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Feasibility Analysis of Applying Financial Risk Management Methods to Tourism Risk Management

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Abstract

The global tourism industry, a significant contributor to economic growth and employment, operates within an environment of profound and increasing uncertainty. Geopolitical tensions, climate change, and the lingering effects of pandemics have exposed the limitations of traditional, qualitative risk management approaches prevalent in the sector. This paper argues for a paradigm shift, exploring the feasibility of transferring quantitative and predictive methodologies from the mature discipline of Financial Risk Management (FRM) to Tourism Risk Management (TRM). We contend that despite surface-level differences, both fields share foundational characteristics: exposure to uncertainty, information asymmetry, systemic interconnectedness, and vulnerability to catastrophic tail events. Through a comparative analysis, this study systematically examines the applicability of key FRM tools—such as Value at Risk (VaR), GARCH models, stress testing, real options analysis, and portfolio theory—to tourism contexts. We propose concrete adaptations for forecasting demand volatility, assessing destination resilience, and predicting supply chain disruptions. While acknowledging significant challenges like data heterogeneity and the subjective nature of tourist risk perception, the paper concludes that such a cross-disciplinary application is not only feasible but also imperative for building more resilient tourism systems. We propose an integrated conceptual framework to guide implementation, paving the way for a more robust, data-driven approach to navigating the complexities of modern travel.

Keywords

Financial Risk Management, Tourism Risk Management, Cross-Disciplinary Methodology, Tourism Resilience, Quantitative Methods

1. Introduction

The global tourism industry is one of the most vibrant yet extremely fragile sectors in the modern economy. As a major contributor to global GDP and employment, it has long been exposed to a broad spectrum of risks, ranging from natural disasters and geopolitical turmoil to public health crises and economic recessions. The tourism ecosystem—which encompasses transportation, accommodation, hotels, and related services—operates within an environment rife with uncertainty. The COVID-19 pandemic serves as the most compelling illustration of this vulnerability, bringing international travel to an almost complete standstill and inflicting unprecedented economic losses (Gössling et al., 2021). However, traditional Tourism Risk Management (TRM) methods primarily rely on qualitative assessments, crisis communication protocols, and reactive emergency response plans (Ritchie & Jiang, 2019). While these measures are crucial, they often struggle to provide forward-looking insights, quantify potential losses, and achieve optimal resource allocation in the face of uncertainty.

Since then, could we leverage methodologies from other disciplines to quantify tourism risks, thereby enabling more precise risk management? We observe that Financial Risk Management (FRM), as an independent discipline, has gradually evolved into a highly mature theoretical and practical system over the past half-century. This field's development has been primarily driven by the inherent high volatility and complexity of financial markets. To address these challenges, the FRM domain has built an entire suite of rigorous quantitative tools to accurately identify, assess, and mitigate various risks. Concepts such as Value at Risk (VaR), stress testing, volatility modeling, and portfolio diversification have become the cornerstones of modern financial practice. It is precisely these tools and methodologies that enable financial institutions to achieve finer-grained risk management and decision-making amidst uncertainty (Hull, 2023).

Thus, this paper proposes a novel concept: to address the challenges faced by TRM by transferring and applying the mature methods and techniques from the field of FRM through an interdisciplinary perspective. Building upon this premise, the paper delves into a central research question: To what extent are the quantitative methods specifically developed for the financial sector feasible when applied to TRM, and how effectively can they ultimately enhance risk governance within the tourism industry? We employ a conceptual comparative analysis approach to review the foundational theories and empirical applications in both fields, assessing the feasibility of transferring these tools. The financial risk management methods selected are based on their theoretical maturity, extensive industry application cases, and feasibility in addressing the various types of risks commonly encountered in the tourism sector.

In this study, "feasibility" is defined across four dimensions: 1) Theoretical Fit, which examines whether the fundamental assumptions underlying a financial risk management method align with the characteristics of tourism-related risks; 2) Data Requirements, which assesses whether the necessary input information can

be obtained or reasonably estimated; 3) Managerial Usefulness, which evaluates whether the resulting outputs can provide actionable insights for decision-making; and 4) Implementation Constraints, which consider the technical and organizational limitations that may arise during implementation.

The research logic of this paper is primarily based on the following two points: First, the essential characteristics of risk—randomness, potential for loss, and systemic interconnectedness—are universal phenomena that transcend industry boundaries. Whether in the financial sector or the tourism industry, these characteristics exhibit a high degree of consistency within their internal operational mechanisms. Second, with the acceleration of digitalization, the tourism industry is now generating vast amounts of structured and unstructured data (such as booking patterns, social media sentiment, and travel trajectory data), which are well-suited for the application of mature quantitative techniques from the financial sector. Based on this, this study aims to build a bridge between these two disciplines. We will clarify the points of integration through a systematic feasibility analysis, including identifying their common theoretical foundations, proposing targeted model adaptation strategies, and conducting an in-depth analysis of the potential challenges and limitations in this process. Through this series of efforts, this paper seeks to propose a new research framework that aims to transform traditional TRM—which has tended to be reactive and reliant on empirical judgment—into proactive, precise, and resilient strategic management.

The structure of this paper is as follows: Section 2 reviews the foundational concepts of risk in both fields, laying the groundwork for theoretical transfer; Section 3 conducts an in-depth analysis of several specific FRM methods and explores their potential applicability to the tourism industry; Section 4 discusses the challenges associated with this interdisciplinary integration; Section 5 proposes a feasible implementation framework based on the preceding analysis; and finally, Section 6 summarizes the paper and provides an outlook on future research directions.

2. Fundamental Commonalities of Risk in Finance and Tourism

Before exploring the feasibility of method transfer, it is first necessary to confirm the commonalities in risk characteristics between the finance and tourism industries at the conceptual level. Fundamentally, both sectors operate in highly uncertain environments: future states are fraught with unknowns, and actual outcomes tend to deviate from expectations, potentially leading to severe negative consequences.

2.1. The Nature of Risk: Uncertainty, Loss, and Information Asymmetry

In the financial sector, risk is traditionally defined as the volatility of returns around an expected value, with research often focusing on downside risk—that is, losses.

This risk characteristic is typically captured through quantitative metrics such as volatility or Value at Risk (VaR). The tourism experience exhibits similar characteristics. It can also be viewed as a form of "return"—namely, the satisfaction, happiness, and experiential value gained by tourists. Tourists invest both time and money in the hope of obtaining a positive experience. When negative events such as flight cancellations, adverse weather, or safety incidents occur, they constitute a negative deviation from the expected "return". Such deviations not only deprive tourists of time utility but are often accompanied by direct financial losses.

In terms of information flow, both fields also exhibit a high degree of asymmetry. In financial markets, insiders often possess more information about a company's condition, leaving external investors at a relative informational disadvantage. In the tourism industry, this information asymmetry is equally evident. Local operators or Destination Management Organizations (DMOs) may have more knowledge than tourists about local safety risks, sudden infrastructure failures, or emerging security concerns. However, such critical information is often difficult to communicate to tourists at the key moments when they are making travel bookings.

2.2. Systemic Interconnectedness and Contagion Effects

A core characteristic of modern finance is systemic risk—the high degree of interconnectedness among institutions within the financial system means that the failure of a single entity can trigger a chain reaction, potentially leading to the collapse of the entire system (Bernanke, 2013). The transmission mechanisms of such risk are equally evident in the tourism industry. Tourism is inherently a complex and interdependent network system. A crisis at one node (for example, a crisis involving a major airline or a key destination) tends to rapidly propagate along the supply chain. For instance, the 2024 Boeing 737 MAX 9 grounding incident severely disrupted airline flight schedules, subsequently affecting airport revenues, hotel occupancy rates, and even impacting tourism boards worldwide. Similarly, a terrorist attack targeting a major city not only inflicts losses on that city but may also trigger a "substitution effect", causing travelers to collectively avoid the entire region. This phenomenon of cross-regional risk contagion represents a common challenge that risk managers in both the finance and tourism sectors must understand.

2.3. Volatility, Seasonality, and Tail Risk

The phenomenon of volatility clustering—where periods of large price movements tend to be followed by further large fluctuations—is well established in financial markets. The tourism industry exhibits a similar yet more cyclical pattern of demand volatility. While seasonality represents a predictable form of fluctuation, sudden shocks (such as an unexpected border closure) can disrupt this regularity and give rise to new volatility clustering, resulting in severe disruptions to local

economies.

In addition, both fields face the challenge of tail risk—extreme, low-probability "black swan" events. The 2008 financial crisis was a quintessential tail risk event for the global financial industry, while the COVID-19 pandemic in 2020 represented a comparable catastrophe for the global tourism sector. Traditional risk models often struggle to accurately capture the destructive impact of such extreme events, further highlighting the necessity of introducing methods such as stress testing and extreme value theory.

2.4. Liquidity Risk and Capacity Risk

In the financial sector, liquidity risk refers to the risk of being unable to execute a transaction without causing significant price fluctuations. In the tourism industry, there exists a highly analogous concept: capacity risk. For instance, hotels or airlines hold fixed inventories (rooms, seats). When a risk event—such as a hurricane—leads to a sudden drop in demand, operators face a "lack of demand": they are unable to convert their inventory into cash flow under the pressure of fixed costs. This predicament closely mirrors the situation faced by financial institutions when they cannot liquidate assets to meet their debt obligations.

In summary, these fundamental commonalities—uncertainty, systemic interconnectedness, volatility clustering, tail risk, and capacity/liquidity constraints—provide a solid theoretical foundation for transferring the mature quantitative risk management tools from the financial sector to the tourism industry.

3. Application of Core FRM Methods in TRM

This section provides a detailed exposition of how six core FRM methods can be applied to TRM. The selection of these methods is based on their theoretical maturity, their functional roles in addressing various facets of financial risk (market, credit, and operational), and their potential applicability within the tourism sector. Specifically, Value-at-Risk (VaR) and GARCH models are employed for the quantitative measurement of market volatility; stress testing and CoVaR/network analysis serve as tools for managing systemic and extreme risks; while Real Options Analysis (ROA) and Modern Portfolio Theory (MPT) guide strategic investment and asset allocation under uncertainty. Other important FRM tools, such as credit risk models (e.g., the KMV model) and operational risk frameworks (e.g., the New Standard Approach), are excluded from this preliminary discussion due to their heavy reliance on finance-specific data and institutional structures. The discussion of each method will focus on its application across three decision-making levels: the destination level (e.g., destination management organizations, tourism bureaus), the enterprise level (e.g., hotel chains, airlines), and the project level (e.g., large-scale infrastructure investments).

3.1. Risk Quantification: Value at Risk (VaR) and Conditional VaR

Principles in Finance: VaR is a statistical technique used to measure the maximum

potential loss that an investment portfolio may incur over a specified time horizon at a given confidence level (e.g., 95%). Its conditional counterpart, Conditional Value at Risk (CVaR), further measures the Expected Shortfall (ES) beyond the VaR threshold and is commonly used to capture tail risk.

Application and Adaptation in Tourism: The core logic of VaR can be transferred to the forecasting of profits and losses for tourism enterprises and destinations. This method is primarily suitable for the destination and firm levels. At the destination level, a DMO can construct a "Tourism Revenue at Risk (TRaR)" model to quantify downside risk. At the enterprise level, airlines or hotel groups can use the VaR model to estimate potential revenue losses in their operations. For example, TRaR model, specifically, by analyzing time series data on historical visitor numbers, expenditure, and drivers of volatility—such as exchange rates, competitors' marketing investments, and weather patterns—the DMO can derive a conclusion along the lines of: "Based on current market and climate conditions, we are 95% confident that tourism revenue for this month will not fall below X amount". The minimum required data inputs include time series of revenue or visitor arrivals, as well as key external volatility drivers (e.g., exchange rates, weather indices). This method addresses the specific issue in TRM of lacking a probabilistic basis for loss measurement, thereby supporting decisions such as reserve allocation and budget distribution.

Similarly, CVaR can be used to analyze losses under extreme shocks. Taking a ski resort as an example, a "Demand at Risk" model could be constructed using data such as historical snowfall and holiday booking patterns. CVaR would then estimate the average number of visitors likely to be lost during the worst 5% of low-snowfall seasons. This information could be used to price weather derivatives or optimize debt structures to more effectively hedge against the impacts of extreme weather events.

3.2. Volatility Modeling: Demand Forecasting Based on GARCH

In the financial sector, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is a core tool for forecasting the volatility of asset returns. It effectively captures the phenomenon of volatility clustering—where periods of high volatility tend to be followed by further high volatility, forming persistent trends. Poon and Granger (2003) provided a systematic review of the application of such models in financial econometrics, highlighting their superior performance in capturing the time-varying nature of risk.

In the tourism industry, demand is also highly volatile. For instance, travelers' willingness to visit a destination is not static but fluctuates sharply in response to changes in the external environment. The GARCH model can be directly transferred to this context to analyze and forecast volatility in tourism demand. This method is highly applicable at both the destination and firm levels. A DMO can use it to predict fluctuations in visitor arrivals, while a hotel group can employ it to forecast variations in occupancy rates. Researchers can use it to model time series

data such as visitor arrivals, hotel occupancy rates, or flight bookings, thereby gaining insights into underlying risk trends. For example, when using a GARCH model to analyze the impact of political instability on inbound tourism volatility, the model may reveal how long a period of high volatility—triggered by an event such as a protest—can persist. The minimum required data input is a time series of a key demand metric (e.g., daily or weekly bookings or foot traffic). This method addresses the TRM problem of being unable to anticipate demand during periods of volatility, thereby supporting decisions related to capacity adjustments and proactive marketing. For tourism operators, such models can serve as real-time market volatility warning systems, alerting businesses to adopt proactive risk management strategies—such as actively exploring new source markets or flexibly adjusting capacity allocation—when volatility intensifies.

3.3. Systemic Risk and Network Analysis

Principles in Finance: Since the 2008 financial crisis, regulatory authorities have developed tools for measuring systemic risk, such as CoVaR (which measures an individual institution's contribution to the overall system's VaR) and network analysis techniques for mapping interconnections.

Application and Adaptation in Tourism: This approach can be adapted to map the tourism supply chain network. This method is most suitable for the destination level and, in some cases, also applicable at the large firm level (e.g., for large corporate groups to map their own supply chain networks). Specifically, a network model can be constructed in which nodes represent entities (airports, hotels, attractions, travel agencies) and edges represent business relationships and financial flows. Using the logic of CoVaR, researchers can calculate the "systemic importance" of a major airline hub. The analysis aims to answer a core question: "If this hub experiences a disruption, what is its contribution to the overall risk of the regional tourism system?". The minimum required data input consists of network data representing the business or financial relationships among tourism entities. This method addresses the TRM issue of identifying hidden vulnerabilities within the supply chain, thereby supporting decision-making aimed at targeted resilience enhancement and contingency planning.

Through such quantitative assessments, policymakers can identify critical nodes whose failure could trigger a cascade of consequences, enabling targeted investment in resilience-building efforts.

3.4. Extreme Event Planning: Stress Testing and Scenario Analysis

Principles in Finance: Stress testing is a core tool of financial regulation. It typically involves simulating hypothetical extreme scenarios—such as a 30% decline in GDP or a 50% drop in housing prices—to assess whether financial institutions have sufficient capital adequacy to withstand shocks.

Application and Adaptation in Tourism: Stress testing may be one of the most direct and operationally feasible tools for cross-disciplinary transfer. This method

is applicable across all three levels: destinations can assess their economic resilience, firms can evaluate their financial solvency, and projects can test their feasibility under worst-case scenarios. DMOs, hotel groups, and national tourism boards can develop their own scenario testing frameworks. Taking a coastal tourist destination as an example, scenarios might include: 1) Baseline scenario: normal seasonal fluctuations; 2) Adverse scenario: a Category 4 hurricane making landfall during the peak tourist season; 3) Extreme scenario: a hurricane strike followed by an economic recession and the bankruptcy of a major airline. The minimum required data inputs consist of the organization's financial statements or operating budgets, along with specified external shock parameters. This method addresses the TRM issue of lacking preparedness for unpredictable events, thereby supporting decisions related to emergency budgeting and the establishment of emergency credit lines. By stress-testing reserve resources, insurance coverage, and operational capacity against these extreme scenarios, DMOs and tourism businesses can identify vulnerabilities in advance, establish contingency budgets, and enhance economic resilience before a crisis actually strikes.

3.5. Investment Decisions: Real Options Analysis (ROA)

Principles in Finance: Traditional Net Present Value (NPV) analysis often underestimates the value of investments in highly uncertain environments. Real Options Analysis (ROA) treats an investment opportunity as a financial option, granting managers the flexibility to "delay decisions", "expand", or "exit" as market conditions evolve, thereby pricing the value of these choices.

Application and Adaptation in Tourism: Large-scale tourism projects—such as mega-resorts or convention centers—are characterized by high sunk costs, long construction periods, and extreme sensitivity to external conditions. This method is primarily applicable at the project level, but it can also inform capital allocation decisions at the firm level. Drawing on studies such as Liu et al. (2025), ROA can provide more realistic valuations for such projects. For example, when investing in a luxury resort, developers need not rely solely on a binary "go/no-go" decision but can instead incorporate the following embedded options: 1) A deferral option—purchasing the land but delaying construction until regional political conditions stabilize; 2) An expansion option—building core facilities first, then adding additional rooms if initial occupancy rates exceed expectations; 3) An abandonment option—selling the assets to a government entity in the event of a predefined catastrophic event (e.g., a major natural disaster). The minimum required data inputs consist of expected cash flows under various scenarios and key value drivers (e.g., anticipated occupancy rates). This method addresses the TRM issue of strategic inflexibility, thereby supporting decisions regarding staged investments and exit strategies.

This approach acknowledges and quantifies the value of preserving optionality in the face of tourism-specific risks, offering a more realistic assessment than static NPV.

3.6. Portfolio Management: Modern Portfolio Theory (MPT)

Principles in Finance (Markowitz, 1952): MPT demonstrates that investors can maximize expected returns for a given level of risk—or minimize risk for a given level of expected return—by constructing portfolios composed of assets with uncorrelated or negatively correlated returns.

Application and Adaptation in Tourism: MPT can be applied in tourism at two levels: destination level and firm level. 1) Destination level: DMOs can treat different source markets (e.g., domestic, European, Asian) as assets within a portfolio. For instance, the domestic market may offer stable but limited growth (low risk, low return), while the Asian market may present high growth potential with greater volatility (high risk, high return). MPT can help DMOs identify the optimal mix of source markets to achieve target growth rates while minimizing overall volatility. Studies such as Jang and Chen (2008) have validated the effectiveness of this approach. 2) Firm level: Decision-makers at large tourism conglomerates—operating across luxury hotels, budget accommodations, cruise lines, and travel agencies—can use MPT to manage overall corporate risk. By analyzing the covariance of revenue streams across different business units, firms can dynamically reallocate resources to mitigate the impact of a downturn in a single sector (e.g., cruise operations) on overall group profitability. The minimum required data inputs include the expected returns and volatility metrics of various source markets or business units, as well as the covariances among them. This method addresses the TRM issue of over-concentration in a single market or product, thereby supporting market diversification and strategic resource allocation decisions. Table 1 summarizes the FRM methods and their proposed tourism applications.

Table 1. Summary of FRM methods and their proposed tourism applications.

FRM Method	Core Principle	Application in Tourism Risk Management	Potential Outputs
VaR	Quantify maximum potential loss	Tourism Revenue at Risk (TRaR) for Destinations or Firms	Probabilistic loss threshold for budgeting
GARCH	Forecast volatility clustering	Demand Volatility Forecasting for Bookings or Arrivals	Dynamic risk indicator for capacity planning
CoVaR	Measure contagion and interdependence	Tourism Supply Chain Network Analysis	Identification of critical nodes (e.g., hubs)
Stress Testing	Simulate extreme adverse scenarios	Destination Resilience Assessment	Capital adequacy and contingency plans
ROA	Value managerial flexibility under uncertainty	Valuation of Large Tourism Infrastructure	Strategic phasing of investment (delay, expand)
MPT	Optimize risk-return through diversification	Source Market Mix Optimization/Business Unit Portfolio	Optimal mix for stable growth and resilience

Note: The "potential outputs" in the table refer to the decision-making basis or tools that each method can provide for risk management after specific application. The transferability of these methods highlights the strong applicability of FRM theories in addressing volatility and uncertainty in the tourism industry.

4. Key Challenges and Viable Pathways

Although FRM methods possess a solid theoretical foundation and broad application prospects, their transfer to the tourism industry still faces several challenges. The following outlines the key issues that must be addressed, along with viable pathways forward.

4.1. Data Heterogeneity and Availability

Key Challenge: Differences in data characteristics. Financial market data is typically high-frequency, standardized, and clean (e.g., tick data for stock prices). In contrast, tourism data often suffers from: 1) Low frequency—common metrics such as tourist arrival figures are often monthly or quarterly, which is too sparse for constructing high-frequency volatility models (e.g., GARCH); 2) Fragmentation—data is frequently held by private entities such as airlines and hotels, which are often reluctant to share it; 3) Unstructured nature—a large volume of risk-related information exists in unstructured forms, such as news reports, social media comments (e.g., safety-related reviews on TripAdvisor), and meteorological reports.

Viable Pathway: This challenge urgently demands the adoption of appropriate methods for data acquisition. Researchers must be proficient in data science techniques, including using Natural Language Processing (NLP) to extract sentiment from social media, employing web scraping to capture real-time booking data, and integrating diverse data sources such as satellite weather data and Google Mobility data to construct proxy variables for TRM.

4.2. Subjectivity of Risk Perception

Key Challenge: Differences in perception. Financial models typically assume that market participants are rational and respond to price signals. However, in the tourism context, tourists' risk perception is largely influenced by subjective factors: they often overestimate the risk of dramatic, low-probability events (such as terrorism) while underestimating more probable, commonplace risks (such as food poisoning). Moreover, media coverage and cultural biases can significantly amplify risk perceptions, leading to demand collapses that far exceed what objective risk levels would warrant.

Viable Pathway: FRM models cannot be applied in isolation from the real-world context. They must be integrated with insights from behavioral economics and consumer psychology. A feasible hybrid model could combine "hard" quantitative forecasts (such as historical VaR) with adjustments based on "soft" factors. For example, a quantitative model might predict a 10% decline in visitor arrivals at a destination based on historical data from similar events. However, if real-time NLP analysis of news and social media indicates a surge in negative sentiment (e.g., a 300% increase in mentions of "unsafe" related to that destination), the model can apply a correction factor, adjusting the predicted decline to 25%. This hybrid approach accounts for the amplification effect of perceived risk, which often deviates from the objective level of risk.

4.3. Structural Breaks

Key Challenge: Environmental uncertainty. Financial models are often built on the assumption of stationarity—that the past serves as a good predictor of the future. However, the tourism industry is highly susceptible to structural breaks that render historical data obsolete. Whether it is political change, the construction of a high-speed railway, or a global pandemic (such as COVID-19), such events fundamentally alter the risk landscape. This means that models built on pre-pandemic data can be misleading when applied to post-pandemic contexts.

Viable Pathway: This calls for a shift toward dynamic model updating and a greater reliance on scenario analysis rather than purely historical simulation. In such environments, stress testing proves more effective than VaR calculations alone.

4.4. Practical and Ethical Risks

Key Challenge: The introduction of inappropriate methods may lead to undesirable outcomes. Applying financial risk metrics can incentivize problematic behavior. For example, a DMO using "Tourism Revenue at Risk (TRaR)" to manage its portfolio risk may be incentivized to neglect or actively exclude high-risk, high-reward markets (such as emerging markets), even if they offer long-term growth potential. Furthermore, there is a risk that risk management becomes a superficial exercise—models may create a false sense of security, masking real vulnerabilities and reducing risk management to a box-ticking exercise.

Viable Pathway: The solution lies in establishing appropriate incentive structures and ensuring that models are used as decision-support tools rather than as the sole basis for decisions. Oversight mechanisms should be implemented at the organizational level to prevent over-reliance on models for market selection and to encourage comprehensive assessments grounded in diverse perspectives.

Conclusion: Despite the challenges, through interdisciplinary integration (drawing on finance, tourism management, behavioral economics, and data science), along with dynamic model adaptation and scenario-based simulations, the application of FRM methods in the tourism industry holds significant potential and promise.

5. Constructing a Specific Implementation Framework

To translate cross-disciplinary theory into practical application, this paper proposes a phased, systematic implementation framework. This framework aims to transcend the limitations of simple model adaptation and integrate these methods into a comprehensive methodology suitable for TRM.

Phase 1: Data Integration and Risk Identification

Objective: To elevate the process from hazard identification to comprehensive risk identification.

Approach: Construct a unified dataset by integrating internal data (historical bookings, financial statements, customer complaints) with external data (macro-

economic indicators, weather, global event databases, social media sentiment).

Outcome: A comprehensive risk register categorized by type (financial, operational, strategic, hazard).

Phase 2: Quantitative Measurement and Modeling

Objective: To translate identified risks into measurable metrics.

Approach: Employ a tiered modeling strategy consisting of a monitoring layer, a core measurement layer, and a strategic layer. The monitoring layer uses GARCH models to track the volatility of demand indicators. The core measurement layer calculates firm-specific Tourism Revenue at Risk (TRaR) for short-term tactical management. The strategic layer guides strategic planning through annual stress tests and scenario analysis, while utilizing ROA to evaluate major capital expenditures.

Outcome: A quantitative risk toolkit comprising volatility indices, loss estimates, and stress test results.

Phase 3: Risk Mitigation and Strategic Response

Objective: To utilize quantitative results to guide decision-making.

Approach: Portfolio Optimization: Adjust the mix of source markets and product lines based on risk-return optimization. Hedging: Explore innovative risk transfer mechanisms. Although traditional financial derivatives are difficult to apply directly in tourism, their underlying principles can inspire new product development, such as weather derivatives for resorts or industry-wide risk pools modeled after mutual insurance companies. Resilience Budgeting: Determine required resource reserves or alternative credit lines based on stress test results to prepare for extreme tail risks.

Outcome: A strategic management plan where capital allocation and operational strategies are directly informed by quantitative risk models.

6. Conclusion and Research Outlook

This paper systematically demonstrates the feasibility of applying FRM methods to the field of TRM. A comparative analysis reveals common theoretical foundations between the two disciplines: uncertainty, systemic interconnectedness, volatility, and tail risk. These commonalities provide a solid theoretical basis for methodological transfer. By adapting core tools such as VaR, GARCH models, stress testing, ROA, and Modern Portfolio Theory, DMOs and tourism enterprises can transition from a traditionally reactive, qualitative approach to a proactive, quantitative, and predictive risk management paradigm.

However, this transition is not without obstacles. The data environment in tourism is considerably more fragmented and unstructured than in finance. Furthermore, the critical role of subjective risk perception and the potential for structural breaks necessitate caution when applying these quantitative models. The ideal pathway lies in constructing hybrid frameworks that incorporate behavioral theory and scenario simulation.

The core contribution of this study is the provision of a structured implemen-

tation framework and methodology that can guide both academic exploration and industry practice. Through cross-disciplinary methodological transfer, this study offers concrete pathways for building a more resilient tourism system capable of withstanding complex risks.

Future research should focus on the following three main directions: 1) Empirical Studies: Conduct case studies applying specific FRM models (such as GARCH for demand forecasting) to real-world tourism data to test their predictive accuracy and practical effectiveness. 2) Building Behavioral-Quantitative Hybrid Models: Develop and test models that integrate objective risk metrics with subjective risk perception indices derived from big data (e.g., sentiment analysis of social media using NLP) to better predict sudden demand shifts. 3) Innovating Risk Transfer Mechanisms: Explore the feasibility of creating new, tradable risk transfer instruments for the tourism industry, such as catastrophe bonds for destinations designed using financial engineering principles, or standardized weather derivatives for seasonal businesses.

The integration of FRM and TRM represents a promising research frontier. As global conditions grow increasingly turbulent, the demand for refined, quantitative risk management in tourism will only intensify. This interdisciplinary endeavor is not only feasible but essential.

Conflicts of Interest

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

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