mathematics

Editorial

Advances in Financial Mathematics and Risk Management: An Overview

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Financial mathematics and risk management have been inseparable companions of economic thought ever since Louis Bachelier, in 1900, had the audacious idea of treating stock prices as stochastic processes. A great deal has happened since then: classical equilibrium models gave way to ever more sophisticated computational architectures, and today the same family of ideas powers algorithmic trading floors, derivatives desks, and robo-advisors alike. What has remained constant is the centrality of risk—measuring it, pricing it, taming it—for anyone who operates in financial markets, whether as an institution, a regulator, or an individual investor. In the past two decades, however, the landscape has shifted in ways that would have been hard to predict. High-frequency data, social-media signals, satellite imagery, ESG disclosures, and real-time geopolitical intelligence have vastly expanded the raw material on which investment decisions rest; at the same time, artificial intelligence and machine learning have given us tools that can detect non-linear patterns, classify market regimes, and optimise portfolios in ways that traditional econometrics simply could not. These algorithms already sit inside credit-scoring engines, fraud-detection pipelines, and compliance dashboards—yet their adoption is far from unproblematic: training data can be biased, models can be opaque, and the question of who is accountable when a black box gets it wrong remains largely unanswered. Running in parallel is another quiet revolution. Sustainability and corporate responsibility have stopped being peripheral concerns and moved to the centre of financial analysis: ESG factors now weigh on portfolio construction, credit ratings, and corporate valuations, forcing modellers to grapple with data that are messy, multidimensional, and often self-reported. And as if that were not enough, the explosive growth of cryptocurrencies and decentralised finance has introduced entirely new asset classes—volatile, data-thin, and governed by market microstructures that classical theory was never designed to handle. It is against this backdrop—where old problems meet new tools and new problems demand fresh theory—that the present Special Issue of Mathematics was conceived. Under the title "Advances in Financial Mathematics and Risk Management," it gathers eight original articles spanning risk measures and investment optimisation, sustainable finance, AI-driven trading, and behavioural decision-making. What follows is a guided tour through their contributions.

The collection opens with two papers on risk measurement and optimal investment. Yamashita (Contribution 1)—selected as a Feature Paper—asks a deceptively simple question: how well do the workhorses of risk quantification, Value at Risk and Conditional

Received: 27 April 2026
Accepted: 13 May 2026
Published: 2 June 2026

Value at Risk, actually respond to very large losses? The answer, it turns out, is "not always well enough," especially once illiquidity breaks the homogeneity assumption that underpins them. Working through certainty-equivalent formulations, divergence utility, and general utility functions, Yamashita maps the connections between these measures and the more recent notions of expectiles and elicitability, then extends the analysis to risk-sharing settings via convex conjugation—arriving at concrete suggestions for how risk measures might be improved, with tangible consequences for the stability of risk-sharing business models. Chebbi and Ounaies (Contribution 2) pick up the thread from the investment side, revisiting Merton's classic portfolio problem in a discrete-time world where trading is not frictionless. Each of a finite set of investors maximises utility subject to the constraint that the portfolio stays non-negative after liquidation, and friction is modelled as a convex penalty—a general formulation that nests transaction-cost and liquidity models as special cases. Their main achievement is a rigorous proof that an optimal strategy exists, obtained by constructing a truncated general-equilibrium economy and passing to the limit, thus pushing the Merton framework closer to the messy reality of markets where multiple agents interact and trade is costly.

A second cluster turns to the evaluation of mutual-fund managers, with the Chinese market as a testing ground. Sheng and Montgomery (Contribution 3) develop a sector-weight-based methodology to gauge stock-picking and market-timing skills across 198 equity fund managers—an approach specifically designed for settings where position disclosure is limited or delayed, as is the case in China. Their within-sample results confirm that the new measures can reliably separate skilled managers from the rest, and the data reveal an encouraging dynamic: managers who score poorly in one period tend to improve in the next, while those with stronger stock-selection abilities enjoy markedly greater job security—a neat empirical link between skill and career survival. In a companion paper (Contribution 4), the same authors explore how herding and anti-herding behaviour interacts with managerial ability. Moderate herding, they find, is actually associated with better picking skills in bull markets, though the effect fades when fund inflows are strong—suggesting that fresh money tempts managers to deviate from their instincts. Excessive herding, by contrast, erodes timing ability, while anti-herding managers turn out to be weaker stock-pickers. Perhaps the most intriguing finding is that managerial replacements are driven by poor past performance rather than an assessment of current abilities; yet the incoming manager's herding behaviour tends to reflect improved competencies, as though the change of guard triggers a genuine strategic reset.

ESG factors have become impossible to ignore in financial analysis, and two papers tackle the question from different angles. Tian, Li, Cao, and Wang (Contribution 5) build a large-scale volatility-spillover network for all Chinese stocks using the VAR-DY method and trace how risk propagates across firms with different ESG ratings. Their headline result is that highly rated companies sit at the core of the network and, through their dense connections, act as stabilisers—but when a genuine crisis hits, as in the 2015 crash and the COVID-19 shock, spillovers surge across the board, and intriguingly the direction of ESG-related contagion reverses between the two episodes, pointing to fundamentally different underlying stress mechanisms. The take-away is that ESG information can sharpen risk-management tools, but its usefulness depends heavily on the kind of crisis one faces. Wu and Chen (Contribution 6) provide a complementary perspective by showing, on a panel of Chinese listed financial institutions from 2015 to 2021, that ESG performance—especially the environmental and social dimensions—measurably boosts operational efficiency. The effect is strongest in the securities sector and among non-state-owned and smaller firms, and it appears to work through the reduction of downside risk and agency costs—a mechanism that gives regulators promoting responsible finance a solid theoretical anchor.

https://doi.org/10.3390/math14111928

The collection also ventures into AI-driven trading and, perhaps unexpectedly, neuromarketing. Fu, Kang, Hong, and Kim (Contribution 7) develop a genetic-algorithm-enhanced triple-barrier labelling method for cryptocurrency pair trading: the algorithm generates distinct label sets—some optimised for maximum profit (High Risk/High Profit), others for minimum drawdown (Low Risk/Low Profit)—and uses them to train machine-learning classifiers. Tested out-of-sample on data from September 2022 to December 2023, the profit-oriented labels boosted returns by over 51%, while the risk-oriented ones slashed the maximum drawdown by more than 73%, offering crypto traders a genuinely useful decision-support tool. At the other end of the disciplinary spectrum, Müller, Gil-Lafuente, and Ferrer-Comalat (Contribution 8) ask a question that might raise eyebrows in a mathematics journal: can colour combinations in clothing be chosen strategically to maximise someone's chances of achieving a specific social goal? Using fuzzy logic and multivalent evaluations drawn from expert judgements and their own survey data, and cross-checking results with Similarity by Direct Computation and the TOPSIS multicriteria method, they show that the answer is yes—and in doing so they build a bridge between mathematical decision theory and the practical world of non-verbal communication and consumer engagement.

Read as a whole, these eight papers offer a snapshot of where financial mathematics stands today: classical concerns—risk measurement, portfolio choice—remain very much alive, but they are being reshaped by machine learning, network science, sustainability metrics, and even fuzzy logic applied to marketing. The practical pay-offs are worth spelling out. Yamashita's work flags the blind spots of standard risk measures and points toward tools better suited to tail events—a message with clear implications for prudential regulation. Sheng and Montgomery hand practitioners a workable method for evaluating fund managers in low-transparency markets. The ESG evidence from Tian et al. and Wu and Chen strengthens the case for weaving sustainability into investment and risk strategies as a matter of course, not of fashion. Fu et al. demonstrate that computational intelligence can deliver real trading edge in the volatile crypto space. And Müller, Gil-Lafuente, and Ferrer-Comalat remind us that quantitative methods can illuminate corners of human behaviour we might not have thought to look at. We hope readers will find in these pages both concrete tools and fresh ideas worth pursuing, and we thank all the authors for the quality of their contributions, the reviewers for their thoughtful and constructive reports, and the editorial team of Mathematics for their steady support.

Conflicts of Interest: The authors declare no conflict of interest.

List of Contributions

1. Yamashita, M. Risk Measure Examination for Large Losses. *Mathematics* **2025**, *13*, 1974.
2. Chebbi, S.; Ounaies, S. Optimal Investment of Merton Model for Multiple Investors with Frictions. *Mathematics* **2023**, *11*, 2873.
3. Sheng, D.; Montgomery, H.A. Assessing Mutual Fund Performance in China: A Sector Weight-Based Approach. *Mathematics* **2024**, *12*, 2449.
4. Sheng, D.; Montgomery, H.A. Does Herding and Anti-Herding Reflect Portfolio Managers' Abilities in Emerging Markets? *Mathematics* **2024**, *12*, 1220.
5. Tian, M.; Li, S.; Cao, X.; Wang, G. Network Analysis of Volatility Spillovers Between Environmental, Social, and Governance (ESG) Rating Stocks: Evidence from China. *Mathematics* **2025**, *13*, 1586.
6. Wu, Z.; Chen, S. Does Environmental, Social, and Governance (ESG) Performance Improve Financial Institutions' Efficiency? Evidence from China. *Mathematics* **2024**, *12*, 1369.

7. Fu, N.; Kang, M.; Hong, J.; Kim, S. Enhanced Genetic-Algorithm-Driven Triple Barrier Labeling Method and Machine Learning Approach for Pair Trading Strategy in Cryptocurrency Markets. *Mathematics* **2024**, *12*, 780.
8. Müller, A.C.; Gil-Lafuente, J.; Ferrer-Comalat, J.C. Colour Choice as a Strategic Instrument in Neuromarketing. *Mathematics* **2024**, *12*, 2212.