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Bivariate FGM distribution with composite Exponential-Pareto marginals for modeling insurance data

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Abstract

Defined from different distributions on contiguous intervals, univariate two-spliced distributions have been proposed with the purpose to better model extreme events in the presence of a high frequency of small to medium data. Therefore, a two-spliced or composite distribution generally combines a heavy-tailed distribution above a threshold with a less heavy-tailed component below it. Such distributions are intensively used in connection with insurance data, the motivation of splicing being that "*the tail behavior may be inconsistent with the behavior of small losses*" (Klugman et al., 2012). In this work, we propose a bivariate Farlie-Gumbel-Morgenstern (FGM) distribution with composite Exponential-Pareto marginals, with the purpose to capture extreme events occurring in a bivariate setting. We present some properties of this bivariate distribution and discuss an estimation procedure which takes into account the fact that the marginal thresholds (where the Exponential changes to Pareto) are unknown, The estimation procedure is illustrated on real data from insurance consisting of bivariate claim costs collected from an auto insurance portfolio.

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Factor rings. The fundamental isomorphism theorem for polynomial rings

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Abstract

First, we briefly present the stages of the construction of the ring of residual classes modulo n, $\mathbb{Z}_n$. Then we will give the general construction of the factor ring of a ring R with respect to an ideal I of it. Factor rings intervene in many other important constructions in mathematics: the fields R and C, finite bodies.

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Some remarks regarding the localization of Hutchinson-Barnsley fractals

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Abstract

This work is concerned with some complementary results to the ones presented in *On the localization of Hutchinson-Barnsley fractals, Chaos Solitons Fractals, 173 (2023), 113-674*. More precisely, to determine a cover for a given iterated function system $\mathcal{S} = ((X,d),(f_i)_{i\in\{1,2,\ldots n\}})$, $n \in \mathbb{N}$, the exact values of the Lipschitz constants of the functions associated to the system are required. In practice, this computation proves to be quite difficult. Due to this impediment, we show that, in fact, it is enough to replace the Lipschitz constants with some values $c_i \in (0,1)$, which verify $d(f_i(x), f_i(y)) \leq c_i d(x,y)$, for all $x, y \in X$ and $i \in \{1,2,\ldots,n\}$.

Some additional remarks regarding the computations and graphical representations are provided.

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On Infinitesimal Variations of Submanifolds

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Abstract

The notions of infinitesimal variation and infinitesimal bending of an Euclidean submanifold are introduced. The fundamental equations and the fundamental theorem of infinitesimal variations are recalled. The hypersurfaces case and the infinitesimal rigidity are presented. We give some alternative proofs of known results and also provide some new results.

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On an eigenvalue problem associated with the (p,q)-Laplacian

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Abstract

Let $\Omega \subset \mathbb{R}^N$, $N \geq 2$, be a bounded domain with smooth boundary $\partial\Omega$. Consider the following generalized Robin-Steklov eigenvalue problem associated with the operator $\mathcal{A}u = -\Delta_p u - \Delta_q u$

$$\begin{cases} \mathcal{A}u + \rho_1(x) \mid u \mid^{p-2} u + \rho_2(x) \mid u \mid^{q-2} u = \lambda\alpha(x) \mid u \mid^{r-2} u, \quad x \in \Omega, \\ \frac{\partial u}{\partial \nu_{\mathcal{A}}} + \gamma_1(x) \mid u \mid^{p-2} u + \gamma_2(x) \mid u \mid^{q-2} u = \lambda\beta(x) \mid u \mid^{r-2} u \; x \in \; \partial\Omega, \end{cases} \tag{1}$$

where $p, q, r \in (1, \infty)$ with $p < q$, $\alpha, \rho_i \in L^\infty(\Omega)$, $\beta, \gamma_i \in L^\infty(\partial\Omega)$ are nonnegative functions satisfying

$$\int_\Omega \alpha \; dx + \int_{\partial\Omega} \beta \; d\sigma > 0$$

and

$$\int_\Omega \rho_i \; dx + \int_{\partial\Omega} \gamma_i \; d\sigma > 0, \; i = 1, 2.$$

Under suitable assumptions, we provide the full description of the spectrum of the above problem in four cases out of five and for the complementary case, we obtain a subset of the corresponding spectra.

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On some applications of Kolmogorov mean

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Abstract The **Kolmogorov mean**, also known as quasi-arithmetic mean or f-mean is a generalization of the regular mean using a function verifying a number of requirements. It is a core concept for constructing generalized entropies with new properties. The choice of the function leads to particular results that may have interesting applications in Probability, Statistics and other related fields. Starting with Renyi's approach and continuing with Jizba's work in hybrid entropy we revisit the axiomatic system with an emphasis on the relevant classes of functions that can be used in the construction of Kolmogorov mean.

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Bounded Solutions of an Iterative Differential Equation

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Abstract

In this paper ,we use Schauder and Banach fixed point theorems to study the existence,uniqueness and stability of bounded nonhomogeneous iterative functional differential equations of some form.

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Positive linear operators and systems of linear equations

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Abstract

This paper is regarding the Kantorovich modifications of linking operators and the Stancu modifications of Bernstein operators. It presents some definitions and properties regarding positive linear operators. In the final, solving systems of linear equations with positive coefficients and solutions to determine the limits of the iterates of the modified operators.

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An alternative framework to visualize the properties of quaternion algebras using the Cayley-Dickson process

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Abstract

The Cayley-Dickson is an iterative process that gives us an alternative framework to view the construction of quaternions and octonions over an arbitrary field $\mathbb{K}$. This process is used in connection with square matrix representations of the Cayley-Dickson algebras and it implies an array operation on square arrays distinct from matrix multiplication.

Applying the Cayley-Dickson process to the real numbers, it forms gradually algebras over $\mathbb{R}$ with a conjugation involution. So, we obtain that $\mathbb{R}$ produces $\mathbb{C}$ then $\mathbb{H}$ then $\mathbb{O}$, eliminating by turn properties such as order, commutativity, associativity from algebra $\mathbb{R}$, fact that illustrates the way how each of these algebras nests inside the next one. Using the previous construction of new algebras from the old ones, we try to explore their properties. Some of them already known are presented in this paper, but the question remains still open.

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Some open problems in the theory of the polynomial hyperrings

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Abstract

The main aim of this presentation is the systematization of the previous results related to different classes of polynomial hyperrings and the construction of the new classes.
We will try to answer the open questions: if there exists a strong distributive subclass of the multiplicative hyperrings used by R. Processi Ciampi and R. Rota in their paper as a starting class over which it is possible to construct multiplicative hyperring of polynomials, and also the question of a contsruction of the Krasner hyperrings with identity, that satisfy the conditions from the paper [5], such that these examples are different from the classes constructed in [5] and [6].
Also, the aim is to construct new examples of polynomialy structured hyper- rings that satisfy certain conditions. We will study under which conditions we can apply Euclid's division algorithm in hyperrings of polynomials. In a case of the superring of polynomials, we will check whether the analogue of Hilbert's base theorem is valid, as well as whether certain generalizations of classical theorems related to polynomial rings are valid.

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The eigenstructure of Beta Operators with Jacobi Weights

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Abstract

The eigenstructure of Beta Operators with Jacobi Weights is presented. The construction follows the technique used in the eigenstructure of classical Bernstein operators. Moreover, the limit of the recurrence relation for computing the coefficients among the eigenfunction is described.

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Improving Support Vector Machine Classifiers: An Information Geometry Approach

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Abstract

Classification is a fundamental task in Machine Learning, where the goal is to assign predefined labels to input data points based on their features. The Support Vector Machine (SVM) is one of the powerful learning techniques for pattern recognition. It embeds patterns into a higher-dimensional space and uses a kernel function to calculate outputs. Computation difficulties caused by large degrees of freedom are avoided when using the kernel method. By analyzing the geometry and the Riemannian structure of the SVM, a method is proposed by Amari in [1] to improve the performance of a kernel. Experiments show that this technique brings an improvement of up to 10% in the accuracy of a kernel based SVM.

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On the lifetime of serial-parallel networks with the lifetime of units exponentially distributed and the random number of subnets

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Abstract

In the paper, a new lifetime distribution of serial-parallel type networks is deduced, a distribution with the approaches of both analytical and Monte-Carlo simulation methods. The novelty of the distribution consists of having random number of subnetworks, governed by Poisson distribution, lifetimes being independent, identically, exponentially distributed random variables. We have shown that the most important characteristics of this random variable, the mean, the dispersion, the distribution function, the Monte-Carlo simulation approximates the same characteristics with any desired accuracy, by means of, respectively, the mean, the selection dispersion, but also the empirical function of distribution. Furthermore, we can also indicate the minimum number of simulations sufficient to guarantee the desired accuracy with the desired confidence probability.

References

An integral type fixed point theorem

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Abstract

In the present paper we prove an integral type metrical fixed point theorem for non-self mappings. The existence of fixed point is ensure by hypotheses formulated in terms of equivalent metric spaces. Some illustrative examples are also furnished to support the main result.

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Weak snd Strong Convergence Theorems for Krasnoselskii Iterative algorithm in the class of enriched strictly pseudocontractive and enriched nonexpansive operators in Hilbert Spaces

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Abstract

In this paper, we present some results about the aproximation of fixed points of enriched strictly pseudocontractive and enriched nonexpansive operators. There are numerous works in this regard (for example [9], [10], [11] [14], [16], [35] and references to them). Of course, the bibliografical references are extensive and they are mentioned at the end of this paper. In order to approximate the fixed points of enriched strictly pseudocontractive and enriched nonexpansive mappings, we use the Krasnoselskii iterative algorithm for which we prove weak and strong convergence theorems.
Also, in this paper, we make a comparative study about some classical convergence theorems from the literature in the class of enriched strictly pseudocontractive and enriched nonexpansive mappings.

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Exploring Copula Entropy Models: Applications Across Diverse Disciplines

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Abstract

Copula entropy models have gained prominence as versatile tools for quantifying and analyzing the information content in multivariate datasets across a wide array of disciplines. This lecture provides a comprehensive survey of the applications of copula entropy models in various fields, including finance, environmental science, healthcare, and engineering.

In finance, copula entropy models serve as invaluable instruments for measuring the information content in joint distributions of asset returns. By assessing the entropy of financial variables, these models contribute to a deeper understanding of market dynamics, risk assessment, and the intricacies of portfolio optimization.

Environmental science has benefited from copula entropy models in assessing the information content and dependence structures within environmental variables. These models offer insights into the entropy of climatic and ecological data, aiding in the identification of patterns, trends, and anomalies crucial for effective environmental monitoring and decision-making.

In healthcare, copula entropy models play a pivotal role in capturing the information content of multivariate patient data. By quantifying the entropy of health-related variables, these models facilitate a more nuanced understanding of disease patterns, treatment efficacy, and overall patient outcomes.

In engineering, copula entropy models contribute to the analysis of information content within complex systems and reliability assessments. These models enable a quantification of the uncertainty and information flow among system components, enhancing decision-making processes related to system design, maintenance, and optimization.

Furthermore, this synthesis explores recent advancements in copula entropy modeling techniques, considering applications of dynamic entropy models and the incorporation of copula entropy in machine learning frameworks for improved predictive modeling.

By presenting a mix of the applications of copula entropy models across diverse fields, this research aims to underscore the versatility and utility

of these models in capturing and quantifying information content in complex multivariate datasets. The insights provided herein highlight the significance of copula entropy models as valuable tools for researchers and practitioners seeking a comprehensive understanding of dependencies and information flow within various domains.

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Quasi-isometric dilations for operators similar to contractions on Hilbert spaces

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Abstract

A continuous linear Hilbert space operator S is said to be a quasi-isometry if the operator S and its adjoint S^* satisfy the relation $S^{*2}S^2 = S^*S$. Such operators are actually those that act isometrically on their range. We study the operators having liftings or dilations to quasi-isometries. We prove that this class of operators is exactly the class of operators similar to contractions. In particular quasi-isometries are similar to contractions. All the results are based on the classical dilation theory for contractions of B. Sz.-Nagy and C. Foias. Special cases are also investigated and some examples are provided.

Join to work with Laurian Suciu from Lucian Blaga University of Sibiu.

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Special elements in Quaternions algebra over $\mathbb{Z}_p$

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Abstract

In this paper, we explore idempotent, tripotent, and nilpotent elements in $\mathbb{H}/\mathbb{Z}_p$. We provide concrete examples and establish conditions for idempotence, tripotence, and nilpotence in $\mathbb{H}/\mathbb{Z}_p$. Additionally, we discuss relevant observations regarding the total number of nilpotent and idempotent elements in $\mathbb{H}/\mathbb{Z}_p$.

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Second-order differential inclusions with two small parameters

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Abstract

Consider in a real Hilbert space H the following problem, denoted $(P_{\varepsilon\mu})$,

$$\begin{cases} -\varepsilon u''(t) + \mu u'(t) + Au(t) + Bu(t) \ni f(t), \ 0 < t < T, \\ u(0) = u_0, \ \ u'(T) = 0, \end{cases}$$

where $T > 0$ is a given time instant, $\varepsilon > 0$, $\mu \geq 0$ are small parameters, $A : D(A) \subset H \to H$ is a maximal monotone operator (possibly multivalued), and $B : H \to H$ is a Lipschitz operator (or monotone and Lipschitz on bounded sets). Consider also the following reduced problem, denoted (P_μ),

$$\begin{cases} \mu u'(t) + Au(t) + Bu(t) \ni f(t), \ 0 < t < T, \\ u(0) = u_0, \end{cases}$$

where $\mu > 0$, as well as the algebraic equation (inclusion),

$$Au(t) + Bu(t) \ni f(t), \ 0 \leq t \leq T. \qquad (E_{00})$$

We investigate existence and uniqueness of solutions to the above problems and to equation (E_{00}), as well as continuity of the solution to problem $(P_{\varepsilon\mu})$ with respect to $\varepsilon > 0$ and $\mu \geq 0$. Moving forward, we are also interested in the convergence of the solution of problem $(P_{\varepsilon\mu})$ to the solution of problem $(P_{\mu 0})$, as $\varepsilon \to 0_+$ and $\mu \to \mu_0$, where μ_0 is a fixed positive number, as well as the convergence of the solution of problem $(P_{\varepsilon\mu})$ to the solution of the equation $Au + Bu \ni f(t)$ as $\varepsilon \to 0_+$ and $\mu \to 0_+$. Last, but not least, we investigate applications in areas such as the regularization of the nonlinear heat equation, or the regularization of the telegraph system.

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