

Stochastic Modeling and Optimization Techniques

Nataša Kontrec , Jelena Vujaković  and Hranislav Milošević 

Faculty of Sciences and Mathematics, University of Priština in Kosovska Mitrovica, Lole Ribara 29,
38220 Kosovska Mitrovica, Serbia; jelena.vujakovic@pr.ac.rs (J.V.); hranislav.milosevic@pr.ac.rs (H.M.)

* Correspondence: natasa.kontrec@pr.ac.rs

1. Introduction

The eight papers presented in this Special Issue provide a broad overview of current developments in stochastic modeling and optimization. While addressing different mathematical problems, they share a common focus on the analysis of uncertainty and the development of methods for supporting decision-making in complex systems. The contributions range from theoretical investigations in probability theory and analytic number theory to applications in reliability engineering, data analysis, multicriteria decision-making, and machine learning.

Several papers examine fundamental probabilistic structures, including heavy-tailed distributions, random summation schemes, and universality phenomena. Others explore optimization and reliability problems motivated by practical engineering applications. The issue also reflects the growing importance of data-driven methodologies through contributions devoted to clustering, fuzzy decision-making, and probabilistic learning models. Together, these studies illustrate how stochastic approaches continue to generate new theoretical insights while addressing contemporary computational and applied challenges.

The main results of the contributions included in this Special Issue are briefly summarized below.

2. Overview of the Published Papers

In Contribution 1, Leipus, Šiaulyš, Danilenko, and Karasevičienė investigate randomly stopped sums, minima, and maxima associated with heavy-tailed and light-tailed distributions. The authors establish new preservation properties for tail behavior under random stopping mechanisms and provide theoretical results that contribute to the understanding of stochastic systems arising in insurance mathematics, risk analysis, and reliability theory.

In Contribution 2, Kontrec, Panić, Vujaković, Stošović, and Khotnenok develop a mathematical framework for optimizing wind turbine maintenance through repair-rate thresholds. By employing stochastic reliability models and renewal-theoretic approaches, they derive analytical expressions for system performance measures and propose maintenance policies that improve operational efficiency and reliability.

In Contribution 3, Hussain, Hussain, Hussain, Bakhet, Arafat, Zakarya, Al-Thaqfan, and Ali introduce new belief and plausibility measures within the framework of intuitionistic fuzzy sets. Their work establishes novel distance and similarity measures and incorporates them into a TOPSIS-based multicriteria decision-making methodology, demonstrating applicability in pattern recognition, clustering, and decision-support problems.

In Contribution 4, Almetwally, Khaled, and Barakat study progressive-stress accelerated life-testing experiments under progressive Type-II censoring for an extended Marshall–Olkin family of distributions. The authors develop maximum likelihood and



Received: 4 June 2026

Accepted: 19 June 2026

Published: 25 June 2026

Copyright: © 2026 by the authors.

Licensee MDPI, Basel, Switzerland.

This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) license.

Bayesian estimation procedures, investigate confidence intervals and optimal censoring schemes, and provide practical tools for reliability assessment and lifetime analysis.

In Contribution 5, Arjdal, Alahiane, Elharfaoui, and Rachdi propose a novel sparse clustering methodology for high-dimensional mixed-type data. Their DBI–SC–Azzalini framework integrates adaptive dissimilarity measures for continuous, ordinal, and nominal variables while preserving ordinal information through Azzalini’s score-based encoding. Theoretical analysis establishes screening consistency, while simulation studies and real-data applications demonstrate improved clustering performance and interpretability.

In Contribution 6, Grigaliūnas, Laurinčikas, and Šiaučius investigate the universality properties of periodic zeta-functions on short intervals. Using stochastic methods, weak convergence techniques, and limit theorems in spaces of analytic functions, they establish approximation results that extend classical universality theory and reveal new interactions between probability theory and analytic number theory.

In Contribution 7, Klebanov and Šumbera examine limit distributions arising from random sums of independent and identically distributed random variables. They show that any probability distribution on the positive real line may occur as a limit distribution under an appropriate random summation scheme, thereby highlighting important differences between classical and randomly indexed summation procedures.

Finally, in Contribution 8, Zhang and Cai present an amortized parameter inference framework for the arbitrary-order hidden Markov model. Their methodology combines probabilistic modeling and machine learning techniques to estimate instance-specific parameters capable of capturing complex higher-order dependencies in sequential data. Experimental results in biomolecular structure prediction demonstrate the effectiveness of the proposed approach.

3. Concluding Remarks

The papers published in this Special Issue demonstrate the diversity and continuing relevance of stochastic modeling and optimization in contemporary mathematical research. Collectively, they contribute new theoretical results, methodological developments, and practical applications spanning probability theory, reliability engineering, decision sciences, data analysis, and machine learning.

Taken together, these contributions illustrate the growing interaction between rigorous mathematical analysis and modern computational approaches. We hope that the results presented in this Special Issue will stimulate further research and encourage new collaborations across the broad range of disciplines represented in this collection.

We sincerely thank all authors for their valuable contributions and the reviewers for their careful evaluations and constructive comments. We also express our gratitude to the editorial staff of Axioms for their support throughout the preparation of this Special Issue.

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

List of Contributions

1. Leipus, R.; Šiaulys, J.; Danilenko, S.; Karasevičienė, J. Randomly Stopped Sums, Minima and Maxima for Heavy-Tailed and Light-Tailed Distributions. *Axioms* **2024**, *13*, 355.
2. Kontrec, N.; Panić, S.; Vujaković, J.; Stošović, D.; Khotnenok, S. Mathematical Optimization of Wind Turbine Maintenance Using Repair Rate Thresholds. *Axioms* **2024**, *13*, 809.
3. Hussain, S.; Hussain, Z.; Hussain, R.; Bakhet, A.; Arafat, H.; Zakarya, M.; Al-Thaqfan, A.A.I.; Ali, M. A Novel Framework for Belief and Plausibility Measures in Intuitionistic Fuzzy Sets: Belief and Plausibility Distance, Similarity, and TOPSIS for Multicriteria Decision Making. *Axioms* **2024**, *13*, 858.

4. Almetwally, E.M.; Khaled, O.M.; Barakat, H.M. Inference Based on Progressive-Stress Accelerated Life-Testing for Extended Distribution via the Marshall–Olkin Family Under Progressive Type-II Censoring with Optimality Techniques. *Axioms* **2025**, *14*, 244.
5. Arjdal, I.; Alahiane, M.; Elharfaoui, E.; Rachdi, M. Adaptive Sparse Clustering of Mixed Data Using Azzalini-Encoded Ordinal Variables. *Axioms* **2025**, *14*, 902.
6. Grigaliūnas, M.; Laurinčikas, A.; Šiaučiūnas, D. Application of Stochastic Elements in the Universality of the Periodic Zeta-Function: The Case of Short Intervals. *Axioms* **2026**, *15*, 58.
7. Klebanov, L.; Šumbera, M. Any Distribution on the Positive Real Line as a Limit of Random Sums. *Axioms* **2026**, *15*, 84.
8. Zhang, S.; Cai, L. Amortized Parameter Inference for the Arbitrary-Order Hidden Markov Model. *Axioms* **2026**, *15*, 289.

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.