extremely large, once the property returns to the VaR threshold, some projections in the hundreds of dollars per room night. These findings underscore the operational and financial vulnerabilities that can play out when challenged by dramatic external shocks, whether in the form of health crises, sudden macroeconomic downturns or geopolitical events that limit demand for global travel.

Implications for Gencom

On a strategic level, the results highlighted the need for stronger contingency planning across Gencom's portfolio. First are dynamic pricing systems that are sensitive to demand signals in real time, allowing rates to be adjusted rapidly in reaction to early indicators of demand weakening. This is one way to stop revenue losses before the compound/snowball. Second, diversifying revenue streams, whether through ancillary services, packages, hosting events, etc., which depends on less-price sensitive segments of the population could mitigate the severity of declines driven by room revenue. Third, strengthening supply chain relationships, either through multi-supplies contracts or fostering local partnerships, is likely to diminish exposure to logistical disruptions. Emboldened procurement networks enable hotels to avoid sudden cost spikes or gaps that put a dent in operating margins. Lastly, Gencom must put more tangible financial cushions or credit facilities

in place against worst-case scenarios. Keeping liquidity on hand when needed can shape how a property endures such a crisis and comes out ready to recover, particularly if it has to pivot its business models on a dime.

Suggestions and Final Remarks

Though conclusions from only four years of historical data at a single Bermuda-based hotel are limiting, Monte Carlo simulations yielded useful observations about the resiliency and vulnerabilities of the hotel's key revenue metrics. Future research may extend this data to cover broader datasets that entail multiple properties in different geographic locations and time periods, even during periods of crisis like COVID-19, building even further upon this model's predictive capability. Yet even the current evidence is enough to guide targeted strategic reforms. In these uncertain times, Gencom can strengthen the Fairmont Southampton's ability to adapt in uncertain times through strong risk resistance protocols, dynamic pricing, diverse offering and agile supply chain management. Implementing these changes will not only safeguard near-term profitability, but foster a culture of resilience that can withstand future disruptions.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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