

10th International Conference on Risk Analysis

Book of Abstracts

September 22 - 24
Patras, Greece

ICRA 10



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10th International Conference on Risk Analysis

We are delighted to present the **Book of Abstracts** for the 10th International Conference on Risk Analysis (ICRA 10), taking place from September 22–24 in Patras, Greece.

This compilation brings together the contributions of leading researchers, academics, and professionals from around the world, organized according to the sessions of the conference. Each abstract reflects the expertise and perspective of its authors, or in some cases, the context provided by the session organizers. The conference program spans a wide range of topics in risk analysis, including:

- Statistical advances in risk modeling
- Health and medical risk applications
- Environmental and climate-related risk
- Risk and resilience in complex systems
- Fraud detection and machine learning methods
- Infrastructure, education, and corporate governance challenges

We encourage readers to explore the abstracts in the context of their respective sessions, which have been structured to facilitate thematic continuity and dialogue. Please note that the responsibility for the content, accuracy, and context of each abstract rests with the submitting authors or the session organizers.

We hope that this compilation provides a valuable reference, stimulates discussion, and inspires new ideas.

The ICRA10 Organizing Committee

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Day 1, 22/9

10:30 - 11:10	<p>Conference Opening Welcome addresses</p> <ul style="list-style-type: none"> • Prof. Christos I. Bouras, Rector of the University of Patras • Mr. Fokion Zaimis, Deputy Governor of Achaia, Region of Western Greece • Prof. George Lampeas, Dean of Engineering School • Prof. Konstantinos Kounetas, Dean of Economics and Business Administration School <p>Honorable Opening Talk: Emeritus Prof. Christos Kitsos</p>	
11:10 - 12:00	<p>Prof. Milan Stehlik Advanced classifications and analyses of bacterial growth and biofilm production of <i>Cobetia</i> sp. MM1IDA2H-1: from fractional to hybrid systems Chair: Kitsos, C</p>	
12:00-13:20	<p>Mini-symp on Risks of Cancer Organizer/Chair: Kimmel, M.</p> <ul style="list-style-type: none"> • Kurpas, M.: <i>Breast Cancer Sequencing Data Analysis – Overview, FFPE Artifact Filtration Results, and Comparison With TCGA Data</i> • Wilk, A.: <i>Prognostic Value of Longitudinal Complete Blood Count Parameters in Lung Cancer Patients Treated With Immunotherapy</i> • Kimmel, M.: <i>Computational Modeling of Shortening and Reconstruction of Telomeres</i> 	
13:20 - 14:30	<p>Lunch Break</p>	
14:30 - 15:50	<p>Statistical Advances in Risk Analysis Organizer/Chair: Gulati, S.</p> <ul style="list-style-type: none"> • Dupuy, J.-F.: <i>Confidence Intervals for the Proportional Hazard Premium for Heavy-Tailed Claim Amounts</i> • Obeysekera, J.: <i>Nonstationarity and Deep Uncertainty: Tools for 21st-Century Infrastructure Planning and Design</i> • Pinheiro, A. C.: <i>Time Series Analysis and Modeling of Sea Surface Temperature Across Depths and Locations: Insights for Climate Change Research in Atlantic Ocean</i> • Gulati, S.: <i>Fitting Skewed Distributions to Flood Loss Data for Accurate PML and Risk Assessment</i> 	<p>Organized Crime and Risk Analysis Chair: Forgione, A.F.</p> <ul style="list-style-type: none"> • Milasi, M.: <i>A General Equilibrium Model Affected by Organized Crime</i> • Migliardo, C.: <i>Perceived Organized Crime and Credit Rationing: Firm-Level Evidence From Italy</i> • Spadaro, M.: <i>The Silent Stranglehold: Quantifying Organized Crime’s Chilling Effect on Firm Efficiency and R&D</i> • Forgione, A. F.: <i>Organized Crime and Resilience in Family Firms: Insights From a Natural Experiment in Judicial Administration</i>

15:50 - 17:10	<p>From Crisis to Opportunity: Rethinking Risk in Modern and Digital Society Organizer/Chair: Oliveira, T.A.</p> <ul style="list-style-type: none"> • Kimmel, B.: <i>Telerehabilitation Methods and Applications of AI to Stroke Recovery for Improvement of the Post-Stroke Outcomes: The Lone Star Stroke Research Consortium Experience</i> • Stanisławska, J. & Kozera. A.: <i>Risk of Housing Poverty in EU Countries</i> • Teodoro, M.F.: <i>Statistical Analysis of a Larzac Engine Operational Efficiency: An Approach to Risk Analysis and Risk Management</i> • Oliveira, T.A.: <i>Exploring Features and Risks of Using Artificial Intelligence tools in Online Education</i> 	<p>Risk, Resilience, and Decision-Making in Complex Systems Chair: Batsidis, A.</p> <ul style="list-style-type: none"> • Konidari, V.: <i>Risk Assessment, Social Trust and Societal Challenges in an Era of Uncertainty: Societal Decision Making and Schools as Critical Infrastructures</i> • Palaiologou, A.: <i>Quantitative Microbial Risk Assessment of Pseudomonas aeruginosa in Municipal Swimming Pools: A Case Study from Patras, Greece</i> • Gulati, S.: <i>Estimating Savings of Skilled Tropical Cyclone Forecasts at U.S. Military Bases</i> • Dereka, X. S.: <i>The Importance for Policy Makers of the Inter-Links, to Minimize the Risk Assessment, in the DPSIR Framework of EEA, Case Study Air Pollution by EC vs Hammarby Sjöstad Stockholm</i>
17:10 - 17:40	Coffee Break	
17:40-19:00	<p>Machine Learning and Forecasting Chair: Stehlík, M.</p> <ul style="list-style-type: none"> • Biris, P.: <i>A Hybrid Statistical–Machine Learning Approach Using Split-Based Forward Selection</i> • Skamnia, E.: <i>Stochastic Optimization for Data-Driven Dynamic Pricing in Reservation-Based Systems</i> • Kallari, C.: <i>Forecasting Spare Parts Purchase Orders Using Statistical, Machine Learning, and Deep Learning Models</i> • Rachaniotis, N. P.: <i>Risk-Centric Siamese Learning: A Comparative Assessment of Multiple Risk Functions for Order-Acceptance and Scheduling Decisions in Hybrid Production Systems</i> 	
19:00-20:00	Welcome Cocktail	

Extending and Strengthening the Risk Analysis framework with ICRA

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Abstract

The target of this paper is to summarize the extensions attempted the last 20 years, 2003-2023, through ICRA, and proposed more areas of interest. The Risk Analysis, although started for Political/Military oriented problems, moved to Biostatistics to offer qualitative methods for the appearance, mainly, of cancer. The “odds ratio” and the “unconditional logistic regression, were applied to a number of Ca problems. CYP3A isozymes are involved in tobacco carcinogen. Therefore studies of CYP3A4 and CYP3A5 genotype-dependent “risk for lung Cancer” are under consideration. In Cancer studies, more mathematics were involved, under Fractal Analysis, while the Relative Risk (RR) can be defined for the family of the *gamma*-order Generalized Normal. The Environmental Risk appears to be a trivial extension adopting Birnbaum-Saunders distribution, or other generalizations of the Normal, while the identification of Pollution Level, needs the appropriate study. Risk Analysis has been proved appropriate in studding Hedge Fund Investments, and Risk Management techniques, in some cases can be based on Tolerance regions, rather than Confidence regions. The strategic risk needs more extension we believe and the Patterns of Strategy for Risk Assessment and Management might be considered under qualitative methods.

Keywords: Risk Analysis, Statagic Risk, Economical Risk, Bioassays

Advanced classifications and analyses of bacterial growth and biofilm production of *Cobetia* sp. MM1IDA2H-1: from fractional to hybrid systems

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Abstract

Biofilms are complex biological structures built by microorganisms with biomolecules over solid or liquid surfaces, producing significant problems in health, food safety, and maritime infrastructure (ports and ships). Using the super biofilm producer *Cobetia marina* strain MM1IDA2H-1 as a model growing in a wide range of temperatures, our aim is to provide statistical support for biological hypotheses on biofilm evaluations across wide ranges of temperatures where bacteria can grow with phenotypical variability such as biofilm behavior. Biofilms were measured across a wide range of growth temperatures at the exponential growth phases. A non-standard ANOVA-like approach to assessing heterogeneity across temperatures is developed to explain biological behaviors related to biofilm formation, biomass, and temperatures. An exponential family-based ANOVA-like analysis with a novel statistical approach has been developed, providing deep biological insights. When considering growth curve classifiers, the standard numerical derivative has not worked well in discrimination, so we need to develop a novel approach, such as fractional derivatives, and implement it. Since the biofilm variable is defined as a ratio of generally two non-unimodal random variables, important statistical issues should be addressed in order to create precise classifications with good properties. False positivity should be maintained in the tractable range. This motivates the construction of a hybrid system, where a deep neural network can be implemented. In particular, in one of the hidden layers, the SPOCU transfer function is found to be a good choice.

Acknowledgement: We acknowledge project ANID GRT-AC: A Global Gene Regulation Based Tool For Modelling The Next Generation Of Biological-Silicon Integrated Systems 2022, Nr. 13220184.

Keywords: ANOVA for non-standard conditions, *Cobetia marina*, biofilm, ratios of biofilm and biomass, estimation

Breast Cancer Sequencing Data Analysis - Overview, FFPE Artifacts Filtration Results, and Comparison With TCGA Data

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Abstract

One of the most commonly sequenced tissue material are formalin-fixed, paraffin-embedded (FFPE) samples. Literature sources and our benchmark experiments have shown that fixing tissues with formalin leads to deamination of cytosine to uracil, which can be recognized by sequencing as $C > T$ or $G > A$ modifications [1] introducing noise in next-generation sequencing data. The subject of this study were FFPE samples obtained in cooperation with the Maria Skłodowska-Curie National Research Institute of Oncology (Krakow Branch). Each set consists of a sample from a primary breast cancer tumor and from an affected lymph node. DNA isolated from the samples was then subjected to whole exome sequencing (WES), qualitative assessment and genomic analysis. FFPE artifacts were filtered using SOBDetector [2] and FFPolish [3] programs. Allelic variants obtained as a result of genomic analysis were used to calculate variant allele frequency (VAF) spectra. The analysis of mutations and copy number changes was conducted in regions encoding known breast cancer driver genes in order to study their mutational landscape. Obtained results were compared with publicly available breast cancer data from The Cancer Genome Atlas (TCGA) repository. Our results suggest differences between obtained biological material and average breast cancer samples from TCGA. Depending on FFPE filtering software the number of real mutational variants was higher (in case of SOBdetector) or lower (FFPolish) than average number of variants in TCGA samples. The choice of filtering method severely impacted also the shape of the VAF spectra. Both tools often marked as artifacts variants occurring at the same positions in samples from the primary tumor and the affected lymph node, which should not happen if the randomness of the formation of artifacts due to chemical processes is assumed. The obtained results emphasize the importance of calibration of bioinformatics tools and their appropriate selection for the analysis of real samples.

References:

- [1] Do, H., & Dobrovic, A. (2015). *Clinical chemistry*, 61(1), 64-71.
- [2] Diossy, M., et al. (2021). *Briefings in Bioinformatics*, 22(6), bbab186.
- [3] Dodani, D. D., et al. (2022). *Frontiers in Genetics*, 13, 834764.

Funding: National Science Centre, Poland, grant no. 2021/41/B/NZ2/04134

Keywords: formalin, artifacts, sequencing, data, cancer

Prognostic value of longitudinal complete blood count parameters in lung cancer patients treated with immunotherapy

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Abstract

In advanced non-small cell lung cancer, immune checkpoint inhibitors are currently the standard of care treatment for patients with PD-L1 expression. However, not all patients respond to therapy, driving the search for prognostic markers. Many studies assess baseline characteristics evaluated before therapy, including demographic and clinical data, blood parameters, molecular and imaging markers. However, the state of the patient may change very rapidly after the start of the treatment. While the baseline characteristics may be useful for therapy assignment, information collected after the start of treatment can be even more informative for prognostics. Data of 134 NSCLC patients treated using immunotherapy (Pembrolizumab or Nivolumab) in Maria Skłodowska-Curie National Research Institute of Oncology Gliwice Branch were analysed. The median survival time was 1.21 years, while the median progression-free survival time was 1.18 years. Almost all patients presented stage IVA or IVB disease. 50% of all patients were diagnosed with squamous cell carcinoma, and 45% with adenocarcinoma. 36% of patients did not receive treatment prior to immunotherapy, others underwent surgery, chemotherapy, radiotherapy, or a combination thereof. Complete blood count (CBC) tests were conducted as part of routine patient monitoring. Measurements before start of treatment, after the first cycle, after three and six months were retrospectively retrieved from the hospital information system. The Cox model was chosen as the gold standard applied in the majority of clinical studies. A baseline survival model including clinical characteristics and the CBC parameters measured before the start of immunotherapy was compared with models using different strategies to incorporate CBC test results after the treatment start. The approaches were:

- including the early-response (after the first cycle) CBC values in the model,
- treating the CBC parameters as time-varying covariates,
- fitting a linear model to each CBC parameter and using slope and intercept as model covariates,
- approximating the CBC trajectories using functional principal component analysis.

While each of the approaches has its caveats, our results highlight the prognostic potential of longitudinal markers.

Keywords: lung cancer, immunotherapy, longitudinal markers, complete blood count, survival analysis

Computational Modeling of Shortening and Reconstruction of Telomeres

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Abstract

We discuss a stochastic model of growth of a cell population of cultured yeast cells with gradually decaying chromosome endings called the telomeres (Olovnikov 1973), as well as models of telomere reconstruction using the so-called ALT (alternate lengthening of telomeres) Mechanism. Telomeres play a major role in aging and carcinogenesis in humans. Our models correspond in part to the experiments of one of us (Teixeira; see Rat et al. 2025). For telomere shortening, we modify the method of Olofsson and Kimmel (1999), who considered properties of the branching process of telomere shortening; this leads to consideration of a random walk on a two-dimensional grid. We derive an integral equation for the probability generating functions (pgf's) characterizing the dynamics of shortening of telomeres. We find that the general solutions have the form of exponential polynomials. Stochastic simulations lead to interesting and non-obvious effects if cell death is included. We further consider more complex models, involving cell death and the ALT mechanism. of telomere reconstruction. These are based on our works and are intended to address the experiments in Kockler et al. (2021). In one version of the ALT Mechanism model, we consider expectations conditional on non-extinction, since only a fraction of ALT telomeres is stably elongated (see Kockler et al. 2021). As a conclusion, the multitype branching processes (Athreya and Ney 1972) produce realistic prediction concurrent with complex biological experiments involving telomeres. Our ultimate aim is to use the models for longer-term prognoses for human telomeres.

References:

- [1] Athreya KB, Ney PE Branching Processes 1972 Springer.
- [2] Kockler ZW, Comeron JM, Malkova A. A unified alternative telomere-lengthening pathway in yeast survivor cells. *Molecular Cell*. 2021 Apr 15;81(8):1816-29. Olofsson P, Kimmel M. Stochastic models of telomere shortening. *Mathematical Biosciences*. 1999 Apr 1;158(1):75-92.
- [3] Olovnikov A.M. (1973) A theory of marginotomy. *J. Theor. Biol.* 41: 181-190.
- [4] Rat A, Martinez Fernandez V, Doumic M, Teixeira MT, Xu Z. Mathematical model linking telomeres to senescence in *Saccharomyces cerevisiae* reveals cell lineage versus population dynamics. *Nature Communications*. 2025 Jan 25;16(1):1024.

Confidence intervals for the proportional hazard premium for heavy-tailed claim amounts

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Boukhetala K., University of Science and Technology Houari Boumediene, Algiers, Algeria

Abstract

Extreme events arise in a wide variety of domains : environment (flooding, heat waves), industry (industrial accident, fire), finance (extreme loss)... and can cause considerable losses in insurers portfolio. It has therefore become crucial for insurance and reinsurance companies to determine adequate premiums for extreme risks. In this talk, we investigate several kinds of confidence intervals for the premium value under heavy-tailed claim amounts (namely, Wald-type and likelihood ratio confidence intervals). The likelihood ratio-based confidence intervals are obtained from a convergence result for the sequence of an appropriate log-likelihood ratio statistic. This result is first described. Then, we describe a simulation study and finally, the intervals are illustrated on a real data set.

Keywords: Likelihood ratio method, Hill estimator, Tail index

Nonstationarity and Deep Uncertainty: Tools for 21st-Century Infrastructure Planning and Design

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Abstract

Restoration, sustainability, and resilience planning and design of large-scale natural ecosystems have traditionally relied on the assumption of climate stationarity. However, emerging evidence of climate nonstationarity—marked by systematic trends in rainfall, temperature, sea levels, wind patterns, and the frequency of extreme events—necessitates a fundamental shift in planning and infrastructure design. Regional and global climate models project that future climatic regimes may evolve beyond the bounds of historical variability while introducing situations of deep uncertainty into the planning process. This presentation introduces a new paradigm for infrastructure planning and designs those accounts for nonstationarity and incorporates recent methodological advances to address dynamically shifting risks. Key innovations include nonstationary extensions to traditional hydrologic and infrastructure planning and design concepts such as return period, risk, reliability, and resilience. These updated tools better characterize the frequency and severity of extreme events in a changing environment. Furthermore, the talk emphasizes the importance of Decision Making Under Deep Uncertainty (DMDU)—a framework that prioritizes robustness and adaptability over reliance on single deterministic forecasts. The presentation also outlines analytical approaches for developing dynamic adaptation pathways, allowing decision-makers to respond to evolving conditions with flexibility and foresight. As environmental hazards and long-term climate trends continue to challenge conventional infrastructure standards, integrating DMDU principles into future planning and design efforts is critical to enhancing resilience across sectors. Through case studies and model-based insights, this presentation illustrates how transitioning to nonstationary planning and design paradigms can support more effective, forward-looking decisions in the face of an uncertain climate future.

Keywords: Planning and Design, Infrastructure, nonstationarity, decision making, deep uncertainty

Time Series Analysis and Modeling of Sea Surface Temperature Across Depths and Locations: Insights for Climate Change Research in Atlantic Ocean

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Abstract

Climate change has contributed to a significant increase in ocean water temperatures, which has in turn facilitated the rise in average sea levels. These changes have substantial impacts on marine life, fishing activities, coastal erosion, and the sustainable management of oceanic resources. In this context, developing models that simulate sea temperature is essential, as it enables the monitoring of its variation over time and the anticipation of trends, providing a solid technical and scientific basis for the formulation of effective mitigation and adaptation strategies. This study analyses time series of seawater temperature in four Atlantic regions — Nazaré, São Miguel and Faro (Portugal), and Praia (Cape Verde) — based on monthly data collected between January 1960 and 2023, made available through the EMODnet platform (<https://emodnet.ec.europa.eu/geoviewer/>). The research applies various time series modelling techniques, including classical decomposition (additive and multiplicative), STL decomposition (Seasonal-Trend decomposition using Loess), ARIMA and SARIMA models for the identification of trends and seasonal patterns, and exponential smoothing methods for forecasting purposes. Additionally, cluster analysis is applied to identify similar patterns across two different depths and locations. The results will contribute to a deeper understanding of ocean thermal dynamics in the regions under study, with relevant applications in climate risk assessment, environmental monitoring, and coastal planning, supporting the development of public policies grounded in scientific evidence.

Keywords: Time series, Trends, Seawater temperatures

Fitting Skewed Distributions to Flood Loss Data for Accurate PML and Risk Assessment

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Abstract

Modeling flood losses in general and extreme losses in particular, plays a vital role in accurate risk assessment and effective policymaking. This is especially true for insurance companies who want to protect themselves from catastrophic losses in vulnerable states like Florida. The Florida Public Flood Loss Model (FPFLM) generates 73,000 years of data to model flood losses. This paper uses the data from FPFLM to explore parametric modeling of the Probable Maximum Loss (PML) for flood losses generated by FPFLM which are presently estimated using non-parametric techniques. A range of appropriate probability distributions are explored as possible fits; including the Lognormal, Gamma, Weibull, Generalized Pareto, and other well-known right-skewed distributions. Goodness-of-fit (GOF) procedures such as the Anderson-Darling, Kolmogorov-Smirnov, and Chi-square tests are used to assess model performance and determine the best-fitting distribution. The results of the study should enhance the accuracy of PML estimates for flood-related losses and provide valuable insights for policymakers and risk analysts involved in disaster risk management.

Keywords: Skewed Distributions, Floods, Losses, Extreme Values, Peak Over Threshold, PML

A general equilibrium model affected by organized crime

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Abstract

In this paper, we introduce an economic equilibrium problem from the perspective of firms operating in a marketplace influenced by organized crime. We assume that firms face pressures such as extortion, resource misappropriation, and other coercive activities imposed by criminal organizations on firms. Furthermore, firms may contemplate participating in organized crime to gain competitive advantages, such as access to illicit resources or market control. Nevertheless, such involvement poses considerable risks; if detected, firms may incur substantial legal and financial penalties. These risks require a complex decision-making process in which firms must evaluate the potential short-term benefits of illicit activities against the long-term repercussions of detection and punishment. To address this issue, we propose a theoretical general equilibrium model that incorporates the influence of organized crime on market dynamics. Firms are modeled as maximizing an expected utility function that accounts for both the benefits and risks of their activities, including the probability of detection and the subsequent penalties. This extends the classical equilibrium conditions by integrating agents' preference allocations, such as prioritizing security investments, risk mitigation strategies, or compliance with legal frameworks to avoid criminal entanglements. Furthermore, market-clearing conditions are modified to reflect the systemic disruptions caused by criminal activities, such as distorted pricing mechanisms, reduced market efficiency, or shifts in resource allocation due to extortion or illicit competition. In our model, we aim to provide a comprehensive framework for analyzing how criminal influences reshape economic equilibria and offer insights into policy measures, such as enhanced law enforcement or incentives for compliance, that could mitigate these effects.

Keywords: Crime Organization, Economic equilibrium problem

Perceived Organized Crime and Credit Rationing: Firm-Level Evidence from Italy

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Abstract

This study examines the impact of perceived organized crime on firms' access to bank loans. The analysis draws on an original survey conducted by the Bank of Italy, which includes a representative sample of approximately 1,100 Italian firms across all sectors. The survey investigates firms' perceptions of organized crime risk and their experiences with credit rationing by banks. Using three standalone indicators of perceived crime risk, we construct a composite index to assess bank credit rationing. Our findings reveal that firms operating in areas with high organized crime risk—particularly those facing elevated risks of extortion, threats, and intimidation—are significantly more likely to experience credit rationing. Organized crime distorts credit markets by increasing financing costs, exacerbating adverse selection, and prompting banks to adopt risk-averse lending practices. Banks in high-crime areas face heightened credit risks due to both direct interference by criminal syndicates and indirect distortions affecting borrowers. These results suggest policymakers and financial institutions should incorporate crime-related risks into risk assessment models and implement targeted measures to mitigate organized crime's adverse effects on credit markets.

Keywords: Organized crime, Credit rationing, Bank loans, Firm efficiency.

The Silent Stranglehold: Quantifying Organized Crime's Chilling Effect on Firm Efficiency and R&D

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Abstract

This study investigates the influence of perceived organized crime on firms' research and development (R&D) activities and technical efficiency. The analysis utilizes data from an original survey conducted by the Bank of Italy, which includes a representative sample of over 2,600 Italian firms across the industrial and service sectors. The survey captures firms' perceptions of the presence of organized crime, which we consolidate into a synthetic measure of the perceived risk associated with mafia syndicates, potentially impairing firm operations. Our empirical findings indicate that firms operating in regions and sectors with elevated levels of organized crime risk are significantly more likely to experience a decline in their propensity to invest in R&D, which adversely affects technical efficiency. Organized crime appears to distort market dynamics by increasing operational costs and reducing firms' ability to effectively utilize production factors, thereby undermining entrepreneurial dynamism. These insights highlight the necessity for policymakers and financial institutions to incorporate organized crime risk into their assessment models and implement targeted financial measures aimed at mitigating its adverse economic impacts.

Keywords: Organized Crime, Innovation, Technical Efficiency, Stochastic Frontier Analysis, Data Envelopment Analysis

Organized Crime and Resilience in Family Firms: Insights from a Natural Experiment in Judicial Administration

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Abstract

This study examines the impact of judicial administration on firm performance, with a particular focus on comparing family owned businesses with their non-family counterparts within the Italian context. Employing a natural experimental design based on the coercive replacement of management by court-appointed administrators, this study employs Difference-in-Differences and Stochastic Frontier Analysis methodologies to assess the effects of such interventions on performance indicators including operational profitability and operating margin, and technical efficiency. The findings indicate that family firms experience a more significant decline in technical efficiency and profitability than non-family firms. This suggests that removing advantages inherent in “familiness”—specifically relational assets, social capital, and tacit know-how—constitutes a vulnerability that, in forced succession scenarios, becomes a source of weakness. These results provide important insights into both the Resource-Based View and Agency Theory, emphasizing the dual nature of family resources as competitive assets and source of potential fragility. Finally, the study highlights the necessity for policy and governance strategies that, while pursuing legal objectives and combating organized crime, can mitigate the adverse effects on family firms and preserve overall economic value.

Keywords: Family Firms; Judicial Administration; Organized Crime; Technical Efficiency; Stochastic Frontier Analysis

Telerehabilitation Methods and Applications of AI to Stroke Recovery for Improvement of the Post-Stroke Outcomes: The Lone Star Stroke Research Consortium Experience

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Abstract

Stroke remains one of the leading causes of death and disability. As advances in technology increase and their speed and superiority improve, telemedicine applications for post-stroke care are expected to be on the rise. In addition, recent advancements in Artificial Intelligence (AI) became a noteworthy method for delivering rehabilitation leading to additional improvements in post-stroke treatment effectiveness. Furthermore, over the past decades, Telerehabilitation (TR) for stroke survivors care arose as a complement to in-person rehabilitation services. TR not only contributes to the reduction of geographic and economic limitations of care, but also importantly, helps to reduce risk by bridging the gap in "care continuity" and enables "care coordination", both central to clinical practice in the post-acute stroke care continuum [1]. Our ongoing extensive literature review reveals that TR is superior or similar to conventional rehabilitation in clinical outcomes and is useful as complementary therapy or as alternative treatment [2]. However, most of these studies also showed that significant knowledge gaps still exist regarding major stakeholders' (patient providers') involvement in the co-design of stroke care and barriers and facilitators identified by the patients and providers in the processes of implementation. In addition, conflicting evidence exists which intervention approaches are most appropriately adapted to telerehabilitation, with respect to their utilization and clinical effectiveness [3, 4]. The Lone Star Stroke Consortium (LSSC) was established in Texas, USA with the primary research objective of finding better therapies and prevention strategies to improve cerebrovascular health for underserved Texans. The aim of this presentation is to summarize the LSSC research efforts to close some of these gaps [5]. We will present the research findings from studies: published [6] and accepted with revisions [7], and preliminary findings from ongoing TR research. We will also introduce the cutting edge research with AI application in TR [8].

References:

- [1] Nicolas B, Leblong E, Fraudet B, Gallien P, Piette P. Telerehabilitation solutions in patient pathways: An overview of systematic reviews. *Digit Health*. 2024 Nov 3;10:20552076241294110. doi: 10.1177/20552076241294110. PMID: 39502480; PMCID: PMC11536572.
- [2] Nikolaev VA, Nikolaev AA. Recent trends in telerehabilitation of stroke patients: A narrative review. *NeuroRehabilitation*. 2022;51(1):1-22. doi: 10.3233/NRE-210330. PMID: 35527574.
- [3] Laver KE, Schoene D, Crotty M, George S, Lannin NA, Sherrington C. Telerehabilitation services for stroke. *Cochrane Database Syst Rev*. 2013 Dec 16;2013(12):CD010255. doi: 10.1002/14651858.CD010255.pub2. Update in: *Cochrane Database Syst Rev*. 2020 Jan 31;1:CD010255. doi: 10.1002/14651858.CD010255.pub3. PMID: 24338496; PMCID: PMC6464866.
- [4] Appleby E, Gill ST, Hayes LK, Walker TL, Walsh M, Kumar S (2019) Effectiveness of telerehabilitation in the management of adults with stroke: A systematic review. *PLoS ONE* 14(11): e0225150. <https://doi.org/10.1371/journal.pone.0225150> LSS website: under development
- [5] Kimmel B, Walder A, Ovalle A, Venkatasubba Rao CP, Savitz SI, Goldberg M, Warach S, Cruz-Flores S, Olson DM, Anderson JA. Stroke survivors' telemedicine experiences during the COVID-19 pandemic: A phenomenological investigation. *Digit Health*. 2024 Oct 7;10:20552076241281464. doi: 10.1177/20552076241281464. PMID: 39381819; PMCID: PMC11459570.
- [6] Stevens et al., Feasibility of Intensive Multidisciplinary Telerehabilitation Combined with Health Coaching for Underserved Stroke Survivors: A Pilot Study: Telemedicine Report, 2025 (accepted with revisions) AI-Powered Stroke Rehabilitation

Risk of housing poverty in EU countries

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Abstract

Poverty is most commonly analyzed in an economic context, whereas the issue of housing poverty is addressed far less frequently (Zaniewska, 2007; Kozera, 2016; Kurowski, Broda-Wysocki, 2017; Sikora-Fernandez, 2018). However, as emphasized by Kozera et al. (2017), housing poverty should not be equated solely with homelessness or lack of shelter, but also with persistent deprivation of adequate housing conditions. This issue tends to be marginalized, despite the fact that housing poverty ranks among the most significant social problems, as confirmed by public opinion research (Olech, 2009). The aim of this article is to provide a multidimensional assessment of housing poverty in the European Union countries and to identify its relationship with the quality of the housing environment. The research problem posed is: What is the variation in the level of housing poverty across EU countries, and to what extent is the risk of its occurrence associated with the environmental conditions in which households are located? The empirical data were sourced from the Eurostat Database, which provides harmonized and comparable data for EU member states. A three-stage research procedure was applied. In the first stage, a univariate analysis was conducted on selected indicators of housing poverty: housing cost overburden rate (%), overcrowding rate (%), and severe housing deprivation rate (%). Simultaneously, environmental quality indicators were analyzed: noise from neighbours or from the street, pollution, grime or other environmental problems, and crime, violence or vandalism in the area. In the second stage, synthetic indicators of housing poverty and environmental quality were constructed using the TOPSIS method, enabling the comparison of levels and trends in 2014 and 2023. To further assess the relationship between housing poverty and environmental quality, correlation analysis and correspondence analysis were employed. The correlation analysis aimed to verify the statistical strength and direction of relationships between the examined variables, while the correspondence analysis facilitated the identification of structural links between EU countries and the categories of housing poverty and environmental quality. The results may serve as a basis for the development of more integrated and territorially differentiated housing policies within the European Union.

Keywords: housing poverty, TOPSIS method, EU countries

Statistical Analysis of a Larzac Engine Operational Efficiency: An Approach to Risk Analysis and Risk Management

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Abstract

This work describes the continuation of an integrated approach to optimize the operational efficiency of a Larzac engine. Statistical methods were used to explore and analyze data, and also to identify potential hazards, allowing for the development of tailored strategies to mitigate risks and enhance the performance of the engines, by identifying and rectifying deviations in performance. This research was initiated in response to reports of diminished propulsive output in certain Larzac engines that resulted in operational immobilization. Thus, based on real data obtained from a test bench, the current study centers on gathering and analyzing statistical data related to engine operations and configuration in order to discern recurring patterns. While the available data set was limited in scope, several potential root causes of the issue were identified. The findings presented herein have also contributed towards the development of a diagnostic framework. Scrutinizing the measured parameters and comparing them against established operational norms and trends, the data analysis has facilitated the identification of certain anomalies, thereby enabling to set recommendations on proactive maintenance measures for their prevention. The study also provided valuable insights to the field of engine optimization and risk management.

Keywords: Risk Analysis, Propulsive Force, Larzac Engine, Diagnostic System

Exploring Features and Risks of Using Artificial Intelligence tools in Online Education

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Abstract

Artificial Intelligence (AI) offer exciting possibilities to make education more efficient, inclusive, and engaging, while providing sustainable learning experiences. Mainly from the beginning of this decade, AI has been rapidly transforming the way we teach and learn online, by experiencing personalized feedback and adaptive content to automated grading and virtual tutors. This presentation explores the evolving role of AI in e-learning, highlighting innovations such as generative models, synthetic data, and immersive platforms like Moodle and WiseFlow - a platform for the online evaluation of students, recently adopted at UAb-University in Portugal. Supported by statistical methods and data science, these technologies enable educators to personalize instruction, monitor progress, and improve learning outcomes. However, with these advancements come important risks. Concerns around data privacy, algorithmic bias, reduced human interaction, and unequal access to technology can undermine the very goals AI seeks to achieve. Additionally, there are the random errors concern, the environmental footprint and cybersecurity threats linked to AI's rapid expansion, which demand urgent attention. By examining both the promise and the pitfalls, this work encourages a thoughtful and responsible approach to AI in education so to foster and improve the academia and scientific advances

Risk assessment, social trust and societal challenges in an era of uncertainty: societal decision making and schools as critical infrastructures.

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Abstract

This communication is based on the fact that risk assessment is a fuzzy concept across disciplines. It emphasizes the need to consider the unpredictability of societal decision-making as a significant risk factor when dealing with risk and uncertainty and argues that social trust should be part of risk assessment methods, especially when addressing societal challenges. In support of the above positioning, this communication draws on the fact that the transition to the Anthropocene and the subsequent transition to a new age of safety and new types of risk brings with it not only the need to address new societal challenges, but also the need to address these challenges simultaneously at the micro, meso and macro levels of society. Secondly, it is argued that one of the lessons learnt from the COVID-19 pandemic is that in an era of increasing uncertainty, unpredictability and interdependence, the societal component of decision-making must be fully considered in risk assessment. In line with the above, this communication extends the literature on education in emergencies and argues, first, that educational institutions should be considered and act as critical infrastructures supporting societal decision-making in societies grappling with risk and uncertainty. Secondly, it argues that society's trust in educational institutions must be guaranteed for this empowerment to take place. To further substantiate this argument, this communication presents the qualitative results of the DRONE innovation project, conducted in the third trimester of 2024, which investigated the trust of secondary school students in their school in Greece and Ukraine. The purposive selection of these two countries is based on the ongoing crisis environment in Greece since 2008 and the ongoing crises and the current war in Ukraine. The results of the thematic analysis of 40 semi-direct interviews in Greece and Ukraine respectively show that 13–17-year-old students have extremely low levels of trust in their schools, which affects their practice of seeking help and counselling when a problem or crisis arises. Following the discussion on the risks that this trust deficit poses to societal decision-making in a context characterized by post-truth phenomena and the exponential growth of AI, this communication concludes with an argument for the consideration of social trust as a cornerstone in risk assessment and for new roles and responsibilities for educational institutions.

Keywords: Risk assessment, societal challenges, societal decision making, social trust, educational institutions.

Quantitative Microbial Risk Assessment of *Pseudomonas aeruginosa* in Municipal Swimming Pools: A Case Study from Patras, Greece

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Abstract

Often safety challenges are encountered in swimmingpools due to constant use and variable maintenance of water treatment systems. *Pseudomonas aeruginosa*, a prevailing waterborne opportunistic pathogen, poses a significant threat due to its potential to affect skin, blood, lungs and other parts of the body. This study applied a quantitative microbial risk assessment (QMRA) methodology to estimate the probability of infection per exposure in chlorinated diving pool environments, utilizing both microbial and operational parameters. We focused on three municipal athletic indoor and one outdoor pool. Sensitivity analysis and Quantitative Microbial Risk Assessment (QMRA) was performed using Monte Carlo simulation via ModelRisk software. The applied data included three indicator bacterial concentrations (*E. coli*, aerobic bacteria and coliforms) and two pathogen concentrations (*Pseudomonas*, *Staphylococcus*), water quality parameters (temperature, pH, chlorine, alkalinity) and exposure-related variables (duration of exposure, number of swimmers per hour, water ingestion volume) as modifying parameters. In Pool B, the average risk of *P. aeruginosa* infection per exposure was estimated 1.3×10^{-4} exceeding the acceptable limit of 0.0001 and approximately as low as 15-20% of simulations outweighed the threshold, indicating slightly elevated risk in the indoor pool environment. In contrast, outdoor pool (pool A) illustrated an essentially lower mean risk of 1.4×10^{-6} per exposure, with 0% of simulations surpassing the threshold, indicating the classification of outdoor pools as safe under current operational conditions. The mean risk per exposure in Pool C was 4.5×10^{-5} . No simulation exceeded the threshold of 10^{-4} , indicating low health risk. The mean risk per exposure in pool D was estimated at 2.8×10^{-4} and approximately 15-20% of simulation outcomes exceeded the threshold, indicating a non-negligible infection risk. Also, in both pools B and D, chlorine was identified as one of the most influential factors in infection risk. Sensitivity analysis consistently showed that deviations in chlorine concentration had a considerable impact on the probability of infection, with simulated values ranging from below 1 mg/L to above 6 mg/L, breaching international disinfection thresholds (1-3 mg/L). The analysis implies that pools B and D are considered of higher microbial health risk than the rest of pools. Pools A and C perform low infection risk from *P. aeruginosa*, with all outcomes remaining within internationally acceptable limits. The QMRA results indicate a possible scientific approach to managing interventions in swimming pools, highlighting the influence of microbial concentrations and chlorine levels.

Keywords: Microbial Risk Assessment, Swimming Pools, Public Health

Estimating Savings of Skilled Tropical Cyclone Forecasts at U.S. Military Bases

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Abstract

The U.S. Military maintains many bases that are vulnerable to tropical cyclone (TC) activity. To address base preparations, commanders mandate preparedness levels that increase in effort and cost as a TC approaches a base. Base preparations are expensive, so commanders prefer to avoid unnecessary preparations. But underpreparing can result in injury and damage to expensive assets that likely far outweigh preparation costs, and this logic is used to justify efforts to improve TC forecasting in the Military. But what are the preparation costs and resultant savings? This is a simple question that is difficult to answer in a rigorous way. In a prior effort, the authors developed a cost/loss model solely for asset protection and damages. In this follow-on effort the authors expand the cost/loss model to address evacuations, injuries, and forecast credibility with rough estimates for each. This new cost/loss model likely provides a more realistic estimate of costs and losses and is therefore more likely to better represent the complex and difficult issues commanders use their base preparedness decisions..

Keywords: Skilled Forecasting, Tropical Cyclone, Tropical Cyclone Conditions of Readiness, Injury Savings, Cost-Loss Models

The importance for policy makers of the inter-links, to minimize the risk assessment, in the DPSIR framework of EEA, case study air pollution by EC vs Hammarby Sjöstad Stockholm

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Abstract

The aim of the research is to identify the proper use and power of the interlinks of DPSIR (Drivers, Pressure, State, Impact, Response) framework for a sustainable response by the policy makers of a municipality. The EEA (European Environmental Agency) proposes and promotes the five-phase-chain framework DPSIR to the European political local authorities of a municipality as the proper tool for urban fabric evaluation, aiming urban sustainability. For EEA the political R (Response) to I (Impacts) depends on how these impacts are perceived and evaluated, also that the results of R on the identified problem through the five-chain framework depend on the effectiveness of the Response, and to which link in the causal chain the Response is mainly directed. EEA states that emphasis should be given to the inter links of the framework by good-quality information and analysis for the policy makers. According to an EC (European Commission) report, risk assessments as currently carried out do not inform the risk management process as well as they should. The method of the research concerns a risk assessment in an EC case study on air pollution in comparison to the municipal approach of Hammarby Sjöstad in Stockholm where they used all the inter-links of the DPSIR framework especial the initial inter-link phase to reduce the I (Impact) and the use of the risk assessment. The conclusions provide a way applied by the Swedish municipalities of a city- model which ultimately guides the environmental targets and impacts, along with type C Efficiency Indicators, and the EIA (Environmental Impact Assessment) in the life circle of a construction. Overall the local authorities are able to reduce the impacts and minimize the inter-link phase of risk assessment for a future development. Thus, the dynamic role of risk assessment and the inefficiency in equivalences of human health and life with economic criteria, is weakened since the impacts and the legal framework are already expected and pre-defined.

Keywords: Policy makers, DPSIR inter-links, Risk assessment, Urban sustainability, EEA tools

A Hybrid Statistical–Machine Learning Approach Using Split-Based Forward Selection

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Abstract

Real-world datasets often involve not only large sample sizes but also high-dimensional feature spaces, making it challenging to analyze every variable comprehensively. This can lead to significant time and resource demands, and in many cases, full variable exploration may be impractical. To address these challenges and support the development of accurate and efficient regression models, feature selection has become a critical step. However, conventional approaches often operate on the full dataset rather than across multiple partitions, potentially resulting in biased or inconsistent feature selection. This study introduces a refined forward selection method that leverages multiple data splits, taking into account both independent variables' strong correlations and data structure to identify the most vital features.

Keywords: Machine Learning, Statistics, Multicollinearity

Stochastic Optimization for Data-Driven Dynamic Pricing in Reservation-Based Systems

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Abstract

In reservation-based service environments characterized by fluctuating demand and competitive market dynamics, effective dynamic pricing is vital for maximizing revenue. This study proposes a data-driven framework that integrates demand forecasting with stochastic optimization. Customer arrivals are modeled using a non-homogeneous Poisson process, where demand is estimated through a Poisson Generalized Linear Model (GLM) trained on historical booking data. A dynamic programming algorithm is then employed to update prices over time, considering real-time availability and market conditions with the aim of maximizing total expected revenue while adapting to evolving demand patterns.

Keywords: Generalized Linear Model, Poisson, Reservation Systems, Dynamic Programming Algorithm

Forecasting Spare Parts Purchase Orders Using Statistical, Machine Learning, and Deep Learning Models

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Abstract

Reliable forecasting of purchase orders is essential for effective inventory planning and supply chain coordination, particularly in environments managing a wide range of spare parts with varying demand patterns. Inaccurate forecasts can lead to overstocking, stockouts, and inefficient use of storage and capital. This study presents a flexible framework for multi-step forecasting of purchase order quantities, tailored to the turnover rate of each product. Spare parts are categorized according to their demand frequency, and the forecasting strategy is adapted accordingly. Daily forecasts are generated for fast-moving items to support close monitoring and frequent replenishment. Weekly forecasts are applied to medium-moving products, while monthly forecasts are used for slow-moving items, where demand changes less frequently. This segmentation allows the forecasting process to match the operational needs and variability of each group. The dataset combines historical purchase transactions with a set of auxiliary features that may influence demand, including calendar-related variables (e.g., weekdays, holidays), pricing trends, sales history, and current inventory levels. This enriched information base supports the training and evaluation of a diverse set of forecasting models. Several modeling approaches are explored, ranging from classical time series methods to more flexible machine learning algorithms and deep learning architectures. Models are assessed based on their predictive accuracy and their ability to generalize across products with different movement profiles. The proposed framework highlights the benefits of aligning forecast design with product-specific demand dynamics. It provides a scalable and adaptable approach that can support more responsive and cost-effective inventory control in real-world procurement environments

Keywords: Spare Parts Forecasting, Deep Learning, Multi-Step Forecasting, Inventory Management

Risk-Centric Siamese Learning: A Comparative Assessment of Multiple Risk Functions for Order-Acceptance and Scheduling Decisions in Hybrid Production Systems

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Abstract

Hybrid production systems (HPS) integrating make-to-stock (MTS) and make-to-order (MTO) workflows serve as a promising alternative to traditional flow- and job-shop approaches. A common challenge in these systems relates to the determination of the optimal mixture of standardized (MTS) and tailor-made (MTO) products that maximizes the organization's profitability. The definition of the optimal MTO/MTS mixture and its production planning has been a long-standing theme in the corresponding literature, with several approaches proposing mathematical programming models towards validating different optimal order acceptance and scheduling (OAS) policies. However, most of the proposed OAS policies often fall short in delivering real-time, preemptive capabilities. Towards addressing this gap, the present work constructs training samples for a Siamese Neural Network (SNN)-infused framework, which first identifies the risk for each new MTO quote made; and then integrates advanced meta-heuristics to plan the accepted quotes within the operating production scheme (including MTS). Moving beyond the limitations of linear risk formulations tied to time and cost deviations, we extend previous works by incorporating a family of nonlinear risk functions (including convex, sigmoid forms etc.) into the SNN training process. This enables the model to learn similarity patterns that better reflect the complexities of real-world HPS environments. Building upon previous policy-optimality proofs, we showcase that incorporating nonlinear risk functions enhances overall profitability by up to 16% compared to linear counterparts. By examining the underlying factors contributing to this improvement, we consolidate critical insights into risk-informed OAS policies, thus enhancing real-time and preemptive decision-making in HPS.

Keywords: Siamese Neural Networks, Risk function, Hybrid MTS/MTO systems, Pattern recognition

<p>9:00-10:40</p>	<p>Environmental, Climate Risk and Energy Organizer: Laboratory of Economics of Strategy, Innovation and Sustainability – LENS Lab, part of the Department of Economics of the University of Patras, Chair: Kounetas, K.</p> <ul style="list-style-type: none"> • Chatzistamoulou, N.: <i>Balancing Trade-Offs in EU's Green Transition: Green Technology Independence vs. EU ETS Adversities in Driving Green Growth Progress</i> • Genstwa-Namysł, N., Standar, A. and Kożera, A.: <i>CO₂ Emission Risk Mitigation and Local Governments' Investment Activity in Poland</i> • Kosmopoulos, G.: <i>Urban PM2.5 Exceedance Forecasting Using Neural Networks</i> • Palaiologou, A.: <i>Probabilistic Risk Assessment of Indoor Air Quality in a Greek Hospital Facility</i> • Stergiou, E.: <i>Stairways to Heaven for European Industries: Multi-Driving Paths for CO₂ Emissions Generation</i> 	<p>Observations Over Time: Lifetime Data and Time Series Analysis Organizer/Chair: Caroni, C.</p> <ul style="list-style-type: none"> • Pierri, F.: <i>Graduation and Dropping Out in an Economics Degree Programme</i> • Dimopoulos, A.: <i>Visualising Crisis Dynamics: Sentiment Analysis and Temporal Patterns in Social Media Data for Tourism Resilience</i> • Kosma, G.: <i>A Review of Outlier Detection Methods in ARMA Models: Classical Approaches and Future Directions</i> • Markou, M.: <i>Backtracking Quasi-Newton Optimisation for Accurate Prediction of Local Optima in Time-Series</i> • Karioti, V.: <i>Evaluating the Effectiveness of Savitzky-Golay Smoothing for Outlier Detection in Time Series Data</i>
<p>10:40-11:10</p>	<p style="text-align: center;">Coffee Break</p>	
<p>11:10 - 12:30</p>	<p>Risk-Informed Pathways for Valorization and Resilience of Environmental Systems Organizer: Environmental Engineering Laboratory (EEL), Dept. of Civil Engineering, University of Patras Chair: Zacharias, I.</p> <ul style="list-style-type: none"> • Chrisanthos N.: <i>Risk-Informed Valorization of Two-Phase Olive Mill Waste: Integrating Methane Production and Vehicle Fuel Substitution in a Regional Agro-Industrial Context</i> • Biliani, S.: <i>Potential Risks of Algal-Based Systems for Wastewater Treatment and Nutrient Recovery</i> • Biliani, I.: <i>Environmental Risk Analysis of Eutrophication and Anoxia in the Aitoliko Lagoon</i> • Yannopoulos, P.C.: <i>Impact assessment of missing hourly observations on daily mean estimation of primary and secondary air pollutants</i> 	<p>Statistical Methods and Risk Analysis in Educational and Health Studies Organizer/Chair: Oliveira, T.A. and Teodoro, M.F.</p> <ul style="list-style-type: none"> • Oliveira, T.A.: <i>Statistical Methods for Analysing Risks in Online Education: An Overview</i> • Pereira, J.: <i>Bridging Gaps in Periodontal Epidemiology: A Neuro-Fuzzy Approach for Imputing Planned Missing Data</i> • Leal, C.: <i>Time Series Disaggregation: Exploring Methods with COVID-19 Data from Municipalities in the Porto District</i> • Silva A.: <i>Integrating Risk Analysis and Response Surface Modeling for Process Optimization</i> • Teodoro M.F.: <i>Assessment of risk factors associated with hypertension in Portuguese adults using GLM and GAM</i>

12:30 - 13:50	<p>Engineering and Infrastructure Risk Chair: Balomenos, G.</p> <ul style="list-style-type: none"> • Loukopoulos, K.: <i>Fragility Assessment of Reinforced Concrete Frames Subjected to Mainshock-Aftershock Sequences</i> • Symeonidou, A.: <i>A Markov Regenerative Process for Modeling the Dependability and Performance of a Wind Turbine Under the Effects of Wind Intensity</i> • Misiri, Z.: <i>Landslide Risk Assessment for Road Infrastructure in the Epirus Region, Greece</i> • Ksoulos, I.: <i>Hidden Markov Model-Based Remaining Useful Life Estimation of Rolling Bearings Using Vibration Signals: A Feasibility Stud</i> 	<p>Health and Medical Risk Applications I Chair: Karioti, V.</p> <ul style="list-style-type: none"> • Economou, P.: <i>Public Health Monitoring Using Control Charts Based on Convex Hull</i> • Stamou, N.: <i>An Explainable Deep Learning Approach for 10-Year Cardiometabolic Risk Prediction Using TabTransformer and SHAP</i> • Nika, E.: <i>Data Analytic Techniques and Statistical Process Monitoring for Efficient Health Budgeting – The Case in Major Neurological Conditions</i> • Papageorgiou, G.: <i>Transforming Text Into Insights: A Deep Learning Approach for Mining Unstructured Data</i>
13:20 - 14:30	Lunch Break	
15:00 - 17:00	<p>Statistical Methods for Risk Analysis Chair: Kitsos, C.</p> <ul style="list-style-type: none"> • Rokakis N.: <i>Performing Dynamic Pricing by Exploiting Process Monitoring Procedures</i> • Stamatiou, I.: <i>Hazard Functions for the Gamma Order Generalized Distributions</i> • Jurečková, J.: <i>Estimation of Expected Shortfall in an Autoregressive Model</i> • Mavridis, P.: <i>Goodness-of-Fit Testing for the Hazard Rate Function</i> • Batsidis, A.: <i>Weight-Biased Sampling Mechanism: Consequences of Its Ignorance and an Adjustment Methodology</i> 	<p>Fraud Detection Chair: Bersimis, S.</p> <ul style="list-style-type: none"> • Katsanakis, I.: <i>From Detection to Prevention: A Machine Learning-Based Framework for Proactive Fraud Risk Assessme Tsioutsios nt</i> • Smani, G. I.: <i>Identifying Critical Assets for Cyber Risk Propagation</i> • Konsta, L.: <i>Cyber Fraud Detection in Banking Sector: A Machine Learning Approach</i> • Katsanakis, I.: <i>Detecting and Assessing Fraud Risk in Tourism: A Machine Learning Framework Using Synthetic Booking Data</i> • Kampouris, C.: <i>Predicting Indication of Fraud Based on Macroeconomic Data: An AI Model Approach</i> • Bersimis, S.: <i>Network-Based Approaches for Identifying Fraud Risk in Health Insurance</i>
17:00 - 17:30	Coffee Break	
17:30 - 18:20	<p>Prof. Mei-Ling Ting Lee Stochastic First-hitting-time Models with Extension to Neural Networks Chair: Malefaki, S.</p>	
18:20 - 20:00	<p>Specialized Risk Models and Applications Chair: Lee, M. T./Caroni C.</p> <ul style="list-style-type: none"> • Malefaki, S.: <i>Modeling Time-to-Event Data With Random Effects Threshold Regression: A Bayesian ABC Approach</i> • Santos, C.: <i>Combining Mixed Models With Shared Algebraic Structure</i> • Abreu, F.: <i>The Influence of Fatigue on Decision Making in a Military Environment</i> • D'Amico, G.: <i>An Information-Theoretic Approach to Risk Analysis</i> • Santos, C.: <i>Injury Risk Factors in Soccer: A Multiple Linear Regression Approach</i> 	
21:00 - 23:00	Gala Dinner	

Balancing Trade-offs in EU's Green Transition: Green Technology Independence vs. EU ETS Adversities in Driving Green Growth Progress

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Abstract

Despite the recognized need for decisive green policy, a significant gap remains in understanding the EU ETS's impact on green growth. While participation effects are well-documented, aspects like carbon pricing and feed-in tariffs remain under-explored. Additionally, the lack of consensus on measuring green growth and the overlooked role of green technology independence hinder a full understanding of green transition mechanisms. To address this, we propose a framework integrating EU ETS elements with green technology independence to guide strategic planning across green growth tiers. Our analysis, based on a unique dataset covering the EU-28 from 2010 to 2019, a critical period for the EU's green transition, uses an instrumental variables panel quantile estimator on the Green Growth Index. Results reveal the EU ETS's adverse effects but highlight the balancing role of green technology independence. Our findings show that national environmental policy safeguards all green growth tiers. These insights emphasize the need for tailored policies that balance green policy and technology to address performance disparities effectively.

Keywords: EU ETS, Green Technology Independence, Green Growth, Instrumental Panel Quantile Estimator, Environmental Policy Effectiveness, Europe

CO_2 Emission Risk Mitigation and Local Governments' Investment Activity in Poland

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Abstract

The main objective of this study is to assess whether regions of Poland characterized by high levels of CO_2 emissions engage in local investments supporting the energy transition, as well as to what extent this activity is related to the perceived or actual risk resulting from emission intensity. The analysis takes into account the level, structure, and dynamics of changes in CO_2 emissions as potential factors determining the investment strategies of local authorities in mitigating environmental and regulatory risks. The research period covers the implementation of the EU financial perspective 2014–2020. The application of multivariate data analysis, based on Ward's method, allowed for the identification of groups of voivodeships significantly differentiated in terms of CO_2 emissions and the degree of involvement in investments supporting a low-emission economy. Relationships between selected features of investment activity and emission levels were confirmed—in this case, investments can be regarded as a risk mitigation mechanism. The analysis showed that two-thirds of local government units in Poland received funding for the implementation of investments related to the energy transition. Particularly high activity was observed in cities with high emission levels. In these regions, point emissions dominated, associated with large industrial plants that require costly, concentrated investment actions. A different situation occurred in regions where diffuse emission sources (e.g., agriculture) or linear sources (e.g., transport) prevail, which require actions distributed over time and space of a systemic nature. Incorporating the results of our research into the planning practices of local government units may contribute to more effective planning of actions aimed at reducing environmental risk and accelerating the energy transition.

Keywords: Local Governments' Investment, CO_2 emission risk, energy transition

Urban PM2.5 Exceedance Forecasting using Neural Networks

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Abstract

Air pollution by fine particulate matter (PM2.5) poses serious environmental and public health risks, particularly in urban areas with complex emission sources. This study presents a deep learning-based early warning system designed to forecast PM2.5 exceedance events in an urban area by using a low-cost sensors (LCSs) network. A long short-term memory (LSTM) neural network integrates the LCSs PM measurements with meteorological forecasts from the Copernicus Atmosphere Service to predict hourly and daily PM2.5 concentrations. The proposed algorithm successfully identified over 83% of daily exceedances (with respect to the WHO guidelines). A total forecast accuracy of approximately 92% was revealed during the testing year. The results demonstrate the model's effectiveness in supporting environmental risk mitigation strategies. Moreover, they highlight how accurate forecasting systems could improve localized air quality management and decision making as well as enhance the resilience of communities to PM related environmental risks.

Keywords: PM2.5, air pollution exceedances, air pollution forecasting, LSTM

Probabilistic Risk Assessment of Indoor Air Quality in a Greek Hospital Facility

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Kosmopoulos G., Laboratory of Atmospheric Physics, University of Patras, Greece

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Abstract

Indoor air quality (IAQ) in healthcare environments is a critical determinant of health outcomes, with the potential to affect both carcinogenic and non-carcinogenic risk. Hospitals demand environmental control strategies to combat airborne transmission of particulate matter (PM) and viruses, while protecting vulnerable populations. A comprehensive probabilistic risk assessment was conducted using ModelRisk software, comparing pre- and post-intervention scenarios in a hospital doctors' room. The analysis utilized real-time measurements of PM₁, PM_{2.5} and PM₁₀ concentrations, viral contaminants (including SARS-CoV-2 and Adenovirus genome copies) and environmental variables such as temperature and relative humidity (RH). Carcinogenic risk was calculated as lifetime excess cancer probability. Non-carcinogenic risk was quantified through Hazard Quotients (HQs). Short-term viral infection risk for Covid-19 and Adenovirus was also modeled for Day 1 and Day 2 exposures. Sensitivity analyses were performed to identify the main contributors to risk variability. The intervention achieved an estimated 9.92 reduction in carcinogenic risk, lowering mean lifetime cancer probability from 8.09×10^{-8} to 7.29×10^{-8} , remaining well below the U.S. EPA's de minimis threshold (10^6). Non-carcinogenic HQs showed consistent post-intervention improvements. PM₁ HQ decreased by 14.9% (0.0281 to 0.0239), PM_{2.5} HQ by 9.2% (0.0209 to 0.0190), PM₁₀ HQ by 8.1% (0.0091 to 0.0084). Overall Total HQ Risk decreased by 11.8% (from 0.0582 to 0.0514). Viral infection risk exhibited mixed results for Covid-19, risk on Day 1 was eliminated post-intervention (from 0.00435 to 0) and for Day 2, however, Covid-19 risk emerged post-intervention (from 0 to 0.01696), suggesting temporal variability in control effectiveness. Adenovirus risk was reduced to zero post-intervention across all days. Sensitivity analysis for Covid-19 Day 2 POST risk revealed that PM₁ and PM_{2.5} exposures, indoor humidity, temperature and exposure time were dominant drivers of risk variability, underscoring the complexity of controlling airborne infection risk in hospital settings. Environmental intervention significantly reduced carcinogenic, non-carcinogenic and viral health risks in this hospital environment. However, the observed persistence and variability of Covid-19 risk on Day 2, influenced by PM exposure, RH, temperature and occupancy patterns, highlights the need for continuous monitoring and control strategies to ensure the elimination of airborne health risks in healthcare facilities.

Keywords: Indoor Air Quality (IAQ), Carcinogenic Risk, Non-Carcinogenic Risk

Stairways to Heaven for European Industries: Multi-driving paths for CO_2 emissions generation

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Abstract

European Commission (EC) recognizes that industries are key contributors to global greenhouse gas emissions. In the face of escalating environmental and climate challenges, EC and governments adopt and implement portfolios of environmental policy instruments, such as laws and regulations that are essential for fostering innovative strategies to combat pollution and reduce CO_2 emissions. However, designing an effective policy package is challenging, as it must be tailored to varying social, economic and technological contexts. This study employs the Fuzzy-Set Qualitative Comparative Analysis (fsQCA) method to investigate the complex and interdependent factors influencing CO_2 emissions across European countries and unravel the intricate interplay between policy instruments and social/economic contexts. Using data from 2008 to 2020 for eleven industries of the manufacturing sector from 29 countries across Europe, we uncover multiple causal configurations that may lead to higher levels of carbon emissions due to trade, energy mix, environmental taxes and economic growth. The findings highlight the importance of proper policy, economic, energy and technological instruments and demonstrate that there is no single path to sustainability. This study not only contributes to the understanding of pollution but also provides practical insights for policy formulation in varied social contexts.

Keywords: Carbon emissions, energy mix, policies, economic growth, fsQCA

Graduation and Dropping Out in an Economics Degree Programme

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Abstract

For financial and reputational reasons, every university and degree course is committed to the goal of increasing the number of enrolments and improving indicators of students' success, including decreasing the time taken by students to obtain their degree and reducing the incidence of dropping out. High rates of dropping out from university courses and excessive time to graduation are matters of great practical importance, with substantial financial and social costs. Student retention or dropout depends on a combination of various factors, the influence of which is mediated by the student's ability to integrate into the academic system. The identification of those factors which may affect the outcome and upon which the academic system can act, is an object of extensive study and research. In order to examine this topic, we collected data at the University of Perugia at the time of initial registration for three bachelor degrees in Economics. The 2015 cohort of students was tracked up to 2025, a period substantially exceeding the nominal duration of their degree courses, allowing the determination of each student's current status at the time of data extraction. Applying binary and multinomial logistic regression, survival analysis and competing risks (graduation and dropout) analysis, we explore which factors influence the students' performance and highlight pros and cons of the applied statistical methodologies in this context.

Keywords: university dropout, student retention, logistic regression, survival analysis, competing risks

Visualizing Crisis Dynamics: Sentiment Analysis and Temporal Patterns in Social Media Data for Tourism Resilience

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Abstract

Social media platforms have become critical sources of real-time information during crisis events, offering valuable insights into public sentiment and temporal dynamics. This presentation reviews the application of sentiment analysis and visualization techniques to social media data, focusing on their potential to enhance crisis management and tourism resilience. We explore various methodologies for extracting sentiment from textual data and visualizing temporal patterns, highlighting the challenges and opportunities in analyzing large-scale social media datasets. By examining case studies related to tourism crises, such as wildfires in the Mediterranean region, the COVID-19 pandemic, and periods of political instability in popular tourist destinations, we demonstrate how these techniques can be used to monitor public perception, identify emerging trends, and inform strategic decision-making. Furthermore, we discuss the role of Artificial Intelligence in improving the analysis of these data, and propose future research directions aimed at advancing our understanding of crisis dynamics and strengthening tourism resilience through social media analytics.

Keywords: Crisis Events, sentiment analysis, social media analysis, data mining

A Review of Outlier Detection Methods in ARMA models: Classical Approaches and Future Directions

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Abstract

This review paper provides a comprehensive analysis of outlier detection methods within Autoregressive Moving Average (ARMA) models, focusing on both classical statistical techniques and emerging research directions. Outliers, or anomalous data points, significantly impact the accuracy and reliability of ARMA-based time series analysis, requiring robust detection methodologies. This paper surveys classical approaches, including residual analysis, hypothesis testing, and influence diagnostics, which have traditionally been employed to identify outliers in ARMA models. Furthermore, it explores recent advancements and future directions, such as the integration of machine learning techniques, robust estimation methods, and adaptive algorithms, aimed at enhancing the sensitivity and efficiency of outlier detection. By critically evaluating the existing literature and highlighting current challenges, this review aims to provide researchers and practitioners with a thorough understanding of the current best practices in outlier detection for ARMA models and to stimulate further research in this critical area.

Keywords: Time series, Forecasting, ARMA models, outlier detection

Backtracking Quasi-Newton Optimisation for Accurate Prediction of Local Optima in Time-Series

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Abstract

Accurate forecasting of local optima in time series is crucial in various fields, including economics, tourism, and medical data analysis. This study proposes a novel methodology for predicting local optima in time series, utilising a Quasi-Newton method as a backtracking mechanism. The approach involves three key stages: (1) analysing historical points to identify trends, (2) approximating the optimal step size using the Lipschitz constant, and (3) applying the step size to predict future extrema. The proposed methodology combines the efficiency of the Quasi-Newton optimisation with the precision of Lipschitz approximations, offering a robust framework for forecasting the behaviour of time series. This contribution has broad applicability, enhancing decision-making processes in scenarios where the identification of critical turning points is essential.

Keywords: Time series, Forecasting, Optimisation, Quasi-Newton method, Lipschitz constant

Evaluating the Effectiveness of Savitzky-Golay Smoothing for Outlier Detection in Time Series Data

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Abstract

This paper proposes a novel methodology for detecting isolated points (anomalies) in time series, with a focus on utilizing the Savitzky-Golay filter for data smoothing. The methodology involves the generation of synthetic time series with artificially introduced anomalies, enabling a controlled evaluation and comparison of the effectiveness of various anomaly detection techniques. Specifically, the study focuses on comparing various methods (including Z-score, IQR, Isolation Forests) following the application of Savitzky-Golay smoothing. The comparison results highlight the impact of smoothing on anomaly detection accuracy. Future directions are proposed, including the evaluation and comparison of additional smoothing techniques, as well as the application of the methodology to real-world datasets.

Keywords: Time series, outlier detection, machine learning, isolation forest, Outlier detection

Risk-informed valorization of two-phase olive mill waste: integrating methane production and vehicle fuel substitution in a regional agro-industrial context

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Abstract

This study presents a comprehensive and risk-informed assessment of a circular bioeconomy model for the valorization of two-phase olive mill waste (TPOMW) in a Greek prefecture characterized by intensive olive cultivation. The proposed system involves the construction of two dedicated valorization units designed to manage the entirety of TPOMW generated during the olive production season (November to end-February). The waste is treated through three sequential processes: (1) mechanical recovery of residual oil, yielding a solid residue suitable for pellet fuel production; (2) membrane-based extraction of phenolic compounds from the liquid fraction; and (3) anaerobic digestion of the sugar-rich, phenol-depleted wastewater—either alone or in combination with solids from step 2—for methane production. The case study incorporated agronomic data to estimate the annual volume of TPOMW generated, based on regional olive oil production trends. A thorough survey of all operational two-phase olive mills was carried out, and the road network linking mills to candidate valorization unit locations was mapped. This dataset supported the development of a transportation network optimization model to identify the most efficient and resilient waste collection and delivery strategy. A transportation network optimization was performed, evaluating scenarios with truck load capacities at 70%, 80%, and 90% over a 20-year operational period. The analysis incorporated uncertainties in fuel consumption, labor, maintenance, and investment costs. Additionally, it considered operational risks such as road accessibility, seasonal peak loads, and the spatial distribution of olive mills. While higher truck loading rates resulted in fewer trips, they were associated with increased per-trip fuel consumption and logistical complexity. To mitigate dependence on fossil fuels and reduce climate-related environmental risk, the potential for substituting diesel with locally produced methane was explored. Representative TPOMW samples were subjected to Biochemical Methane Potential (BMP) tests to estimate methane yields for each substrate stream. These results informed scenario analysis for replacing diesel with biomethane as vehicle fuel. The feasibility of this transition was assessed, accounting for engine conversion costs, and fuel logistics. The integration of methane utilization demonstrated clear environmental risk mitigation benefits, including reduced greenhouse gas emissions, enhanced energy autonomy, and lower exposure to fossil fuel price volatility. A techno-economic and risk-benefit analysis evaluated the long-term viability of the valorization system under various operational, economic, and environmental risk scenarios. Key revenue streams include recovered oil, phenolic compounds, pellet fuel, and biogas. Sensitivity analyses addressed uncertainties in feedstock availability, market prices, and energy demands. The study demonstrated that combining circular bioeconomy strategies with spatial logistics modeling and environmental risk assessment can lead to robust and adaptive waste management systems. Overall, this work highlights how risk-informed decision-making, integrating environmental, logistical, and economic uncertainties,

can optimize agro-industrial waste valorization. It offers a replicable framework for regional bioresource planning, contributing to sustainable development, energy resilience, and climate risk reduction.

Keywords: Circular bioeconomy, Olive Mill Waste valorization, Anaerobic digestion, Transportation network optimization

Potential Risks of Algal-Based systems for Wastewater Treatment and Nutrient recovery

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Abstract

Nature-based solutions systems are gaining appeal as environmentally friendly alternatives to traditional wastewater treatment and biomass usage technologies. These technologies, such as constructed wetlands, algae-based systems, and land-based systems, provide ecological and economic benefits, but they also present complicated environmental concerns that necessitate comprehensive evaluation of potential risks. This work critically evaluates the environmental risk profile of nature-based solutions and especially of microalgae-based systems. Microalgae systems consist of open pond systems, closed photobioreactors, and hybrid configurations. They harness the natural processes of photosynthesis to remove nutrients like nitrogen and phosphorus from wastewater, thereby reducing eutrophication potential in receiving bodies of water. The successful implementation and operation of microalgal-based systems depend on environmental conditions such as light availability, temperature, and nutrient concentrations, as well as operational mode, harvesting, and biomass processing. These parameters affect both the efficiency and stability of the systems while also posing potential environmental risks such as algal blooms, contamination, and biomass disposal issues.

Keywords: Microalgae, nature-based solutions, wastewater treatment, environmental risk

Environmental Risk Analysis of Eutrophication and Anoxia in the Aitoliko Lagoon

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Abstract

The Aitoliko Lagoon, a vital aquatic ecosystem in Western Greece, has been increasingly affected by eutrophication and periodic anoxic events, threatening biodiversity, fisheries, and local livelihoods. This study presents a comprehensive environmental risk analysis of the lagoon, focusing on the drivers, impacts, and mitigation strategies associated with nutrient overloading and oxygen depletion. Using historical water quality data, real-time dissolved oxygen monitoring, and hydrodynamic modeling, we assess the probability and severity of anoxic events. The study identifies key risk factors, including agricultural runoff, wastewater inputs, and restricted water circulation, which exacerbate oxygen depletion and harmful algal blooms. A risk characterization framework is developed to map high-risk zones and forecast potential ecosystem disruptions. To mitigate these risks, we explore nature-based solutions such as water quality remediation, artificial oxygenation, and improved water exchange mechanisms. Additionally, policy recommendations include nutrient management strategies and stakeholder engagement to enhance resilience against eutrophication. The findings of this study highlight the importance of integrating scientific monitoring, risk modeling, and adaptive management in addressing environmental threats to coastal lagoons. The proposed framework can be applied to similar water bodies facing anoxia-related ecological degradation, offering a proactive approach to ecosystem restoration and climate resilience.

Keywords: water quality, remediation, anoxic events

Impact assessment of missing hourly observations on daily mean estimation of primary and secondary air pollutants

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Abstract

Human health may be at risk under certain conditions of air pollution. The Environmental Engineering Laboratory (EEL) of our department has monitored the air pollutants of particulate matter less than 10 μm (PM_{10}), 2.5 μm ($PM_{2.5}$), 1 μm (PM_1), as well the air pollutant of ozone (O_3), nitrogen oxide (NO), nitrogen dioxide (NO_2) and total nitrogen oxides (NO_x) in the University Campus at Rion during the period 2012-2020. However, during the period of measurements there is a possibility to get some days with missing hours due to several reasons, like power off, scheduled service, or other random incidents. Therefore, the question is whether such a day may derive a reliable mean value to be safely used for calculating the mean monthly and yearly values to be compared to the permitted limits for human health and the environment. The present work tries to answer this question through a statistical analysis of all complete 24-h days of the monitoring period regarding the above-mentioned pollutants. Three scenarios were assumed for 1 to 12 missing hours: a) completely randomly during each day of the period (*MCAR_hour*); b) more likely missing during rush hours and excess randomly within the day (*MAR_rush*); and c) more likely missing during low activity hours and excess randomly within the day (*MAR_low*). For each pollutant and scenario, the error proportion and the RMSE were calculated and shown in diagrams with respect to the missing number of hours. Data shows that the most critical scenario hierarchically is the *MAR_rush*, *MAR_low* and *MCAR_hour*.

Keywords: Air pollution monitoring; particulate matter; gaseous air pollutants; hourly and daily mean values

Statistical methods for analysing Risks in online Education: An overview

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Abstract

The application of advanced statistical techniques to risk analysis in online education is crucial for transforming educational data into useful knowledge for diagnosis, prediction, and intervention. For example, with logistic regression, it is possible to predict the probability of school dropout based on certain types of variables. Through generalized linear models (GLM), we can estimate the influence of socio-economic and pedagogical factors on academic performance. With factor analysis and principal component analysis, it is possible to reduce a large set of variables (e.g., questionnaires on family environment, stress, motivation) into latent factors for further analysis. Using structural equation modeling (SEM), we can study complex causal relationships between multiple variables, such as the indirect impact of poverty on performance, mediated by motivation or family support. This work presents an overview of what can be investigated and which statistical techniques are most appropriate in the context of online education. Some practical examples are also discussed.

Keywords: Risk, logistic regression, linear generalized models, factorial analysis, educational data mining.

Bridging Gaps in Periodontal Epidemiology: A Neuro-Fuzzy Approach for Imputing Planned Missing Data

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Abstract

In periodontal epidemiology, partial-mouth surveys are commonly employed to reduce clinical burden, despite introducing planned missing data (PMD) and subsequent biases in disease prevalence estimation. Traditional imputation methods frequently struggle with the inherent complexity and spatial relationships present in periodontal data. This research addresses these limitations through the development of a novel, neuro-fuzzy inspired artificial intelligence-based method called MoDau. MoDau leverages the symmetry properties of oral structures quantified via a newly developed Symmetry Measure (SM), which has shown high correlation (0.96) with expert clinical evaluations. The methodology comprises two integrated models: a "Mother" model, trained to recognize spatial patterns of symmetry in complete datasets, and a 'Daughter' model, specifically designed to impute missing periodontal probing depths (PPD) based on learned spatial dependencies. Using XGBoost algorithms, the approach demonstrates high predictive accuracy, particularly for clinically significant PPD values ($\geq 4\text{mm}$), and preserves the statistical structure essential for unbiased epidemiological analysis. This presentation summarizes the rationale, methodological innovations, validation outcomes, and potential implications of applying this neuro-fuzzy approach, demonstrating its robustness and practicality for improving periodontal health assessments in large-scale epidemiological studies.

Keywords: Planned Missing Data, Periodontal Epidemiology, Symmetry Measure, XGBoost Imputation, Artificial Intelligence in Health Data

Time Series Disaggregation: Exploring Methods with COVID-19 Data from Municipalities in the Porto District

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Abstract

Accurate reconstruction of fine-scale epidemiological time series from reports with lower temporal granularity is critical for timely public-health decision making. In this work, we explore five disaggregation approaches—(1) uniform-distribution allocation; (2) smoothness-penalized least squares (H-FUSE); (3) spline-interpolation with local renormalization; (4) hierarchical Bayesian dynamic modelling; and (5) the HOMERUN sparse-spectrum reconstruction—on weekly COVID-19 case counts reported by municipalities in Portugal’s Porto District. We aggregate the official daily series into non-overlapping weekly sums, apply each method to recover daily incidence, and compare their outputs using fidelity to known weekly totals, reconstruction error metrics (e.g., RMSE), preservation of epidemiologically meaningful patterns (such as peaks and troughs), uncertainty quantification, and computational demands. This systematic methodological comparison aims to elucidate the strengths and limitations of each algorithm in the context of real-time epidemic surveillance and to inform the selection of appropriate disaggregation techniques.

Keywords: Time Series Disaggregation, Epidemiology, COVID-19 Data, Spectral Methods, Spline & Bayesian Models

Integrating Risk Analysis and Response Surface Modeling for Process Optimization

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Abstract

This study presents a comprehensive methodological framework that integrates Risk Analysis with Response Surface Methodology (RSM) to support robust optimization in complex industrial processes. By combining statistical modeling, experimental design, and multi-objective optimization techniques, the approach enables the identification of critical factors and their interactions under uncertainty. Predictive models based on second-order polynomials are constructed to capture nonlinear relationships, while desirability functions and genetic algorithms are employed to optimize multiple responses simultaneously. Embedding risk analysis into the optimization framework helps ensure that the outcomes remain stable and reliable across different scenarios. This framework includes practical applications using free computational resources.

Assessment of risk factors associated with hypertension in Portuguese adults using GLM and GAM

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Abstract

In the present work, the authors used GLM and GAM approach, considering the physical characteristics, consumption habits, family medical register and other socio-demographic information of 1000 individuals to identify risk factors of hypertension in adult age. Some risk factors were identified, namely when a GAM approach was considered, identifying as the most significant factors, tobacco use, excess weight, cholesterol, age, with the first-order interaction being significant.

Keywords: Risk Analysis, GLM, GAM, Hypertension

Fragility assessment of reinforced concrete frames subjected to mainshock-aftershock sequences

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Abstract

The goal of the specific study is to examine the importance of the selection of the appropriate intensity measure and damage measure for reinforced concrete buildings subjected to mainshock-aftershock (MS-AS) sequences. Thus, this research work presents an extensive study for the seismic assessment of RC planar frames subjected to real MS-AS sequences. Low-rise 2D frames are analyzed and categorized into two different families, i.e., regular and irregular frames with setbacks in order to investigate how the configuration of buildings affect their seismic performance. In addition, the specific study aims to investigate the effect of the design regulations on the fragility of RC frames. Thus, the frames are also categorized based on the code used for their design, i.e., Family A consists of frames designed in compliance with Eurocode 8 seismic provisions, while Family B consists of frames designed solely for gravity loads, as per earlier codes that neglected seismic effects. Incremental dynamic analyses (IDA) are conducted using Ruaumoko software for each frame across all seismic sequences to assess their structural behavior. Three limit states are defined for the fragility assessment of the frames regarding the MS-AS sequences. The results highlight the significant impact of MS-AS sequences on the seismic fragility of RC frames. In conclusion, it is necessary during a future study to investigate how corrosion and ageing will affect the fragility of RC frames exposed to MS-AS sequences.

Keywords: Reinforced concrete, Mainshock-aftershock, Incremental dynamic analysis, Fragility assessment, Design codes

A Markov Regenerative Process for Modeling the Dependability and Performance of a Wind Turbine under the Effects of Wind Intensity

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Abstract

The increasing energy consumption has made wind turbines an essential power generation component, as they are one of the most cost-effective and greenest renewable energy solutions. Wind turbine's functionality is based on the transformation of the wind's kinetic energy into electrical energy. This transformation depends on both the wind speed and the condition of the wind turbine. Beyond repair actions after a turbine's failure, preventive maintenance (PM) is also critical for turbine's functionality and should be properly designed to avoid power production interruptions. To this end, the optimal time to enable PM must be determined for a wind turbine, to delay or postpone failures that result in power energy production interruptions. However, the power generation capacity of a wind turbine strongly depends on the wind intensity too. The uncertainty on the operational mode of a wind turbine due to failures and moreover due to the wind intensity, makes stochastic models essential for modeling wind turbine's condition combined with the wind intensity. In this work, firstly, a state space, which includes combinations of turbine's condition and wind intensity levels, is identified and then a Markov Regenerative Process (MRGP) is used to describe the dynamic behavior of the entire system. This process is selected because it can capture certain conditions that incur when the mode of the wind turbine and the wind intensity level are combined into one model and thus it can be used to evaluate the entire system dependability and performance. Thus, the asymptotic availability is considered in this work as a measure for the system dependability, whereas the Expected Energy Not Supplied (EENS) and the Loss of Load Probability (LOLP) are considered as measures of performance. The aim is to examine how the state of the system and consequently the energy production is affected by PM policies for the wind turbine, since these policies apparently affect the dependability and the performance measures. To demonstrate the theoretical framework, a numerical example, using data for wind turbine's functional mode as well as for wind speed, is presented.

Keywords: wind turbine, wind intensity level, preventive maintenance, Markov Regenerative Process, dependability, performance

Landslide Risk Assessment for Road Infrastructure in the Epirus Region, Greece

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Abstract

The current study presents the results of Landslide Risk Assessment for Road Infrastructure in the Epirus Region, Greece. For this purpose, a detailed record of active landslides was created, and the assessment of landslide susceptibility was made based on the analysis of five predisposing factors (geology, slope angle, elevation, land use, and rainfall accumulation as derived by ERA-5 Land) and the application of the frequency ratio (FR) prediction model. FR is a statistical model of bivariate analysis that performs reliability tests on the results and is internationally accepted to quantitatively describe susceptibility. The final degree of landslide susceptibility was assigned through the landslide susceptibility index (LSI), which assumes that as the value of LSI increases, so does the susceptibility. In this way, several susceptibility scenarios and associated maps were carried out for the entire study area, and all of them were evaluated for their ability to classify landslides in different susceptibility zones. Afterwards the susceptibility models were compared, and the most suitable with the highest LSI was used for accessing the intensity and hazard of landslides on the road infrastructure. The produced from this process hazard model was then used for accessing the landslide risk of the entire road network in the Region of Epirus by presenting three different risk levels low, medium and high.

Keywords: Landslide Susceptibility Index, Frequency Ratio, Rainfall, ERA-5, Landslide Hazard, Risk assesment, Road infrastructure

Hidden Markov Model-Based Remaining Useful Life Estimation of Rolling Bearings Using Vibration Signals: A feasibility study

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Abstract

This feasibility study presents a Hidden Markov Model (HMM)-based framework for the Remaining Useful Life Estimation (RULE) of rolling element bearings using vibration signals. Rolling bearings are critical components in rotating machinery, and their timely RULE may significantly reduce operating costs, protect neighbouring components, and enhance overall machinery reliability. An AutoRegressive (AR) model is first employed to capture the machinery dynamics using vibration acceleration measurements from an initial operating period where all components including the considered bearing are still under healthy condition. The AR model is then used to filter a newly acquired vibration signal from the machinery, and typical Envelope Analysis is applied to its residual signal to identify fault-related repetition frequencies (e.g. BPFO, BPFI). The amplitudes of these frequencies, combined with statistical features of the residual signal (RMS, IQR, Crest Factor, Peak-to-Peak) are used to construct various sensitive to bearing degradation Condition Indicators (CIs). This is achieved by applying Principal Component Analysis (PCA) to each feature combination, and the first principal component, characterized by maximum variance, is selected as CI. The best CI is then defined based on its trendability, robustness and prognosability, which are typical criteria in RULE applications. Based on this CI, a threshold is defined for the healthy state using the training data, while a fault is detected once this threshold is exceeded. Fault degradation process is subsequently approximated as a sequence of consecutive distinct states, which are segregated via K-Means clustering. A left-right HMM with continuous observation densities is finally estimated for the prediction of the RUL. The HMM-based RULE framework performance is assessed using a limited number of two run-to-failure vibration measurements from two nominally identical bearings for its training, with RUL estimation applied to a third bearing of the same type, all from the same experimental setup. The obtained results indicate that the HMM-based framework provides conservative RUL estimates, however certain comparisons indicate a promising overall performance.

Keywords: Remaining Useful Life Estimation, Hidden Markov Model, Envelope Analysis, Vibration Signals, Rolling Bearing

Public Health Monitoring Using Control Charts Based on Convex Hull

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Abstract

Early detection of unusual health, emergency, or environmental events is critical for safeguarding public safety. Monitoring systems must account for both temporal patterns (how events evolve over time) and spatial patterns (where clusters of events occur). This perspective applies across a wide range of domains: in public health, detecting early signs of outbreaks or localized clusters of cases; in emergency response, identifying concentrations of emergency calls to guide resource allocation; and in environmental monitoring, locating the source or hotspots of chemical or biological incidents.

In this paper, a practical monitoring framework that jointly tracks the number of events and their spatial distribution is presented. The method combines the convex hull, a flexible geometric tool, with control charting techniques to provide timely and interpretable detection.

As an illustration, the proposed framework is applied to Emergency Medical Services calls in three municipalities of Montgomery County, Pennsylvania (Abington Township, Rockledge, and Jenkintown). Using a three-day interval as the sampling unit, we analyze 17,516 unique calls collected between December 2015 and April 2020. Results show that the method effectively identifies temporal fluctuations and spatial clustering, demonstrating its value for real-world monitoring and early warning systems.

An Explainable Deep Learning Approach for 10-Year Cardiometabolic Risk Prediction Using TabTransformer and SHAP

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Abstract

Background. Dietary patterns remain a cornerstone of cardiometabolic health, yet conventional risk-prediction tools struggle to capture complex feature interactions without sacrificing interpretability. **Objective.** To develop an explainable deep-learning model that predicts 10-year cardiometabolic risk for the second follow-up interval of the ATTICA cohort (baseline 2011–2012; outcomes 2012–2022) and to illuminate the dietary factors that drive those predictions. **Methods.** Baseline data collected during the 2011–2012 re-examination of ATTICA participants—including detailed dietary intake, lifestyle behaviours and clinical measurements—were analysed. A Transformer-based architecture for tabular data (TabTransformer) was trained on these variables to estimate the probability of a composite cardiometabolic end-point occurring over the subsequent decade. Model transparency was achieved with SHapley Additive exPlanations (SHAP), which provided global importance rankings, interaction insights and individual-level attribution plots. **Results.** The TabTransformer produced accurate 10-year risk estimates and showed good calibration across the full risk spectrum. SHAP analysis highlighted the features that most strongly influenced the model’s predictions, while dependence and interaction plots revealed both synergistic and mitigating relationships among them. Individual waterfall plots enabled case-by-case identification of actionable dietary levers. **Conclusions.** An end-to-end TabTransformer augmented with SHAP yields both high predictive performance and clinically meaningful explanations for cardiometabolic risk in the 2012–2022 follow-up of the ATTICA study. The framework supports personalised nutrition counselling and refines population-level dietary guidance by pinpointing the components of diet most closely linked to long-term cardiometabolic outcomes.

Keywords: cardiometabolic risk, dietary patterns, TabTransformer, SHAP, explainable AI

Data Analytic Techniques and Statistical Process Monitoring for Efficient Health Budgeting – The case in Major Neurological Conditions

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Abstract

This paper introduces a data-analytic framework for evaluating direct healthcare costs associated with two prevalent neurological conditions: Alzheimer’s disease and anxiety disorders. By leveraging statistical process monitoring techniques and national health data, the methodology estimates disease prevalence, identifies target patient populations, and maps standard therapeutic protocols using ICD-10 classifications. Direct treatment costs are computed by aggregating pharmaceutical, hospitalization, and diagnostic expenses. Based on a 3.8% prevalence rate for Alzheimer’s (derived from the HELIAD study) and 2021 Greek census data, the affected population was estimated at 396,434 individuals, corresponding to a minimum annual direct cost of €132.4M—comprised of pharmaceutical (€23.6M), hospitalization (€0.24M), and diagnostic (€108.6M) expenditures. For anxiety disorders, with a 4.8% prevalence, the estimated population reached 500,759 individuals, with a minimum annual direct cost of €843.6M, including pharmaceutical (€673.3M), hospitalization (€0.4M), and diagnostic (€170M) components. This disease-centric budgeting model shifts away from traditional expenditure-driven frameworks, enabling more strategic allocation of resources and improved cost rationalization in healthcare systems through informed, data-driven planning.

Keywords: Alzheimer’s disease, Anxiety disorders, Data analytics, Statistical process monitoring, Health economics, Disease-based budgeting, Neurological healthcare planning

Transforming Text into Insights: A Deep Learning Approach for Mining Unstructured Data

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Abstract

Extracting useful information from large amounts of unstructured text is a major challenge in text mining, especially when trying to separate important data from irrelevant content. We introduce a new deep learning method for text mining that finds hidden patterns in large text collections. Our approach starts with a sentence classification step that removes unnecessary content while keeping important information. Following this preprocessing step, we implement a deep learning-powered Named Entity Recognition (NER) system that uses predefined feature extraction to identify and extract critical entities, transforming them into structured data formats. We test our method using two datasets: the BioCreative II Gene Mention dataset to compare our results with existing methods, and real shipping industry data containing emails about completed orders. Our results show that deep learning greatly improves text mining performance, making it valuable for extracting important information from large text collections.

Keywords: Natural Language Processing, Name Entity Recognition, Machine Learning, Artificial Intelligence, Data Mining

Performing Dynamic Pricing by Exploiting Process Monitoring Procedures

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Abstract

Pricing decisions play a pivotal role in revenue management, as they directly influence demand and profitability. Traditional static pricing approaches often fail to capture the dynamic nature of markets, which are affected by fluctuating demand, seasonal patterns, and competitor behavior. This work proposes a novel dynamic pricing methodology that integrates process monitoring procedures to achieve adaptive and data-driven decision-making. The methodology involves clustering booking time series, modeling booking behaviors, applying price adjustment mechanism, and continuously monitoring the process to ensure stability and alignment with market conditions. By incorporating feedback loops and sensitivity parameters, the proposed approach enables prices to adjust in real time while preventing extreme fluctuations. The study demonstrates how process monitoring can enhance pricing accuracy, improve utilization, and increase revenue, while also highlighting avenues for future research such as inertia and proximity effects.

Keywords: Dynamic pricing, process monitoring, clustering, revenue management, price adjustment, demand forecasting, time series analysis, adaptive pricing, competition, real-time decision making

Hazard functions for the gamma-order Generalized Distributions

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Abstract

The target of this paper is to introduce the hazard functions for the γ -order Generalized distributions. The classical distributions are depending on a position parameter, usually denoted by μ , a scale parameter, usually denoted by σ . Due to γ -order Generalized Normal distribution (γ GN), immersed from Logarithm Sobolev Inequalities (LSI) a third parameter, γ say, a shape parameter, was considered and fat-tailed distributions were obtained. From γ GN the truncated γ -order was obtained, and the Lognormal, as well as the γ -order Chi-Square and the γ -order Chi- γ . Moreover for the applications in Physics the γ -order Rayleigh and the γ -order Maxwell-Boltzmann distributions were introduced and their Laplace transform was evaluated. Thus for these families of distributions the hazard functions are evaluated for Risk problems applications, and theoretical framework.

Keywords: hazard function, gamma-order Generalized Normal distribution, Logarithmic Sobolev Inequalities

Estimation of Expected Shortfall in an Autoregressive Model

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Abstract

Consider the p -order autoregressive model (AR(p))

$$X_t = \phi_0 + \phi_1 X_{t-1} + \dots + \phi_p X_{t-p} + Z_t, \quad t \in \mathbb{Z}$$

with observations $\mathbf{X}_n = (X_1, \dots, X_n)^\top$, while the i.i.d. variables $\mathbf{Z}_n = (Z_1, \dots, Z_n)^\top$ are unobservable, distributed according unknown distribution function F . The $\phi = (\phi_0, \phi_1, \dots, \phi_p)$ is an unknown autoregression parameter vector. The order of the autoregressive model p is assumed to be finite and known. Our problem is to estimate the possible loss of an asset or a portfolio Z in a given period and with a particular confidence level α . This can be achieved by estimating a suitable risk measure based on quantiles of Z , e.g. by the expected shortfall equal to $\text{CVaR}_\alpha(Z) = (1 - \alpha)^{-1} \int_\alpha^1 F^{-1}(t) dt$.

If independent observations Z_1, Z_2, \dots, Z_n of Z were available, the estimate of $\text{CVaR}_\alpha(Z)$ could be obtained from the empirical quantile function based on the order statistics $Z_{n:1} \leq Z_{n:2} \leq \dots \leq Z_{n:n}$. Its form would be:

$$\widehat{\text{CVaR}}_\alpha(X) = \frac{1}{[n(1 - \alpha)]} \sum_{i=[n(1-\alpha)]}^n Z_{n:i}.$$

However, all inference on \mathbf{Z} and on distribution function F is possible only by means of \mathbf{X} . Because only the observations of X are available, we should look for an alternative solution of explicit estimating of $\text{CVaR}_\alpha(Z)$. A possible estimate can be based on the autoregression quantiles of the model, or on their functionals, e.g. on the average autoregression quantile, or on the two-step autoregression quantile, with an R-estimate of ϕ involved.

References

- [1] Yeşim Güney, J. Jurečková and O. Arslan (2020). Averaged Autoregression Quantiles in Autoregressive Model. In: *Analytical Methods in Statistics*. Eds.: M. Maciak et al. *Springer Proceedings in Mathematics and Statistics* 329, pp. 1–15. ISBN 978-3-030-48813-0
- [2] J. Jurečková, J. Kalina, J. Večeř (2022). Estimation of expected shortfall under various experimental conditions. arXiv: 22.12419v1 [stat.ME].
- [3] J. Jurečková, J. Pícek and J. Kalina (2024). Estimation of Conditional Value-at-Risk in Linear Model. In: *Combining, Modelling and Analyzing Imprecision, Randomness and Dependence*, J. Ansari et al. (Eds.), AISC [Advances in Intelligent Systems and Computing] 1458, pp. 200–207. Springer. DOI : 10.1007/978 - 3 - 031 - 65993 - 5₂₄.

Keywords: Autoregression model, Expected shortfall, Autoregression quantile

Goodness-of-Fit testing for the hazard rate function

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Abstract

This work introduces a novel kernel based goodness-of fit test for the hazard rate function, in the presence of right-censored data. The proposed test statistic is constructed based on the L2 metric, and a central limit theorem for its asymptotic distribution is derived under the null and under composite Pitman local alternatives. Based on the central limit theorem we derive the asymptotic size and power of the test. Furthermore, extensive numerical studies are conducted to evaluate the empirical performance of the proposed procedure across various sample sizes and censoring percentages, thereby demonstrating its efficacy and robustness.

Keywords: Hazard rate function, Goodness-of-fit, Kernel, Censoring, Pitman local alternatives

Weight-Biased Sampling Mechanism: Consequences of Its Ignorance and an Adjustment Methodology

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Abstract

In numerous scientific domains—including environmental, meteorological, and biomedical research—the probability of observing a unit from a population is frequently proportional to a known non-negative weight, giving rise to a weight-biased sampling mechanism. If this mechanism is ignored, the resulting sample may lead to biased estimators, distorted inference, and ultimately suboptimal decisions. In this presentation, we rigorously examine the statistical consequences of disregarding such biased sampling schemes, with particular emphasis on their impact on the estimation of population-level quantities and inferential validity. Applications of practical relevance include, but are not limited to, the estimation of mean biomass in forest inventories and the derivation of design criteria based on user data. We further highlight how weighted distributions offer a coherent framework not only for characterizing the induced bias but also for deriving adjustment methodologies that restore validity to inference procedures.

Keywords: Biased samples, Weighted distributions, Distorted inference

From detection to prevention: A machine learning-based framework for proactive fraud risk assessment

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Abstract

In an era where fraudulent activities are becoming increasingly sophisticated, traditional risk assessment models often fail to detect and mitigate them in a timely manner. This paper proposes a methodological framework that integrates machine learning-based fraud detection into proactive fraud risk assessment, leveraging historical fraud cases to enhance predictive capability and decision-making accuracy. The proposed approach conceptualizes a data-driven pipeline where past fraud cases serve as structured inputs to machine learning models designed to identify patterns, anomalies, and predictive indicators of future fraud. By correlating detection mechanisms with dynamic risk assessment processes, the framework aims to shift the focus from reactive investigation to proactive risk management. The methodology outlines key phases, including data preparation, feature extraction, supervised model training, and risk scoring calibration. Emphasis is placed on how detection outputs can inform risk assessment models, creating a feedback loop that continuously updates risk profiles based on new findings and evolving fraud tactics. This study does not rely on primary data but builds on existing literature, empirical case studies, and best practices in fraud analytics. It contributes to the growing field of intelligent risk management by providing a theoretically grounded yet practically adaptable model, applicable across financial, governmental, and compliance-driven sectors. The proposed framework offers substantial value for organizations seeking to strengthen internal controls, anticipate fraud scenarios, and align risk strategies with modern analytical capabilities. Future research directions include empirical validation of the model using synthetic or real-world datasets, as well as adaptation to sector-specific regulatory requirements.

Keywords: Fraud risk assessment, Fraud detection, Machine learning

Identifying critical assets for cyber risk propagation

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Abstract

Modern digital infrastructures increasingly rely on interconnected heterogeneous components spanning from IoT to edge, server, and cloud. Governed by AI-driven autonomous decision systems, they introduce complex behaviors, interdependence, and evolving threat exposures. This creates a dynamic and uncertain, cybersecurity risk landscape, challenging traditional static risk models (NIST SP 800-30 Rev. 1, “Guide for Conducting Risk Assessments,” 2012). A key challenge is capturing threat propagation, identifying critical assets, and prioritizing mitigations under constraints. Traditional frameworks, often static or linear, fail to reflect the evolving and interdependent nature of modern infrastructures (S. Noel et al., “Measuring and Comparing the Risk of Networks Using Attack Graph Metrics,” IEEE TDSC, 2017) (G. Loukas, “Cyber-Physical Attacks: A Growing Invisible Threat,” Elsevier, 2015). This work proposes a novel cyber risk modeling approach based on attack risk propagation in dynamic attributed graphs. Assets (processes, systems, sensors, computing units, operators) are nodes; technical or operational dependencies are edges. Modeling infrastructure as time-evolving graphs enables graph-theoretic prediction of risk propagation (T. Laishram and S. H. Kim, “Risk Propagation Modeling and Mitigation in Cyber Physical Systems Using Graph-based Techniques,” Sensors, 2021). Building on previous research in influence maximization in dynamic social networks, we adapt and extend the following algorithms:

- DM: foundational influence tracking in dynamic networks (Smani G.I., Megalooikonomou V., “Maximization Influence in Dynamic Social Networks and Graphs,” Array, vol. 15, 2022).
- DM Core (DM-C) and DM Truss (DM-T): DM extensions integrating k-core and k-truss decompositions for structural awareness and node stratification (Smani G.I., Megalooikonomou V., “Maximization Influence in Dynamic Social Networks and Graphs,” Array, vol. 15, 2022). These models reflect cyber-physical and AI-enabled infrastructures, interpreting influence as cyber risk propagation and key nodes as high-risk assets. k-core and K-truss decompositions (Rossi, Maria-Evgenia G., et al. “MATI: An efficient algorithm for influence maximization in social networks.” PloS one 13.11 (2018): e0206318.) identify tightly connected subgraphs that correspond to critical service clusters or control pathways, whose compromise may cause cascading failures or rapid threat spread. The methodology includes:
 - Defining propagation functions modeling risk probability and impact along connections.
 - Using propagation maximization to find high-impact nodes whose compromise amplifies risk disproportionately.
 - Prioritizing these for mitigation: patching, isolation, monitoring, redundancy.
 - Simulating multiple propagation scenarios under uncertainty.

This supports cybersecurity functions:

- Risk identification: mapping cascading vulnerabilities.
- Risk analysis: quantifying risk likelihood, scope, velocity.
- Risk evaluation: comparing scenarios under various mitigation plans.
- Risk treatment: optimizing controls via centrality metrics.

Moving beyond static lists, this dynamic, predictive modeling suits AI-driven environments with autonomous behavior, data drift, and adversarial inputs requiring continuous risk reassessment. It fits smart grids, intelligent healthcare, industrial IoT, and other dynamic topologies. It can potentially integrate cybersecurity tools with:

- Machine learning to learn influence parameters from incidents.
- Reinforcement learning for adaptive mitigation policy selection.
- NLP to extract structural risk relations from unstructured data.
- Uncertainty quantification for explainability and trust.

Modeling risk dynamically enables:

- What-if simulations to assess attack/failure impacts.
- Detecting emergent vulnerabilities beyond static catalogs.
- Real-time risk monitoring for resilient, adaptive defense.

Aligned with emerging regulations and AI governance, the framework supports continuous risk monitoring, decision explainability, traceability, and uncertainty modeling. In conclusion, modeling infrastructures as time-evolving graphs and risk as dynamic propagation enables richer, actionable insights. It bridges theory and practice, unlocking proactive threat modeling, real-time scoring, and automated support, empowering organizations to anticipate, quantify, and mitigate cyber threats in autonomous, distributed digital environments. This work was supported by the CyberNEMO project, which has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No.101168182. The opinions expressed in this document reflect only the author's view and in no way reflect the European Commission's opinions. The European Commission is not responsible for any use that may be made of the information it contains.

Keywords: Cybersecurity Risk Propagation, Dynamic Network, k-core decomposition, K-truss decomposition

Cyber fraud detection in banking sector. A machine learning approach

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Abstract

This study empirically investigates the performance of machine learning models in detecting fraudulent transactions within the banking sector. To conduct the simulations, we use AI-generated data that includes key variables such as banking transactions, IP addresses, and other network-related indicators. The simulation dataset comprises approximately 1,000 transactions recorded at short intervals (5 and 15-minute intervals). Simulated cyber frauds are introduced into these transactions to reflect realistic event scenarios. Using the open-source Elastic software for anomaly detection, we identify patterns indicative of potential cyber threats. Specifically, when the Elastic machine learning (ML) algorithm is properly trained, it can detect red flags that signal imminent cyber fraud. For example, a sharp and unexpected increase in the number of IP addresses accessing a single account within five minutes is highly likely to be abnormal and warrants immediate investigation. The results suggest that the Elastic AI platform demonstrates strong predictive accuracy, effectively detecting all simulated cyber frauds by flagging suspicious behavior during the fraud window. Consequently, the banking sector could significantly benefit from adopting this AI-driven tool as part of its early warning and cybersecurity defense systems.

Keywords: Cybercrime, Machine learning, Elastic software, banking sector, financial system

Detecting and assessing fraud risk in tourism: A machine learning framework using synthetic booking data

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Abstract

The tourism-related industries are increasingly exposed to fraudulent activities, including fake bookings, payment chargebacks, bot-generated reservations, and identity misuse. Despite the growing digitalization of travel transactions, most fraud detection systems remain fragmented and reactive. This paper proposes a machine learning-based framework for proactive fraud risk assessment tailored to the tourism sector. The framework leverages behavioral and transactional features, such as booking timing, booking channel, payment method, device trust score, and past cancellation behavior, to predict the likelihood of fraudulent activity. Fraud probabilities are translated into interpretable risk scores that support early warning mechanisms for online travel agencies (OTAs), hotel platforms, and destination management systems. To demonstrate the methodology, a synthetic dataset of 5,000 simulated bookings was generated, capturing common patterns and anomalies encountered in digital tourism transactions. Fraud scenarios such as last-minute high-value bookings, low device trust, suspicious countries of origin, and abnormal customer behavior were embedded in the dataset. The model was evaluated using ROC and precision-recall curves, and optimal classification thresholds were calibrated based on F1-score maximization. The results indicate that, even in the absence of real-world data, the proposed approach can serve as a blueprint for implementing intelligent fraud prevention strategies in tourism. This study provides both a conceptual and technical foundation for future work that combines AI-driven fraud analytics with domain-specific risk management in the travel industry.

Keywords: Fraud risk assessment, Fraud prevention, Synthetic tourism data

Predicting Indication of Fraud based on Macroeconomic Data: An AI model approach

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Belesis N., University of Piraeus, Greece

Rokakis N., University of Piraeus, Greece

Kampouris Ch., University of Piraeus, Greece

Abstract

The paper examines the factors that may signal the existence of potential fraud in companies' financial statements. Using a sample of the Russell 3000 firms from 2000 to 2023, we explore the relationship between country's economic condition and the presence of fraud indicators in companies. Two dependent variables are employed as proxies for potential fraud: the existence of Key Audit Matters (KAMs) reported by auditors and the restatement of financial statements. The independent macroeconomic variables examined GDP change, Unemployment Rate, Borrowing Interest rates, Inflation Rates, Balance of Trade and Business Confidence Index. The objective is to assess whether these factors can statistically predict the presence of fraud-related red flags in financial reporting. Our research contributes to the literature on audit quality, corporate governance, and financial reporting reliability by offering insights into the potential predictors of fraud indications in financial statements.

Network-Based Approaches for Identifying Fraud Risk in Health Insurance

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Michelakis Ch., Department of Business Administration, University of Piraeus, Greece.*

Abstract

Health insurance fraud poses significant challenges, leading to substantial financial losses and undermining the integrity of healthcare systems. Traditional fraud detection methods, often reliant on rule-based systems and isolated claim analyses, struggle to uncover sophisticated, collusive schemes orchestrated by networks of providers, patients, and intermediaries. The application of network analysis techniques could enhance the detection of such fraudulent activities by modeling complex relational patterns within healthcare data. A variety of networks could be the subject of investigation, for example provider-intermediary-patient and hospital-doctor-diagnosis. In this paper, we compare a variety of approaches. Fraudulent activities often involve temporal anomalies, unusual patterns, or collaborative behaviors that evolve over time. Thus, we extend this comparison by incorporating Dynamic Temporal Analysis techniques for networks. Finally, we explore the potential of detecting sophisticated fraud schemes and more generally any fraudulent patterns that evade detection by traditional network analysis techniques by utilizing Graph Neural Networks. All the techniques are applied on synthetic data based on real world health insurance datasets in order to evaluate their usefulness and practicality in a real setting.

Keywords: Health Insurance Fraud, Network Analysis, Fraud Detection,

Stochastic First-hitting-time Models with Extension to Neural Networks

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Abstract

Neural networks are a subset of artificial intelligence (AI). I'll give a brief introduction of the concepts and then explain how to use it. Degradation of an engineering system or a patient's health can be described mathematically by a stochastic process. The system (or the patient) experiences a failure event when the condition of the system (or the patient's health) decreases to a critical event threshold level. This happening defines a failure event and a first hitting time (FHT). First hitting time risk models are based on an underlying stochastic process; they do not require the proportional hazards assumption and represent a realistic alternative to the Cox model. I'll present the methods to extend the FHT risk models to neural networks.

Modeling Time-to-Event Data with Random Effects Threshold Regression: A Bayesian ABC Approach

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Bobotas P., Department of Mathematics, University of Patras, Greece

Malefaki S., Department of Mechanical Engineering & Aeronautics, University of Patras, Greece

Abstract

Time-to-event data arise frequently across diverse scientific domains, including economics, engineering, sociology, and medical research, particularly in clinical and epidemiological studies. A powerful framework for analyzing such data involves threshold regression models with random individual effects, in which, for example, an individual's latent health status is modeled as a Wiener process. In this setting, the event of interest occurs when the stochastic process first reaches a predefined boundary—interpreted as the first hitting time. Due to the intractability or high computational cost of the likelihood function in this model, a Bayesian estimation approach based on Approximate Bayesian Computation (ABC) is employed. This likelihood-free method facilitates efficient parameter inference without requiring the explicit computation of the likelihood. The proposed methodology is demonstrated through its application to a representative dataset

Keywords: Survival analysis, First hitting time regression, Wiener process, Approximate Bayesian Computation (ABC) method

Combining Mixed Models with Shared Algebraic Structure

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Mexia J.-T., Center for Mathematics and Applications (NovaMath), FCT NOVA, Portugal

Abstract

In this work, we address the problem of combining mixed models that share the same algebraic structure and have independent observation vectors, focusing on models with Commutative Orthogonal Block Structure (COBS). The approach to the joint analysis is based on the algebraic structure of the models, using binary operations on commutative Jordan Algebras of symmetric matrices. We show that joining iso-structured COBS results in a new COBS, that the estimators for the joint model can be explicitly derived from the estimators of the individual models, and therefore, that it is ensured that in the resulting joined model, the least squares estimators for estimable vectors are the Best Linear Unbiased Estimators. These results provide a rigorous and efficient framework for the integration and analysis of independent datasets with shared algebraic structure.

Keywords: Best Linear Unbiased Estimators, Commutative Orthogonal Block Structure, Iso-structured models, Joining models

The Influence of Fatigue on Decision Making in a Military Environment

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Simões P., Military Academy Research Center - Military University Institute (CINAMIL) and MRLab- Military Readiness Lab-Portugal and NOVA MATH - Center for Mathematics and Applications, NOVA University of Lisbon

Abstract

Decision making is fundamental in military operations, requiring speed and accuracy in increasingly uncertain scenarios. In such contexts, military personnel face high physical and cognitive demands that can cause fatigue and affect their operational performance. This study analyzed the influence of fatigue on decision making in a military environment, aiming to optimize performance in demanding situations. A sample of 4th year students from the Portuguese Military Academy was selected. Each participant completed the RP 30 Problem Solving Test, which assesses cognitive abilities essential to decision making, on two different measurement moments. At first, the individuals performed a ruck march carrying an approximate load of 30 kilograms, second, on another day, they completed the test in a resting condition. The data collected on the physiological parameters in the participants, namely heart rate, continuously monitored during the march, enabling calculation of internal load through Training Impulse and also the calculation of the Summated Heart Rate Zone method, as well as changes in the percentage of heart rate reserve. The data was analyzed using various descriptive statistical methods, combined with adequate statistical inference techniques and probability models. Two indices are proposed, the Decision Making Speed Index and the Decision Making Performance Index, which quantify, respectively, the speed and quality of decisions under fatigue providing standardized metrics for future studies. The indices revealed that, when fatigued, cadets experienced a 23.33 % reduction in decision-making speed and a 15.09 % reduction in decision-making quality. The results demonstrated that fatigue significantly compromises both the speed and quality of decision making, impairing several key cognitive abilities. It is concluded that implementing training protocols that combine intense physical effort with decision making tasks is fundamental for deepening understanding as an effective measure to enhance the functional integration of physical and cognitive capacities in order to optimize the operational performance of military personnel, even under exhaustive conditions.

Keywords: Decision Making, Fatigue, Physical Load, RP 30, Statistical hypothesis tests.

An information-theoretic approach to risk analysis

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Abstract

This work introduces a basic model for analyzing the spatial distribution of risk, emphasizing the inequality that arises under specific risk-generating assumptions. Classical and modern metrics of entropy and divergence are explored as quantitative tools to measure such disparities. The core contribution of this talk lies in the introduction of doubly weighted divergences and the examination of their key mathematical properties. The practical applicability of the proposed methods is demonstrated through selected numerical examples based on real data.

Keywords: risk, divergences, entropies

Injury Risk Factors in Soccer: A Multiple Linear Regression Approach

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Abstract

This work addresses multiple linear regression as a tool for analyzing and predicting injury risk in soccer athletes. The study focuses on applying the model to data from a soccer team competing at the district level, considering variables that are recognized in the literature as determinants of injury risk. Although previous injury history, accumulated fatigue, and physical conditioning level are particularly influential factors, they present more complex relationships that may require more advanced models. However, according to the literature and applied studies, some determinants of injury risk can be reasonably modeled by a linear relationship. Variables such as age, minutes played, and recovery time may, in certain cases, show an approximately linear relationship with injury risk—especially when analyzed individually and in homogeneous samples. Due to the club's limited structure for data collection, the study prioritizes these variables, aiming to identify risk factors and contribute to more informed team management.

Keywords: Determinants of injury risk, Multiple linear regression, Soccer

Day 3, 24/9

8:30-9:00	Council Meeting Members of Council are all the ICRA organizers and the editors of ICRA volumes	
9:00-10:40	Health and Medical Risk Applications II Chair: Escott-Price, V. <ul style="list-style-type: none"> • Nakamura, T.: <i>Cause-Distinct Incidence to Resolve the Confusion Over Cause-Specific Incidence</i> • Leonenko, G.: <i>Improving Risk Stratification in Alzheimer's Disease Through Harmonised PRS Methodologies</i> • Bersimis, F.: <i>Utilization of Polygenic Risk Scores in Neurological Diseases</i> • Kougioumtzoglou, T.: <i>Clustering Analysis of Cognitive Assessment and Demographic Data Using Machine Learning Methods</i> • Alexopoulos, P.: <i>Assessing Service Differentiation and Risk Coverage for Older Adults With Cognitive and Mental Health Needs</i> 	
10:40 - 11:30	Keynote Speaker: Prof. Valentina Escott-Price Genetic Risk Prediction for Brain Disorders: Current Insights and Future Directions Chair: Alexopoulos, P.	
11:30 - 12:00	Coffee Break	
12:00 - 14:00	Financial Risk and Corporate Governance Chair: Petropoulos, C. <ul style="list-style-type: none"> • Tsagkanos, A.: <i>Volatility Risk, Climate Risk and Green Corporate Bonds</i> • Dias, C.: <i>Analysing Financial Variability in SMEs in the Wine Sector Using the Coefficient of Variation</i> • Koutsouradis, G.: <i>Eco-Process Innovation: "Win-Win" or "You Have Lemons Make Lemonade"? The Moderating Role of Marketing Innovation</i> • Kostara, O.: <i>Enhancing Credit Risk Prediction for SMEs: A Comparative Analysis of Traditional and Machine Learning Approaches</i> • Lazarou, E.: <i>Modeling Early-Stage Startup Dynamics and Risk Using Innovation Readiness Levels (IRL)</i> • Thomopoulou, A.: <i>ESG and Risk Management</i> 	Extreme Value Theory and Applications Chair: Konstantinides, D. <ul style="list-style-type: none"> • Brito, I.: <i>Extreme Risk Measures for the Risk Assessment of Air Pollution With Fine Particulate Matter Using the Generalized Pareto Distribution</i> • Dias, S.: <i>Probability Weighted Moments in Tail Independence</i> • Gomes, M. I.: <i>PORT Generalised Means and Non-Regular Frameworks for an Extreme Risk Assessment</i> • Passalidis, C.: <i>Uniform Asymptotic Estimates for Ruin Probabilities of a Multidimensional Risk Model With Cadlag Returns and Multivariate Heavy Tailed Claims</i> • Katsouda, M.: <i>Extreme Value Detection in HR Environment</i> • Konstantinides, D.: <i>Tail Behavior of Randomly Weighted Sums With Interdependent Summands</i>
14:00 - 14:30	Closing Ceremony	
14:30-	Light Lunch/Excursion	

Cause-distinct incidence to resolve the confusion over cause-specific incidence

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Yamada T., Osaka University, Japan

Nose Y., Kyushu University, Japan

Abstract

The current confusion regarding the cause-specific incidence and hazard in the competing risk analysis appears to stem from misunderstandings of the statistical methods proposed by pioneers, such as Kalbfleisch and Prentice (1980, 2000), Fine and Gray (1989, 1999) and Klein and Morgenshtein (1997, 2003). The objective of this paper is to describe the cause-distinct (CD) incidence to overcome the confusion. The CD-incidence is applied to some examples presented in literature to demonstrate its usefulness with interpretation of the results.

Keywords: competing risk, incidence, hazard, survival, subdistribution

Improving Risk Stratification in Alzheimer's Disease Through Harmonised PRS Methodologies.

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Valentina, Escott-Price, UK Dementia Research Institute at Cardiff, Division of
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University.*

Abstract

Alzheimer's disease (AD), the most prevalent neurodegenerative disorder, results from a complex interplay of genetic, lifestyle, and environmental factors. Early prediction of AD risk is crucial for stratifying individuals with respect to the disease risk and selecting candidates for functional studies. Polygenic risk scores (PRS) have emerged as promising tools for quantifying individual genetic susceptibility by aggregating the effects of multiple genetic variants identified through genome-wide association studies (GWAS). However, variability in PRS construction methods and discovery GWAS has led to inconsistencies in identifying individuals at high risk for AD. Comprehensive analyses comparing different risk prediction models, GWAS summary statistics, and PRS derivation approaches have demonstrated that individual risk scores can vary significantly depending on the GWAS data used—with discrepancies of up to 70%. To ensure comparability across different studies and methods, we recommend: a) incorporating APOE genotype—the strongest risk factor in late-onset AD—alongside PRS; and b) standardizing PRS against the background population, rather than within individual cohorts. These methodological refinements have significant implications for prioritising individuals for clinical trials, early intervention strategies, and the development of personalised therapeutic approaches in AD.

Keywords: genetic risk predictions, Alzheimer's Disease

Utilization of Polygenic Risk Scores in Neurological Diseases

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Abstract

Neurological diseases are complex diseases that affect the nervous system, and their cause may be genetic to some extent. Neurodegenerative diseases, such as Alzheimer's and Parkinson's, have a genetic background and their onset is related to age and gender. Polygenic Risk Scores are numerical estimates of the genetic predisposition to various complex diseases including neurodegenerative ones based on the effect of many genetic variants. The use of Polygenic Risk Scores in health care systems is relatively limited today as their benefit has not been fully evaluated, but potentially in the future could offer the opportunity to health professionals to provide suitable intervention in individuals classified as at high genetic risk for developing diseases, such as Alzheimer's and Parkinson's. This work explores the advantages and disadvantages of applying PRS approaches in neurodegenerative diseases.

Keywords: Polygenic Risk Scores, Neurodegenerative Disorders

Clustering Analysis of Cognitive Assessment and Demographic Data Using Machine Learning Methods

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Abstract

This study presents an analysis of medical data aimed at identifying patterns of cognitive function through clustering techniques. The dataset included scores from cognitive assessments (MMSE, COGTEL, MoCA, Bristol) as well as key demographic variables such as age, education level, and medication use. Data preprocessing involved handling missing values either by listwise deletion or through multiple imputation using the MICE (Multiple Imputation by Chained Equations) method. The analysis was conducted in R, employing three clustering algorithms: k-Means, AGNES (Agglomerative Nesting), and DBSCAN (Density Based Spatial Clustering of Applications with Noise). The goal was to explore the internal structure of the data and group patients based on similar cognitive profiles. The results revealed distinct clusters with differences in cognitive performance and demographic characteristics, offering valuable insights into cognitive decline profiles and potentially supporting clinical decision-making.

Assessing Service Differentiation and Risk Coverage for Older Adults with Cognitive and Mental Health Needs

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Abstract

Three different types of services for older adults with cognitive complaints and/or mental health difficulties operate in the metropolitan area of Patras: A community-based memory clinic, a tertiary old age psychiatry outpatient clinic, and telepsychogeriatric services integrated into two primary healthcare centers. This study explores the extent to which these services address different risk profiles and population needs. Using advanced statistical analysis, the demographic and clinical characteristics of service users across the three models were examined. The resulting components revealed distinct patterns of vulnerability and healthcare engagement, highlighting how each service targets specific segments of the older population. The findings underscore the importance of maintaining a diversified service ecosystem to ensure broad risk coverage and mitigate gaps in mental health and cognitive care for ageing populations.

Keywords: dementia, mild cognitive impairment, geriatric depression

Genetic Risk Prediction for Brain Disorders: Current Insights and Future Directions

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Abstract

Brain disorders are complex and often highly heritable traits that can be caused by a combination of genetic, physical, psychological and environmental factors. Such complexity is evident in their diagnosis, which is often based on symptoms. Differentiation between brain disorders is further challenged by a pronounced overlap in symptoms and comorbidities. Neurodegenerative disorders, like Alzheimer's disease, triggers a range of psychiatric symptoms, including depression and anxiety, in addition to physical difficulties like incontinence. The phenotypic complexity of brain disorders is mirrored in their genetics. Polygenic risk scores are a method increasingly used to capture the combined effect of genome-wide significant variants and those which individually do not show genome-wide significant association but are likely to contribute to the risk of developing diseases. However, their practical use incurs complications and inconsistencies that so far limit their clinical applicability. With expanding datasets and computational advances, Machine Learning (ML) has the potential to further enhance risk prediction and gene discovery, particularly through federated learning and multi-omic integration. A key challenge is the ability to condense and filter large-scale data, effectively distinguishing signal from noise while capturing the complexity of brain disorders. The success of ML largely depends on data quality, the features extracted, the choice of objective or loss function, and the selection of an appropriate model architecture and hyperparameters that best fit the research question. Future advancements will rely on the willingness of researchers from non-computational disciplines to collaborate openly with mathematicians and computer scientists, their readiness to share data, and a collective effort to carefully develop, interpret, and report results.

Volatility risk, Climate risk and green corporate bonds

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Abstract

The last years, there is an attention of the research community to the effects of idiosyncratic volatility and volatility risk on corporate bonds returns and pricing. More recently a strand of literature focused on isolation on the impact of volatility risk and climate risk on corporate bond returns and pricing. In this study, we make focus on corporate green bond returns regarding the Greek market beginning by examining the effect of idiosyncratic volatility. The most important part concerns the investigation of the join effect of volatility risk and climate risk on the pricing of green corporate bonds. For this reason, we incorporate a volatility factor, a climate risk factor and the bond market factor into the term-default two-factor bond pricing model of Fama and French (1993) constructing a new five-factor pricing model of green corporate bonds. Finally, to capture the strong impact of inflation as expressed through two phases of rise and fall during the period under consideration, we apply the Markov Switching Regression. Our results show that idiosyncratic volatility has a different impact on Greek corporate green bond returns depending on the magnitude of inflationary pressures. Similarly, based on Markov Switching Regression on new five-factor pricing model the results show that in the presence of inflationary pressures the increase of climate risk decreases the valuations of green corporate bonds by investors while the volatility risk is an insignificant factor for their decision. During the presence of non-inflationary pressures, the investors reinforce their positions to green corporate bonds when the climate risk increases, the volatility risk decreases and at the same time face low term structure and strong market behavior. Additionally, the parameter alpha of the five-factor bond pricing model decreases moving from regime 1 to regime 2. Thus, our proposed model captures the premium of volatility risk and climate risk well and makes a significant marginal contribution to explaining the excess returns of green corporate bonds.

Keywords: Corporate Green Bonds, Climate Risk, Volatility Risk, Five Factor Pricing Model.

Analysing Financial Variability in SMEs in the Wine Sector Using the Coefficient of Variation

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Abstract

This work addresses the use of the coefficient of variation (CV) to assess the stability of financial indicators in small and medium-sized enterprises (SMEs) within the Portuguese wine sector from 2011 to 2020. Based on a sectoral database, four indicators were analysed: return on equity, liquidity, total indebtedness, and financial autonomy. For each company and variable, the CV was applied to measure relative variability over time. The results reveal significant differences in financial stability among the companies, with indebtedness standing out as a highly relevant variable. The presence of high CV values for this indicator suggests greater exposure to defaults and less predictability in financial management. The analysis of relative dispersion in indebtedness allows for the identification of companies most exposed to financial risk and enables the distinction between groups with different vulnerability profiles. The study illustrates how the CV is an effective tool for identifying patterns of consistency or instability, offering an accessible approach to comparative risk analysis in SMEs.

Keywords: Financial Variability, Small and Medium-sized Enterprises (SMEs), Risk Analysis, Coefficient of Variation (CV)

Eco-process innovation: “Win-win” or “you have lemons make lemonade”? The moderating role of marketing innovation

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Abstract

Despite intensive EU efforts to promote green transition (European Union, 2022), firms are still hesitant to commit to green transition fully (Filiou et al., 2023; Dimakopoulou et al., 2023). This is primarily attributed to the significant challenges firms face in fully capitalising on the positive effects of green technology (Barbieri et al., 2020; Vasileiou et al., 2022). In this context, there is an urgent need for sustainable methods and pathways that facilitate green technology adoption without ramifications for firm performance (De Marchi et al., 2022). Green technologies can be categorised into two types (Triguero et al., 2015): (i) End of the pipe technologies (EPT), which refer to “technologies designed to reduce pollution and/or recover resources at the end of the production process” (Garcia-Quevedo et al., 2022; Frondel et al., 2007) and (ii) Resource-efficient technologies (RET), which refer to “efficiency-enhancing technologies that optimize processes and reduce energy or input consumption” (Ozusaglam et al., 2018; Cheng and Shiu, 2012). The extant literature suggests that EPT does not affect or is non-significant or negatively affecting the firm’s performance (Garcia-Quevedo et al., 2022). On the other hand, RET appears to be insignificant or positive for firm performance (Stucki et al., 2019). While the direct impact of EPT and RET on firm performance has been extensively studied, limited attention has been given to the corresponding impact on firms’ innovation performance. Even more neglected is the question concerning the role of marketing innovation in shaping the relationship between EPT and RET with innovation performance (Dimakopoulou et al., 2024). Indicatively, marketing innovation can improve the visibility of green innovations and link the already environmentally conscious consumer to the green firm while expanding the customer base by better communicating the firm’s environmental messages. It can also assist in identifying opportunities to elevate eco-technologies from niche applications to mainstream designs for mass markets. (Pinkse et al., 2024). In this context, we argue that firms forced to adopt eco-technologies, mainly through environmental regulation, operate based on the principle “when you have lemons, make lemonade”. In technical terms, marketing innovation positively moderates the relationships between EPT and RET technologies. This leads us to form the following research hypotheses:

H1: Marketing innovation positively moderates the relationship between EPT adoption and Firms’ Innovation Performance.

H2: Marketing innovation positively moderates the relationship between RET adoption and Firms’ Innovation Performance

Keywords: eco-process innovation, marketing innovation, complementary assets, dynamic capabilities, cmp

Enhancing Credit Risk Prediction for SMEs: A Comparative Analysis of Traditional and Machine Learning Approaches

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Abstract

Accurate prediction of loan default is critical for effective credit risk management, particularly for Small and Medium-sized Enterprises (SMEs), which constitute a vital yet vulnerable segment of bank lending portfolios. As banks strive to minimize financial losses and strengthen their credit evaluation processes, there is an increasing demand for predictive models that are both reliable and operationally efficient. This study compares traditional statistical methods—such as logistic regression and the Cox proportional hazards model—with modern machine learning algorithms, including Random Forest and XGBoost, in the context of SME loan default prediction. Following an overview of key banking principles and SME credit assessment criteria, the models are applied to real-world data from the U.S. Small Business Administration (SBA) Loan Approvals dataset. Model performance is evaluated using accuracy, sensitivity, and ROC curves. The findings offer insights into the relative strengths of each approach and highlight the potential for banks to enhance their credit risk frameworks by integrating advanced analytics into SME lending practices, enabling more proactive and informed decision-making. Logistic regression and Cox model, while yielding satisfactory results with relatively good accuracy, demonstrated limitations in performance compared to more advanced models. In contrast, machine learning models achieved significantly higher performance, with elevated levels of accuracy and sensitivity, rendering them the most effective tools for predicting loan default.

Keywords: SME credit risk, loan default prediction, logistic regression, Cox model, XGBoost, Random Forest, machine learning, financial risk analysis, SBA loans

Modeling Early-Stage Startup Dynamics and Risk Using Innovation Readiness Levels (IRL)

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Abstract

This study proposes a novel approach to modeling early-stage startup dynamics and risk by combining expert-assessed IRL (Innovation Readiness Level) scores with probabilistic modeling techniques. Using data collected from evaluation forms in existing startup incubator programs, scored by mentors and startup coaches, the research aims to identify the dynamics between IRL factors in pre-seed startups and manage the type of risk that incubators are called to eliminate. To manage the high uncertainty in early stages and the partial availability of outcome data, Monte Carlo simulations are used to generate multiple IRL score scenarios. This allows for the estimation to model how startup characteristics behave in early stages, and the identification of which combinations of IRL factors most influence startup readiness. For the simulation process, each IRL factor (Team, Business, Technology, Customer, Funding, IP) is statistically analyzed and fitted to an appropriate probability distribution, with the Beta distribution selected for flexibility in modeling bounded and discrete score ranges. Through simulation, a weighted IRL-based scoring formula is composed, to calculate an overall readiness score for each startup. Leveraging the Probability Density Function (PDF), the Cumulative Distribution Function (CDF) of readiness scores is examined to evaluate the evolution of startup performance before and after participation in an incubation program. By comparing the pre- and post-incubation CDFs, the method provides statistical insights of how many startups surpass a defined readiness threshold after completing the incubator program. This comparative approach not only quantifies the improvement attributed to the incubation process but also equips incubators and investors with a robust tool to evaluate program effectiveness, develop data-driven actions, and manage portfolio risk more strategically.

Keywords: Startup Risk Modeling, Innovation Readiness Level (IRL), Monte Carlo Simulation, Cumulative Distribution Function (CDF), Incubator Program Evaluation

ESG and Risk Management

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Abstract

This presentation reframes risk analysis not as a compliance checkbox, but as the cornerstone of strategic leadership in a world increasingly shaped by ESG imperatives and disruptive forces like AI. Through vivid, real-world cases — from diagnostic startups to agricultural exporters and apparel giants — we uncover how overlooked risks, from regulatory gaps to geopolitical shocks, can derail even the most visionary initiatives. We demonstrate how scenario planning, predictive modeling, and AI-assisted foresight can transform risk management from a reactive response into a strategic compass. Ultimately, we argue that risk analysis is not about predicting every threat, but about fostering a mindset of adaptability, empathy, and informed decision-making — where ESG and AI are not constraints, but enablers of resilient, future-ready organizations.

Keywords: Strategic Risk Management, ESG Integration, Scenario Planning, AI in Decision-Making

Extreme risk measures for the risk assessment of air pollution with fine particulate matter using the Generalized Pareto distribution

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Abstract

Concerning the risk assessment of air pollution caused by fine particulate matter, modelling the tail of the data distribution provides valuable insights into extreme values, that could have catastrophic consequences for the environment and human health. In this work we propose a risk assessment approach adapted to extreme value theory, in which risk measures are determined based on the Generalized Pareto distribution. These measures are then combined using multi-criteria decision making methods. This approach is applied to air pollution risk assessment, in the form of a monthly risk analysis of fine particulate matter concentrations in Madrid.

Keywords: Risk assessment, Risk measures, Extreme value theory, Air pollution

Probability Weighted Moments in Tail Independence

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Abstract

Extreme Value Theory (EVT) focuses on methods for making inference in the tail of a probability distribution. The Gaussian model, commonly used for inference in the central part of the data, becomes inadequate when addressing extreme observations, which require an entirely different inferential framework provided by EVT. In the univariate setting, EVT introduces parameters such as the tail index, which plays a crucial role in characterizing the type and extent of the tail. Several estimators for the tail index are proposed in the literature, including the Hill estimator and the Probability Weighted Moments (PWM) estimators. In the bivariate context, EVT not only models the tails of the marginal distributions but also emphasizes the importance of understanding extremal dependence between variables. In this study, we focus on the Ledford and Tawn Coefficient (LTC) as a measure of tail dependence between two variables. This measure can be interpreted as a tail index obtained from a transformation of the margins of a random pair. We explore several variants of the PWM estimator applied to the LTC and evaluate their performance through a simulation study. Finally, we present an application to real data.

Keywords: Extreme Value Theory, Probability Weighted Moments, Extremal Dependence, Tail Dependence Coefficient

PORT Generalised Means and Non-Regular Frameworks for an Extreme Risk Assessment

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Abstract

For $p \in \mathbb{R}$, the mean-of-order- p (MO_p) extreme value index (EVI) estimators (see, Caeiro *et al.*, 2016, among others) are a powerful generalisation of the Hill EVI-estimators (Hill, 1975). But these MO_p EVI-estimators are not location-invariant, being thus preferable to work with the associated peaks over a random threshold (PORT) EVI-estimators, a discussion initiated in Araújo-Santos *et al.* (2006). The normal asymptotic behaviour of the PORT MO_p EVI-estimators has been obtained for $p < 1/(2\xi)$, with consistency achieved for $p < 1/\xi$, where ξ denotes the EVI. Just as in Gomes *et al.* (2022), we shall now also consider the non-regular case, $p \geq 1/(2\xi)$, a situation in which either normal or non-normal sum-stable laws can be asymptotically obtained, together with the possibility of an ‘almost degenerate’ EVI-estimation. An algorithm for such an ‘almost degenerate’ PORT MO_p EVI-estimation, and associated high quantiles and expected shortfall estimation, is suggested and studied for finite samples, through a small-scale simulation study, and an application to real data.

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References

- [1] Araújo-Santos, P., Fraga Alves, M.I. and Gomes, M.I. (2006). Peaks over random threshold methodology for tail index and high quantile estimation. *Revstat—Statist. J.* 4:3, 227–247.
- [2] Caeiro, F., Gomes, M.I., Beirlant, J. and de Wet, T. (2016). Mean-of order- p reduced-bias extreme value index estimation under a third-order framework. *Extremes* 19:4, 561–589.
- [3] Gomes, M.I., Henriques-Rodrigues, L. and Pestana, D. (2022). Non regular frameworks and the mean-of-order- p extreme value index estimation. *J. Statistical Theory and Practice* 16:3, 17 pages.
- [4] Hill, B.M. (1975). A simple general approach to inference about the tail of a distribution. *Ann. Stat.* 3:5, 1163–1174

Keywords: Generalised means, PORT methodology, Risk assessment, Semi-parametric estimation

Uniform asymptotic estimates for ruin probabilities of a multidimensional risk model with cadlag returns and multivariate heavy tailed claims

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Abstract

We study a multidimensional renewal risk model, with common counting process and cadlag returns. Considering that the claim vectors have common distribution from some multivariate distribution class with heavy tail, are mutually weakly dependent, and each one has arbitrarily dependent components, we obtain uniformly asymptotic estimations for the probability of entrance of discounted aggregate claims into a some rare sets, over a finite time horizon. Direct consequence of the claim behavior is the estimation of the ruin probability of the model in some ruin sets. Further, restricting the distribution class of the claim vectors in the multivariate regular variation, the estimations still hold uniformly over the whole time horizon.

Keywords: Multi-dimensional risk model, Heavy-tailed random vectors, Interdependence, Uniformity, Ruin probability

Extreme Value Detection in HR Environment

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Abstract

Outliers, also known as extreme values, are patterns in data that don't fit into a clear definition of typical behavior and typically seem to be generated by a separate mechanism than the rest of the data. Extreme value detection plays a crucial role in identifying hidden risks and anomalies in organizational environments. In this study, we apply a previously proposed graph-based method—based on bar visibility—to human resources data, including variables such as workload and absenteeism. Detecting outliers in these variables and investigating their correlation can help spot unusual patterns of behavior, such as sudden changes in attendance or performance. It can also detect operational inefficiencies, such as resource mismanagement. Outliers in this type of data can be early indicators of operational risks, such as burnout, increased turnover, or sharp increases in absenteeism due to a negative work climate. The method's effectiveness is evaluated on HR datasets, demonstrating its value in early identification of potential risks and decision support. This study emphasizes the importance of applying outlier detection techniques to the field of human resources, especially in contexts where uncertainty and workforce-related risks must be accounted for.

Keywords: outliers, extreme values, anomaly detection, human resources, operational risks

Tail behavior of randomly weighted sums with interdependent summands

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Abstract

We reconsider a classical, well-studied problem from applied probability. This is the max-sum equivalence of randomly weighted sums, and the originality is because we manage to include interdependence among the primary random variables, as well as among primary random variables and random weights, as a generalization of previously published results. As a consequence we provide the finite-time ruin probability, in a discrete-time risk model. Furthermore, we established asymptotic bounds for the generalized moments of randomly weighted sums in the case of dominatedly varying primary random variables under the same dependence conditions. Finally, we give some results for randomly weighted and stopped sums under similar dependence conditions, with the restriction that the random weights are identically distributed, and the same holds for the primary random variables. Additionally, under these assumptions, we find asymptotic expressions for the random time ruin probability, in a discrete-time risk model

Keywords: Interdependence, tail asymptotic independence, heavy-tails, generalized moments of sums, weighted random sums

Building of Accurate Reliability Assessment Bounds for Large Coherent Systems and Penultimate Behaviour of Extremes

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Abstract

The lifetime of any coherent system (see, Barlow and Proschan, 1975) can always be written as the maximum of minima or the minimum of maxima, due to the fact that it can be represented as a parallel-series or a series-parallel system. For large-scale coherent systems, it is sensible to assume that the number of system components goes to infinity, working then with the possible non-degenerate *extreme value* (EV) distributions either for maxima or for minima to get adequate lower and upper bounds for the system reliability. But for randomly stopped maxima (and similarly for minima), limiting models, different from the EV model, like the extended logistic, can be the limiting law for maxima (see Rachev and Resnick, 1991). Rates of convergence to these limiting distributions are often slow and penultimate approximations (see, Gomes, 1978, 1994, 2021; Gomes and de Haan, 1999, among others), generalizing the EV models, can provide a faster rate of convergence, providing more accurate lower and upper bounds to the system reliability (see, Reis and Canto e Castro, 2009, Reis *et al.*, 2015, Gomes *et al.*, 2017, also among others). The gain in accuracy when a penultimate approximation is used instead of the ultimate limiting one is revisited, using both Monte-Carlo and asymptotic methodology.

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References:

- Barlow, A.A. and Proschan, F. (1975). *Statistical Theory of Reliability and Life Testing: Probability Models*. Holt, Rinehart and Winston, Inc., USA.
- Gomes, M.I. (1978). *Some Probabilistic and Statistical Problems in Extreme Value Theory*. Ph.D. Thesis, University of Sheffield.
- Gomes, M.I. (1994). Penultimate behaviour of the extremes. In J. Galambos, J. Lechner and E. Simiu (Eds.), *Extreme Value Theory and Applications*, Kluwer Academic Publishers, pp. 403–418.
- Gomes, M.I. (2021). Revisiting rates of convergence and penultimate approximations for extremes. *Annales Univ. Sci. Budapest., Sect. Comp.* **50**, 135–149.
- Gomes, M.I. and Haan, L. de (1999). Approximation by penultimate extreme value distributions. *Extremes* **2**:1, 71–85.
- Gomes, M.I., Reis, P., Canto e Castro, L. and Dias, P. (2017). Penultimate approximations in extreme value theory and reliability of large coherent systems. In Christos H. Skydas (Ed.), *Proceedings of the 17th Conference of the Applied Stochastic*

Models and Data Analysis International Conference (ASMDA 2017), ISBN (e-book) 978-618-5180-23-2, pp. 431–442.

Rachev, S.T. and Resnick, S.I. (1991). Max-geometric infinite divisibility and stability. *Communications in Statistics — Stochastic Models* **7**, 191–218.

Reis, P. and Canto e Castro, L. (2009). Limit model for the reliability of a regular and homogeneous series-parallel system. *Revstat—Statist. J.* **7**, 227–243.

Reis, P., Canto e Castro, L., Dias, S. and Gomes, M.I. (2015). Penultimate approximations in statistics of extremes and reliability of large coherent systems. *Methodology and Computing in Applied Probability* **17**:1, 189–206.

Keywords: Extreme value theory, Monte-Carlo simulation, Penultimate and ultimate approximations, Rates of convergence, System's reliability

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