mathematics

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Editorial

Special Issue "Probability Theory and Stochastic Modeling with Applications"

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This Special Issue (SI), titled "Probability Theory and Stochastic Modeling with Applications", is concerned with the theory and applications of stochastic models. It consists of sixteen papers, and we would like to thank all the authors for their positive answers to our call for papers for the SI, as well as for their efforts to provide a high-quality contribution. The outcome of each paper is also due to the reviewers, who helped the authors to clarify their research, detect mistakes or come up with new ideas following the review. Forty-two reviewers were involved in the revision of this SI, with between two and three working on each paper. Therefore, we would like to recognize their commitment to research improvement.

Among the papers with a theoretical approach to the SI's subject matter, that of S. Jiang, N. Liu and Y. Liu [1] focused on a theoretical analysis framework and computing issues regarding the steady probabilities in block-structured, discrete-time Markov chains. Their proposal extends previous results on quasi-birth-death processes.

The work of H. M. Alshanbari, Z. Ahmad, H. Al-Mofleh, C. B. Ampadu and S. K. Khosa [2] proposes a method to obtain new probability distributions that cover the gap in models that fit data sets with extreme values. This is a common problem in a number of areas, such as reliability/survival, finance or hydrology, where heavy-tailed distributions are required for goodness of fit. The major disadvantage of previous research is that a number of parameters must be introduced to the models to ensure they have enough flexibility to match extreme observations. The authors try to avoid this shortcoming, thus preventing estimation and re-parametrization problems.

Z. Zhang and S. Ross [3] present new research on dueling bandit problems with the objective of determining the best among a set of n players with games involving two players. The authors aim to find the optimum policy that minimizes the expected number of games needed to find the best player. The proposed strategy outperforms other policies in the literature, and this superiority suggests its potential use for algorithm development in large-scale applications.

The paper [4] by A. Oya addresses the solution to a number of problems in signal processing by means of quaternion models, which have a higher capacity to manipulate multi-dimensional data than conventional kernel-based formulations. This research presents a general framework based on Hilbert space theory that simplifies the statistical treatment, resulting in a suitable approach to signal detection.

B. A. Escobedo-Trujillo, J. Garrido-Meléndez, G. Alcalá, and J. D. Revuelta-Acosta [5] deal with an optimal control problem with applications in car suspension systems and the accumulation of pollution caused by the consumption of gas, oil, etc. A number of assumptions prove the existence of optimal controls that can be useful in real life, according to the examples.

The research [6] carried out by A. García-Pérez is centered on robust statistics for handling spatio-temporal data. He presents a new estimator of the variogram used in prediction by kriging. When a random characteristic is measured at different locations and times, sample data are realizations of a random field and the variogram is the function that

Citation: Badía, F.G.; Berrade, M.D. Special Issue "Probability Theory and Stochastic Modeling with Applications". *Mathematics* **2023**, *11*, 3196. https://doi.org/10.3390/math11143196

Received: 5 July 2023
Accepted: 17 July 2023
Published: 21 July 2023

measures the dependence between observations. This is a valuable tool for the analysis of spatio-temporal phenomena such as temperature or precipitation, and the new estimators defined in this paper are less sensitive to outliers than previous ones. The objective of this investigation is, therefore, relevant to the analysis of climatic change and geostatistics, among others.

The work [7] of J. Escobar and A. Poznyak addresses the problem of parameter estimation in auto-regressive-moving average with exogenous input (ARMAX) models under non-Gaussian noise. The authors also provide a review of the significant literature on this subject. This type of time series is found in Econometrics studies.

The research [8] by A. G. Nogales focuses on Bayesian statistics, exploring the properties of the Bayes estimator of densities and sampling distributions. These estimators, which are provided by the posterior predictive distribution and density, respectively, are key to making inferences from the data. The Bayesian interpretation holds in many studies and is expected to become more widely used in the era of Big Data.

A second group of papers [9–11] is centered on the application of stochastic models in economics. M. C. Pocelli, M. L. Esquível, and N. P. Krasii [9] developed a spectral analysis to distinguish Bitcoin from some traditional currencies and gold. The particular volatility property of the former is highlighted.

L.-P. Shao, J.-J. Chen, L.-W. Pan and Z.-J. Yang [10] study the deregulated electricity market. Using fuzzy variables and robust optimization, the authors provide the electricity transaction policy under different expected costs so that the expectation of the risk-averse distribution system operator is fulfilled.

J.C.J. Ferreira, A.P. Matias Gama, L. P. Fávero, R. Goulart Serra, P. Belfiore, I. Pinheiro de Araújo Costa, and M. dos Santos [11] use quantile regression to explain the variability in economic growth over time in emerging and developed countries. They also analyze the significance of two explanatory variables, time and country, by means of random coefficient models.

Four papers [12–15] are devoted to reliability/survival: G. M. Rodrigues, E. M. M. Ortega, G. M. Cordeiro, and R. Vila [12] build a new quantile regression model to analyze the effect of covariates on the quantiles of the survival times. When compared to classical approaches, it presents several advantages and presents some of them as particular cases.

Two reliability measures, the residual lifetime and the inactivity time, are analyzed by F.G. Badía and M.D. Berrade [13]. The authors study their behaviour under changing risks when there are no observable covariates, using mixtures of distributions.

H. Lee, J.H. Cha and M. Finkelstein [14] present a preventive maintenance policy for a system with two dependent components. The authors model the real-life situation when non-failed components are severely affected by the failed ones. Thus, the reliability of the former is worse after repairing the failed units than before the failure. This is known as a worse-than-minimal repair.

Z. Zhang and W. Gui [15] deal with accelerated life testing. The authors consider a cumulative risk model, assuming that there is a lagged effect of increasing the stress level, rather than its being instantaneous. Their study involves a parameter estimation of the Chen distribution, which is more flexible than the exponential and Weibull models.

The last paper [16] by R. Real-Miranda and J.D. López-Barrientos is connected to both economics and reliability, as it is motivated by insurance in the extraction of non-renewable resources. The probability of ruin is key for actuaries; therefore, the cost and the time to failure have to be weighted. Stochastic dynamic programming is the basis of this research.

Funding: The work of both authors was supported by the Spanish Ministry of Science and Innovation under Project PID2021-123737NB-I00.

Acknowledgments: We would like to thank Helene Hu from the *Mathematics* Editorial Office for her friendly support and help in our task as guest editors. She has resolved all our concerns with kindness and efficacy.

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

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