

SMTDA 2024

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Cultural Centre of Chania

Crete, Greece

BOOK of ABSTRACTS

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Preface

Dear Guests, Dear Colleagues,

We welcome you to the 8th Stochastic Modeling Techniques and Data Analysis International Conference and Demographics 2024 Workshop in Chania.

As the previous years, a considerable number of high quality research papers are accepted for oral or poster presentations.

Important speakers present onsite and virtually their work promoting the scientific development and research.

We have submissions from 35 countries: Algérie, Australia, Austria, Belgium, Brasil, Bulgaria, Canada, Chile, China, Costa Rica, Czech Republic, France, Germany, Greece, Hungary, India, Israel, Italy, Japan, Kuwait, Lithuania, Luxembourg, Malta, Mexico, Mozambique, Northern Ireland, Poland, Portugal, Russia, South Africa, Spain, Sweden, United Kingdom, USA, Uzbekistan.

I'd like to thank the Committees of the Conference which worked hard for this success.

I'd also like to thank the Region of Crete, our Sponsor.

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Dr Christos H. Skiadas
ex- vice Rector
Technical University of Crete
Chair of ISAST

Plenary Lectures

Mixtures of Multivariate Gaussians

Robert Elliott

joint work with John Van Derhoek

University of South Australia and University of Calgary

The talk will discuss the approximation of probability densities by sums of Gaussian densities. One of the earliest contributions to this construction was by Alspach and Sorenson [1] in 1972. More recent contributions discuss related ideas for Ensemble Kalman Filters. New methods include the use of the Kullback-Leibler Divergence as a measure between densities followed by applications of the EM algorithm.

Abel-Gontcharoff Polynomials, Parking Trajectories and Ruin Probabilities

Claude Lefèvre

Université Libre de Bruxelles

5 The central mathematical tool discussed is a non-standard family of polynomials, univariate and bivariate, called Abel-Goncharoff polynomials. First, we briefly summarize the main properties of this family of polynomials obtained in previous work. Then, we extend the remarkable links existing between these polynomials and the parking functions which are a classic object in combinatorics and computer science. Finally, we use the polynomials to determine the non-ruin probabilities over a finite horizon for a bivariate risk process, in discrete and continuous time, assuming that claim amounts are dependent via a partial Schur-constancy property. This is a joint work with Philippe Picard, Université de Lyon.

Stochastic approximation of gamma processes in random media and their applications in degradation

N. Limnios

Sorbonne University Alliance, UTC, LMAC

Gamma processes are particular cases of Lévy processes. They evolve by jumps and have an increasing path. This is the reasons why they are useful in degradation of materials and items in real applications. The aim of this presentation is to approximate gamma processes by a diffusion process. In fact, as the gamma process is an increasing one, the diffusion approximation requires an average approximation first. This averaged process will serve as an equilibrium to the initial gamma process.
(In collaboration with Sergey Bocharov).

Analyzing Fluctuations in Sex Ratio at Birth using Time Series Models: A Comparative Study of 38 Countries (TextSRB2023)

Peter Pflaumer

Department of Statistics, Technical University of Dortmund, Germany

Forecasting trends in the Sex Ratio at Birth (SRB) is a pivotal pursuit within demographic research, offering insights into evolving population dynamics. This study presents a comprehensive investigation into the selection and evaluation of optimal forecasting models for SRB data. Drawing on historical SRB records from 39 countries, we meticulously assess various models, including Autoregressive Integrated Moving Average (ARIMA) and Autoregressive (AR) models. Through empirical analysis, we unveil the dominance of the AR(2) model in capturing intricate SRB dynamics. Our findings underscore the AR(2) model's efficacy, arising from its parsimonious complexity, empirical validation, theoretical alignment, and superior statistical performance. With projections extending to 2070 for Germany, our study not only provides foresight into future SRB trends but also contributes a robust methodology to the wider field of time series analysis.

Special Sessions

Session I.

International Comparison and Method Innovation: Differentials of Male and Female Fertility Rates and Their Significance

Session Organizer: Hong Mi

*Professor and Doctoral Supervisor, School of Public Affairs, Zhejiang University
Director of Laboratory for Population Big Data and Policy Simulation, Zhejiang University
Executive Deputy Director of Center for Non-Traditional Security & Peaceful Development Studies,
Zhejiang University
Dean of Institute for the Elders and the Children, Ningbo College of Engineering
Executive Deputy Chairman for Mayinchu Learned Society
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I believe that this subject holds significant academic value in today's realm of demography, and we aim to use this platform to engage in an in-depth discussion with fellow scholars.

Male fertility is largely ignored in demography and related socioeconomic studies compared with female fertility. Recently, male fertility studies have attracted attention due to profoundly improved data availability. These studies have estimated male fertility rates for almost all the countries of the world through different methods and data sources and analyzed the differentials of male and female fertility rates. However, not all estimates of male fertility rates are equally reliable due to varying data quality and the common problem of missing paternal age information. In addition, the mechanisms behind the pattern of differences in male and female fertility and how to deal with the discrepancies are important research questions, about which not much has been studied. In summary, we believe that estimating male fertility and studying the patterns, mechanisms and solutions of differentials of male and female fertility rates are important. These studies will improve our knowledge about reproductive behavior, population projection, and the process of population and socioeconomic development.

This special session aims to cover various aspects, including but not limited to the following four themes:

1. Data sources related to male fertility, challenges and methods in collecting male fertility data.
2. Estimation methods for male fertility rates and strategies for handling missing data on paternal age.
3. Investigations of the differences between male and female fertility rates and the underlying mechanisms driving these differences.
4. The problem of the discrepancies between female and male fertility rates: Significance and solutions.

I believe that this proposed special session will bring novelty and depth to the conference, providing a platform for discussion, exchange, and collaboration among participants. I look forward to the opportunity to engage with scholars from around the world in exploring this captivating topic at the SMTDA2024 International Conference.

Session II.

Monitoring Structured and Unstructured Data

Session Organizers and Chairs:

Polychronis Economou and Sotirios Bersimis

Presenters* Title and authors:

Visualizing Temporal Dynamics in Time Series Topics: A Convex Hull Approach

G. Papageorgiou, E. Skamnia, S. Bersimis and P. Economou

**Sequential Text Analytics: Enhancing Understanding and Insights from Unstructured
Text Utilizing Large Language Models**

G. Arvanitopoulos, S. Bersimis and P. Economou

Monitoring Multivariate Poisson Processes

E. Skamnia, P.E. Maravelakis, P. Economou and S. Bersimis

Methods for Monitoring Non-Shows in Healthcare

A. Karaminas, P. Economou and S. Bersimis

Session III.

Machine Learning Applications

Session Organizers and Chairs:

Polychronis Economou and Sotirios Bersimis

Presenters* Title and authors:

Machine Learning Applications in Sports Data

C. Spyropoulos, P. Economou and S. Bersimis

Ship Engine Model Selection by Applying Machine Learning Classification Techniques

P. Biris, K. Skarlatos, G. Papageorgiou, E. Skamnia, P. Economou and S. Bersimis

**Generative AI Growing Role in Enhancing Corporate Sustainability Performance and
Addressing Climate Change Risks**

M. Makris, A. Fousteris and S. Bersimis

Methods Comparisons for Fraud Detection in Auto Insurance

C. Michelakis and S. Bersimis

**Exploring the degree of innovation's implementation in restaurants. The case of
Athens**

C. Kalpidis, F. Bersimis, and P. Tsartas

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Session IV.

Business Analytics in Practice

Session Organizers and Chairs:

Polychronis Economou and Sotirios Bersimis

Presenters* Title and authors:

**Collecting insights from the combination of digital twins and machine learning for
Optimizing Indoor Building Environmental Performance**

A. Fousteris, , G. Papageorgiou, V. Lazari, S. Bersimis , S. Karatzas, P. Economou and A.
Chassiakos

The utilization of Data Analytics and Artificial Intelligence: The case of Greece

M. Karvounidi, M. Maniati, A. Fousteris, C. Boudoulis and S. Bersimis

A Data-Driven Approach for Health Budgeting

E. Nika, A. Sachlas and D. Georgakellos

**Using BA Tools to Measure the Environmental Performance of Ports: A Review from
Major Ports Around the World**

A.Alexandropoulou, M.Karvounidi, A.Fousteris, E.Didaskalou and D.Georgakellos

**Reinvent Knowledge Management: Artificial Intelligence and Technological Innovation
in the Digital Economy**

K. Agoraki, A. Fousteris, A. Alexandropoulou and D. Georgakellos

Invited and Contributed Talks

Topological Analysis of Multiple Tables

Rafik Abdesselam

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The paper proposes a topological approach in order to explore several data tables simultaneously. These data tables of quantitative and/or qualitative variables measured on different homogeneous themes, collected from the same individuals. This approach, called Topological Analysis of Multiple Tables (TAMT), is based on the notion of neighborhood graphs in the context of a joint analysis of several data tables. It's allows the simultaneous study of possible links between several thematic tables. The structure of the correlations or associations of the variables in each thematic table is analyzed according to the quantitative, qualitative or mixed variables considered. Like the Multiple Factorial Analysis (MFA), the TAMT allows several tables of variables to be analyzed simultaneously, and to obtain results, in particular graphical representations, which make it possible to study the relationship between individuals, variables and tables of data. These can also be tables of temporal data, collected at different times on the same individuals. The proposed TAMT approach is illustrated using real data associated with several and different homogeneous themes. Its results are compared to those from the MFA method.

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Keywords: Multiple data tables, Proximity Measure, Neighborhood graph, Adjacency matrix, Factorial analysis and clustering.

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Reinventing Knowledge Management: Artificial Intelligence and Technological Innovation in the Digital Economy

Konstantina K. Agoraki, Andreas Fouteris, Alexandra Alexandropoulou, Dimitrios Georgakellos

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Abstract. Technological evolution as well as knowledge revolution have forced firms to re-examine the traditional methods in obtaining a sustainable competitive advantage that enhance firm performance. Knowledge management (KM) and technological innovation are closely related, influencing each other for triggering advances. Innovation requires a blend of knowledge and technology to drive growth, yield positive results and improve market positioning. Knowledge acquisition, knowledge transfer and technology adoption are crucial to

the innovation process. The companies have to be agile enough to adapt to the changes occurring in the environment by deriving benefits from both the explicit and tacit knowledge. Knowledge management includes technologies like cloud storage, collaborative tools and enterprise social networks that are really helping the scope for the spread of knowledge even out of the geographical and departmental limits of an organization. Knowledge management helps to build up and retain intellectual capital through capturing tacit knowledge and convert into explicit knowledge, which is possible to be documented and shared. The knowledge that is accumulated as tacit (i.e., the personal know-how that is often difficult to formalize and communicate) is converted into explicit knowledge that can be documented and shared. This repository of intellectual capital becomes one of the key assets for fostering innovation and maintaining a competitive advantage. The latest of such technological innovations, with Artificial Intelligence (AI) and machine learning-based applications, have even started involving knowledge management itself, with more advanced adaptive learning systems.

Artificial Intelligence has transformed knowledge management in a great range of ways. Recent research shows a shift in technology adoption based not just on need, but on motivations from a digital mindset of changing perception and use of technologies by the organization. Some effective mechanisms used in the field of knowledge management have been identified by Artificial Intelligence. Artificial Intelligence is increasingly becoming a scientific field that assists in competent knowledge-based management systems integration. Artificial Intelligence is notably focused on managing knowledge, which can really be well represented and put into use through technological means. In addition, Artificial Intelligence enhances knowledge management through data analysis to pull out the patterns, trends and relationships that would not be easily identifiable by human observers. This includes among others, the installation of strategies for reasoning and enhanced communication through natural language processing, global networking and machine learning.

Moreover, Artificial Intelligence could help automate the curation of content by categorizing information in respect to relevance and importance. This not only does fasten the process of retrieval of information, but also ensures that most relevant information is made easily accessible to those who may need it. Artificial Intelligence greatly improves the efficiency, accuracy and access of the knowledge management systems and turns big data sets into manageable and actionable insights that can drive organizational success. Furthermore, Artificial Intelligence is also integrated into knowledge management systems for more effective procedures in the decision-making process. Artificial Intelligence provides decision-makers with the ability to build strategies over data-driven insights in a way that minimizes errors and maximizes the output from decisions. The benefits that Artificial Intelligence provides to knowledge management cover a wide range, though it comes with challenges like data privacy concerns as well as the need for first-grade quality data to be used in training an AI-model. These requirements are important along with robust data governance and AI ethics policies.

The aim of this work is to analyse the role of technological innovation and Artificial Intelligence in knowledge management. In the end, knowledge management is not only a supporting function, but rather a strategic asset that may greatly enhance and be enhanced by technological innovation.

Keywords: Knowledge Management, Knowledge Management Processes, Artificial Intelligence, Technological Innovation.

Contribution Heuristic Approaches for Small Geographical Area: An Empirical Political Study

Shafiqah Alawadhi

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University, Safat, Kuwait*

This research proposes approximate approaches that generate alternative non-dominated districting plans for the country of Kuwait. The population survey of the country provides some information regarding the population size, the expected number of voters and their genders, the family size, and educational level per area. This model is approximately solved using an approximate approach that clusters the population with the objective of obtaining a balanced

distribution in terms of population and voting equality, geographical contingency, social, ethnic, family size, and educational homogeneity. Computational results highlight the advantages of the proposed clustering plan in comparison to the exiting one.

Keywords: Optimization, Heuristics, Approximate approach.

Using BA Tools to Measure the Environmental Performance of Ports: A Review from Major Ports Around the World

Alexandra Alexandropoulou, Maria Karvounidi, Andreas Fousteris, Eleni Didaskalou, and Dimitrios Georgakellos

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Abstract. With the ever-increasing global maritime trade, ports have become important hubs of development and drivers of economic growth in local, regional, and interregional scale. These nodes of transport and their accompanying nexus are usually responsible for the prosperity of their communities both in economic and social terms. However, their environmental footprint is often being debated, raising concerns among local communities about their potential negative impact. Therefore, port authorities develop strategies to shift port activities towards sustainability and environmental protection. Aiming to increase their environmental performance, ports need to develop new insights and understanding on their environmental impact. This research explores how major ports around the world are using Business Analytics (BA) to measure their environmental performance as best practices in the framework of blue economy.

Keywords: Ports, Environmental performance, Business Analytics, Environmental Performance Tools.

Acknowledgement: This work has been partly supported by the University of Piraeus Research Centre.

Linear and Nonlinear Dependencies in Statistical Tests Suites

Elena Almaraz Luengo

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One of the current lines of research related to statistical test batteries is their design and implementation. Regarding their design, it is essential that they contain hypothesis tests capable of detecting properties of the sequences generated by PRNGs or TRNGs such as independence or uniformity and that they do so in an "acceptable" computational time. Therefore, it is not desirable that the tests measure features from the same perspective, as this would increase the execution time of the battery and could also lead to conclusions about the generators that are not entirely correct, e.g. if a generator fails in two overlapping tests, it would not be failing in two desirable features, but in the same one. This is why it is necessary that the tests that make up a battery are not interrelated, that they do not have dependencies. In this paper the problem of testing linear and non-linear dependencies between hypothesis tests will be addressed and case studies will be presented.

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Keywords: Hypothesis tests, Statistical test suite, Tests battery, Correlation, Mutual information.

Modelling/Forecasting Patient Recruitment in Multicentre Trials using Time-dependent Models

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Clinical trials in the modern era are characterized by their complexity and high costs. Patient recruitment is one of the main engines driving the operation of clinical trials. However, the imperative to enroll vast numbers of patients across multiple clinical centers has become a major challenge. A classic Poisson-gamma (PG) recruitment model [1,2] assumes time-homogeneous recruitment rates. However, it can be potential time-trends in the recruitment driven by various factors, e.g. seasonal changes, exhaustion of patients on particular treatments in some centres, etc. Recently a few authors considered some extensions of the PG model to time-dependent rates under some particular assumptions. In this presentation, a natural generalization of the original PG model to a non-homogeneous PG model with time-dependent rates is introduced. Some tests on homogeneity of the rates (non-parametric test using a Poisson model and parametric one using a PG model) are considered. The techniques for modeling, simulation and forecasting of the recruitment over time with mean and predictive bounds using time-dependent rates are discussed. The techniques for estimating parameters at interim time using a traditional maximum likelihood technique and also a new country-site pure Bayesian PG model are proposed. To create a re-projection of the remaining recruitment for non-homogeneous PG model it is proposed a novel analytic technique using a moving window and Bayesian re-estimation of the parameters at every interim time, PG approximation of the recruitment processes in country/globally, and also using extrapolated time-dependent rates in the future interval. The results are supported by simulation of different scenarios.

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1. V. Anisimov and V. Fedorov. Modelling, prediction and adaptive adjustment of recruitment in multicentre trials, *Statistics in Medicine*, 26, 4958–4975, 2007.

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Keywords: Multicentre clinical trial, Poisson-gamma recruitment model, Time-dependence, modelling, Forecasting.

A Neoclassical Growth Model for Quantum Computing, Growth, and Innovation

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Quantum computers have been prophesised as instruments for the attainment of further scientific achievements. For example, applications of quantum computing include the development of space exploration, advance pharmaceutical research, and tackle complex environmental issues. We posit that technology and scientific innovation contributes to sustained economic growth and, since quantum computers are cutting-edge technology, they

contribute to the productive capacity of an economy. The present study structures quantum computing in the context of a neoclassical growth model and uses a growth accounting exercise to measure the role of computing capacity in total factor productivity. Moreover, using a system GMM for dynamic panel methodology we aim to capture the role of high-computing capacity on research and development and economic growth. Building on a novel dataset ranging from 1993-2023, the data aspire to provide us with findings aimed at shedding useful light into an area with vast opportunities in artificial intelligence and cybernetic prioritisation.

Keywords: Quantum computing, Economic growth, Innovation.

Sequential Text Analytics: Enhancing Understanding and Insights from Unstructured Text Utilizing Large Language Models

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Abstract. This work introduces a document sequence monitoring technique based on sequential text similarity tailored for unstructured text data. The proposed methodology incorporates several key state-of-the-art steps, including pre-processing unstructured text data, text vectorization, application of semantic similarity measures, and utilization of data-driven thresholds. The method aims to analyze and uncover hidden patterns within sequential data by employing these techniques. The proposed approach can be used in various domains, such as healthcare, online booking systems, or topic modeling. In the healthcare domain, it can detect, for example, potential transitions in a patient's health status while in the context of customer experience on accommodation booking platforms, the method can distinguish genuine customer reviews from potentially biased or fake ones, enhancing the reliability of information for future bookings. Regarding the topic modeling domain, the technique can be applied, for example, to academic research, tracking changes in a researcher's area of focus and identifying trends within a university, thereby providing valuable insights into evolving research directions and concurrent trends in specific domains. This proposed method holds promise for comprehensive and effective analysis of sequential text data in diverse applications.

Keywords: LLMs, Artificial Intelligence, Natural Language Processing, NLP, AI, Text Analytics.

Forecasting the Next Mega Cycle of the Economy

George S. Atsalakis and Ioanna Atsalaki

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The year 2024 is the most important year of this century. It is the beginning of new changes that will shock the world. Never before has the world seen such rapid pace of change. In 2024, the next economic megacycle of the economy begins. During the stagnation that will follow in the next 28 years, 2024-2052, humanity will discover and apply new technologies that, when widely disseminated in every business and every household, will lead to the new mega cycle of economic growth of the years 2052-2080. New technologies such as artificial intelligence, 3D printing, new materials technologies, biotechnology, quantum computing, etc., will transform economies and societies in the coming decades. Some of these new technologies will enable the widespread deployment and integration into the global production infrastructure of the cheap, clean and inexhaustible fuel for nuclear fusion that will emerge in the 2040s. which in turn surpassed oil which had been the dominant cheap source in the 1940-1968 upward cycle and which had surpassed cheap coal in 1884-1912. New technologies will increase productivity. The innovations so far have mainly increased our muscle strength. New innovations in artificial intelligence will massively increase intellectual capabilities and boost productivity. With cheap energy and productivity growth, there will be growth in states and decent survival of households and businesses until the end of the next economic cycle in 2080.

Flexible Modeling of LTRC Data with Covariates

N. Balakrishnan

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Fellow of the Royal Society of Canada
Fellow of the American Statistical Association
Fellow of the Institute of Mathematical Statistics*

Abstract: In this talk, I will first provide an introduction to left-truncated right-censored (LTRC) data containing covariates. I will motivate the problem with some real-life datasets. I will then describe a general method of inference by using piecewise linear approximation to the baseline hazard function and explain how this method would facilitate the development of a general method of inference for LTRC data with covariates. I will then present some Monte Carlo simulation results to demonstrate the effectiveness and accuracy of the proposed inferential method. Next, I will analyze the real-life dataset with the method and explain the obtained results. Finally, I will conclude the talk with some brief remarks and some possible directions for future research.

A New Method for Monitoring Multivariate Data Streams

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Abstract. Statistical process monitoring is of vital importance in various fields such as biosurveillance, data streams, etc. This work presents a non-parametric monitoring process aimed at detecting changes in multidimensional data streams. The non-parametric monitoring process is based on the use of convex hulls for constructing appropriate control charts. Results from applying the proposed method are presented and the competitive advantages against other competitors are highlighted.

Keywords: Statistical process monitoring, data streams, convex hull.

Asymmetric Kernel Estimation of the Regression Function

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This work focuses on nonparametric regression modeling of time series. The asymmetric kernel estimator we propose here is constructed to reduce the estimation error near zero for which we study strong uniform convergence with a rate. Simulation studies are carried out to compare the performance of our estimator against the symmetric kernel.

Keywords: Asymmetric Kernel; Regression function; Relative error regression; Strong uniform consistency rate.

Ship Engine Model Selection by Applying Machine Learning Classification Techniques

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Abstract. The maritime industry is dealing with a small but steady increase in data, often accompanied by incomplete data, missing and duplicate records, incomplete entries caused by human error or a lack of access to critical and sensitive collaborative information. Data constraints and limitations play a critical role in ineffective data-driven decision-making, which in turn causes lower productivity, higher operating costs, and a significant loss of competitive advantage. Important information, including the main engine model of the vessel, is either incompletely or not presented in a way that is sufficient to affect the vessel's capabilities, operating expenses, and environmental impact. The present study used a comprehensive approach to classifying a ship's main engine model by comparing and utilizing multiple machine learning classification approaches, as well as various imputation strategies to handle missing data and dimensionality reduction techniques. The vessel's technical and operational attributes, such as its size, different capacities, speeds, and consumptions, are taken into account in classification procedure. Three dimensionality reduction methods (Principal Component Analysis, Uniform Manifold Approximation and Projection, and t-Distributed Stochastic Neighbor Embedding) were used and combined with a variety of classifiers and the appropriate parameters of the dimensionality reduction techniques. According to the classification results, the ExtraTreeClassifier with PCA with 4 components, the ExtraTreeClassifier with t-SNE with perplexity equal to 10 and 3 components, and the same classifier with UMAP with 10 neighbors and 3 components outperformed the rest of the combinations. This classification could offer essential insights for shipowners to improve the vessel's performance through optimization.

Keywords: machine learning in shipping, dimensionality reduction, supervised learning, model comparison and selection, ship engine classification.

Ekaterina Bulinskaya

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Finite Sample Properties of the BLUE of the 3 parameter Log-Logistic Distribution

Frederico Caeiro¹ and Ayana Mateus

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The Log-Logistic distribution is widely used in survival analysis, reliability engineering, and other fields due to its flexibility in modeling various shapes. In this work, we study the finite sample properties of the Best Linear Unbiased Estimator (BLUE) for the location and scale parameters of the three-parameter Log-Logistic distribution, providing insights into its accuracy, precision, and robustness. The research employs Monte Carlo simulations to evaluate the finite sample behavior of the estimators. Through a systematic analysis of various sample sizes and parameter configurations, this work aims to identify the conditions under which the BLUE estimator excels or encounters challenges.

Keywords: Log-logistic distribution, BLUE, Monte Carlo simulation.

Minimizing the Ruin Probability of an Insurance Company

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⁴Math and Stats Department, McMaster University, Hamilton, Canada

We explore a portfolio problem faced by an insurance company which issues an annuity, collects fees/premiums for this as a lump-sum, and invests in a financial market. The company must choose the investment strategy (portfolio) which minimizes the probability of being unable

to pay the annuity before it stops operating, and this occurs when portfolio value adjusted for annuity becomes negative. The novelty of our work is that mortality intensity is stochastic. This problem is solved via dynamic programming and the dependence of the optimal investment/probability of default on model parameters is emphasized.

Modeling Cargo Clearance Duration at Kenyan Borders using Multilevel Survival Models

Liberato Camilleri¹ and David Kemboi¹

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Nested data is often encountered in survival applications, for instance when analyzing the time to suffer a first heart attack for individuals who are nested within families and who are treated by the same doctor or the time to master a literacy skill for children nested in classrooms which are nested within schools. Indeed, multilevel survival models are the appropriate models to analyze durations that have a nested structure. This paper makes use of multilevel survival models to analyze cargo clearance durations at Kenyan borders. In the application, the dependent variable is the duration to release cargo, which is the time taken to release of the cargo since arrival. The explanatory variables include cargo weight, continent of cargo destination, cargo clearance year and customs regime, which is the regime that differentiates several types of cargo, including bonded warehousing cargo, export cargo, temporary importation cargo and transit regime. The multilevel survival models presented in this paper make use of the Cox proportional hazard model framework, which includes random effects in the models to denote the increase or decrease in hazard for distinct clusters. The theoretical framework of the two-level random coefficient models are discussed from a frequentist perspective. The Exponential and the Weibull distributions are the two choices for the baseline hazard function. Moreover, the categorical variable 'Worth of Cargo' will be used as a nesting structure for the Kenyan cargo data, where individual cargoes (level-1 units) are clustered by their worth (level-2 units). All fitted multilevel models include a random intercept and a random slope for the cargo weight.

Keywords: Shared and unshared frailty survival models, Gamma frailty, Cargo release duration.

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Comparison of Approximate Markov Generators in a One-Jump Setting

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The problem of Markov embedding involves verifying whether a given stochastic matrix P can serve as a one-step transition matrix of a Markov chain. This is done by checking if P is the exponential of a generator matrix Q , with non-negative off-diagonal elements and zero row sums. However, it is known that a generator matrix may not be unique or may not exist.

Here, we focus on finding the approximate generator matrix under the additional assumption that the process jumps at most once during time intervals of a unit length. We determine an expression for the conditional one-step probability given at most one jump and investigate if this matrix is the same as the given transition matrix P . In this setting, we prove that for all transition matrices P with non-zero diagonal entries, the so-obtained generator matrix $QJ1$ is unique. We also compare our $QJ1$ with the Markov generator $QJLT$ of Jarrow, Lando, and Turnbull (1997) in their interpretation of the single jump frequency context. To this end, we study different measures of similarity between the given transition matrix P and the exponentials of $QJ1$ and $QJLT$, such as f -divergences and norms, as well as various mobility indices. We find that, in a vast number of cases, $\exp(QJ1)$ provides a closer approximation to P than $\exp(QJLT)$.

Keywords: Markov chain; Embedding problem; transition matrix; f-divergence; mobility index.

Tree-Based Learners for Motor Insurance Fraud Detection

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In this paper we investigate motor insurance fraud detection by implementing and comparing tree-based methods renowned for their performance and interpretability. We focus on tree-based ensemble methods, including random forests, gradient boosting machines, LightGBM, XGBoost, and CatBoost. A significant challenge in motor insurance fraud detection is addressing class imbalance. To tackle this issue, we consider cost-sensitive learning approaches and resampling techniques to optimize model performance. The comprehensive analysis concludes that LightGBM is the most effective method, achieving a balanced accuracy of 81% and successfully identifying 83% of fraudulent cases. The findings of this study provide valuable insights into the effectiveness of tree-based methods in detecting motor insurance fraud. By presenting a rigorous comparison of different techniques and addressing the class imbalance issue, this research contributes to the ongoing development of robust and interpretable solutions for combating insurance fraud.

Keywords: Motor Insurance fraud, Random forests, Gradient boosting, Class imbalance.

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Modeling Functioning as a Determinant of Wellbeing: A Mediation Analysis

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The purpose of this paper is to explore the relation of functioning as a determinant of wellbeing to social trust, satisfaction with life and feelings of safety. Furthermore, it investigates the mediating role of feelings of safety walking alone in the local area after dark in the relationship between social trust, satisfaction with life and functioning. The analysis was based on the 2012 European Social Survey datasets for France, Poland, Spain and Sweden. The models of the separate path analyses provided acceptable model fit for France, Spain and Sweden and adequate model fit for Poland. In all countries, functioning was positively predicted by feelings of safety and satisfaction with life demonstrating strong direct effects with the latter. Feelings of safety were positively affected by the two items of social trust and satisfaction with life. The findings showed weak mediation effects of social trust and satisfaction with life by feelings of safety. However, strong total effect of satisfaction with life on functioning was observed in all countries. The resulting low percentages of the total variation explained by the models with feelings of safety and functioning as the mediating and dependent variables, respectively, indicate that further research is necessary.

Keywords: Path analysis, Mediation, Wellbeing, Safety, European Social Survey.

A Novel Tensor Factorization-based Missing Data Analysis Technique

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This study proposes a novel approach to handling missing data in quality-of-life questionnaires. The proposed tensor-based technique imputes missing data by adding an extra dimension to the tensor representation of a dataset with missing values by converting all decimal numbers to binary. The seven different methods, including four tensor-based methods, are evaluated using a dataset comprising the responses of 43 patients to a rhinoconjunctivitis quality-of-life questionnaire. The canonical polyadic (CP) tensor decomposition-based method with decimal-to-binary conversion outperformed all other methods and improved on other existing techniques. The study results also demonstrated the strength of binary conversion in the missing value imputation and other prediction applications.

Keywords: Missing data analysis, Quality-of-life questionnaires, Tensor factorization, Canonical polyadic (CP) tensor decomposition, Decimal-to-binary conversion.

Internal Migration and Urbanization: Shaping Faridabad City

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Faridabad city situated in the northern Indian state of Haryana, has undergone extensive urbanization and internal migration as a result of industrial development, its proximity to Delhi, and the government's investment in infrastructure. This internal migration has led to the city's urbanisation, with a rapid increase in population and the expansion of urban areas. Urbanisation in Faridabad has been accompanied by the development of residential areas, commercial zones, and improved transportation networks. About 98.2 % of the total urban population of the district is concentrated in Faridabad Municipal Corporation which is the only million plus city in the State. However, this rapid urbanization has led to challenges such as traffic congestion, insufficient housing, and environmental issues. After 1990, Faridabad became a manufacturing hub, significantly contributing to Haryana's state revenue. The city's inclusion in the Smart Cities Mission in 2016 aims to improve its infrastructure and services, but it requires an inclusive approach to optimize the potential of smart management. Despite these challenges, the growth trajectory of Faridabad emphasizes the need for effective urban planning and sustainable development.

The study presents a current scenario of internal migration and urbanisation that is ongoing in Faridabad city. Study is based on the secondary source of data collected from the census of India.

Keywords: Urbanization, Migration, Tend, Development.

Crosscultural Issues in Psychological Assessment. A Multistrategy Approach

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The issue of culturally and ethnically unbiased psychological tests has been widely faced in the areas of abilities and attitudes, less so in the context of some other areas frequently relying on self-report symptom measures to assess and monitor symptom change. A very convenient situation would consist of relying on scales for which the measurement properties are consistent across groups, namely for cross-cultural bias. Measurement invariance and differential item

bias are critical evidence to this aim, when comparing levels of functioning across people of different demographic characteristics and of culturally divergent groups (Poortinga, 1989). Various approaches to comparability in cross-cultural studies have been developed, a privileged psychometric approach consisting of assessing factors equivalence across several groups (Asparouhov, & Muthén, 2014). Most often, such a single strategy is adopted, satisfactorily addressing some contexts but sometimes leaving a few issues still unanswered. A multistrategy approach has been suggested, where the potential flaws of a single technique may be amended by additional methods, e.g. multidimensional scaling (Hui, & Triandis, 1985). In our study, we focused on suicide risk among youth, suicide being the fourth leading cause of death at this age, with a prevalence that varies widely worldwide. In particular, we collected data upon 1665 Italian university students (Magliocca et al., 2023) and 402 Indian ones. Applying a multistrategy statistical approach, we compared them with respect to suicidal ideation, psychological/psychiatric measures, somatic pain measures, as well as social measures.

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Keywords: Cross-cultural, Item bias, Intergroup significant difference.

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A family of random graph evolution models with moderate density

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In this paper, we shall study a discrete time network evolution model. The evolution of the graph is based on constructions and deletions of k -cliques, where k is a fixed integer being larger than 1. A k -clique is a sub-graph containing k vertices and any two different vertices are connected by 1 edge. In each evolution step of the network, we choose k vertices uniformly at random from the existing vertices. If they do not form a k -clique, then we construct a new k -clique on these vertices. In the other case, when the sub-graph consisting of the k vertices chosen is a k -clique, then the edges of that k -clique are deleted but its vertices are not deleted. A new vertex is added to the graph and two new k -cliques are created. We prove asymptotic theorems for the number of vertices and for the degree of a fixed vertex. Our results are extensions of the theorems of [1]. **Keywords:** Network evolution, asymptotic theorems **References**

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Further Demographic Shrinking or Fluctuating Age Structures

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Optimal control theory can be used to establish a firm fundament of population policy. Taking countermeasures against further shrinking of populations leads to fluctuating age compositions of concerned populations. In the present contribution it is shown how several populations would develop along an efficient transition to a stationary target at the end of a given planning period. Assuming concentrated vitality rates and fertility as unique instrument, the optimal trade-off between further depopulation and irregular age structures can be calculated in an analytic manner. Additional numerical calculations for more realistic mortality projections deliver interesting insights into 'what -if' paths for declining populations.

Keywords: Population dynamics, Ageing, Optimal control.

On a New Family of Robust Estimators for the Parameters of the Log-logistic Distribution

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We present a new family of estimators for the parameters of the log-logistic distribution based on density power divergences. The log-logistic is a well-known distribution modelling lifetime data which is commonly adopted in survival analysis and reliability engineering studies when the hazard rate is initially increasing but then it decreases after some point. It is also applied in Economics, where it is named as Fisk distribution. This distribution depends on two parameters, one measuring the scale and another one measuring the shape. In this paper we apply density power divergence divergences to estimate these parameters. The goal is to obtain a family of robust estimators and, in this sense, density power divergence seems an interesting choice, that provides efficient estimators that are at the same time robust. This family of divergences depends on a tuning parameter that controls the trade-off between efficiency and robustness. Besides, it contains as a special case the classical maximum likelihood estimator. We derive the expression of these new estimators. Besides, we obtain their asymptotic distribution in three different situations, namely the case for each parameter separately and for the joint pair. Finally, the corresponding influence function of the MDPDE is obtained, and its boundlessness is proved, thus leading to robust estimators.

A simulation study is carried out to illustrate that it is possible to find values of the tuning parameter leading to a slight loss in efficiency with respect to MLE and, at the same time, present a considerable gain in robustness.

Keywords: Log-logistic distribution, Minimum density power divergence estimator, Robustness.

Assessing Asymptotic Tail Independence: A Simulation Study

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The occurrence of extreme values in one variable can trigger the same in other variables, making it necessary to assess the risk of contagion. Usual dependence measures based on the central part of the data typically fail to assess extreme dependence. Within the scope of EVT, tail dependence measures were developed, such as the Ledford and Tawn coefficient that we discuss here. This is a measure of residual dependence that is particularly important when it comes to analyzing at the tail level where data is scarce. We will consider different estimation methodologies and compare them based on a simulation study. We finish with an application to real data.

Keywords: Extreme value theory; Coefficient of asymptotic tail independence.

Implications of the Proposal to raise the Retirement Age in the Czech Republic since 2030

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The continuing ageing of the population brings, among other things, ever higher costs for financing old-age pensions. Pension reforms are therefore underway or in the pipeline in a number of European countries. The Czech Republic is no exception. The current pension reform proposal includes, among other things, a continuation of the increase in the retirement age after 2030, when the retirement age will reach 65 years and should not be further increased under current legislation. The proposal foresees that for persons born after 1965, the retirement age will be raised above 65 by the difference between the life expectancy at the age of 50 of that generation and the life expectancy at the age of 50 of the generation born in 1965. The life expectancy values will be determined on the basis of the period life tables for the year in which the generation concerned reaches age 50. The difference between the retirement ages of two adjacent birth years may not be more than 2 months; in the event of a decrease in life expectancy, the retirement age will not be reduced but will remain at the value for the previous birth year. The article presents an analysis of the development of the retirement age when the proposal is approved and a comparison with the previous proposal, where seniors would spend roughly the final quarter of their lives in retirement, as well as with the proposal for a so-called equitable normal pension age. It also shows the evolution of expected time of old-age pension receipt (based on cohort life tables) and the adjusted OADR values (using as the upper threshold of productive age the actual value of retirement age, not the usual value of 65 years) under different scenarios of future development not only for mortality but also for fertility and migration.

Keywords: Retirement age, Pension reform, Adjusted OADR, Czechia.

Control Charts for Data Sets with an Excessive Number of Zeros

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Data sets that contain an excessive number of zeros, structural zeros when the measurement is actual zero and/or zeros due to measurement noise or other factors, appear in several fields of applications. For instance: health services visits data made by patients in a year; insurance claims data, where many claims are zero (no claims) and the positive claims follow a skewed distribution; in medical studies, where data often exhibit a combination of zero values (no disease occurrence) and positive measurements; in chromatography applications when evaluating compound concentrations (e.g. pesticide residues in food or water samples). The traditional control charts used for monitoring processes over time, i.e. to detect deviations from the expected behavior, are not appropriate for dealing with data sets with an excessive number of zeros. In this paper we propose some control charts for monitoring such type of data.

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Keywords: Control charts, Statistical quality control, Zero-inflated data, Hurdle models.

Introducing an Ontology of Adolescents' Digital Leisure

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An ontology is a formal description of a set of concepts and relations in a given area or domain that describes the categories objects and their inter-relations. The current paper presents an ontology that was constructed to set out the basic concepts, features, characteristics, and processes that concern the online leisure time of adolescents. The ontology, as well as the respective annotation tool offer users the ability to organize and analyse data in a well-structured and systematic manner, while simultaneously allowing concept and relational analysis to draw complex conclusions and make inferences. The terminology of the ontology has been first extracted in a semi-supervised way from a large number of scientific papers, with the aid of machine learning methodologies and a specific tool implemented for this aim, and then curated by social researchers that are experts in the field. The final ontology was developed with the use of Protégé, an open-source ontology editor. Examples of diverse data analysis using the proposed tool and the respective ontology are provided.

Keywords: Ontology, Ontology learning, Machine learning, Adolescents' digital leisure, Open-source, Crowdsourcing platform.

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Collecting insights from the combination of digital twins and machine learning for Optimizing Indoor Building Environmental Performance

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Abstract. Recent advancements in distributed sensing, pervasive computing, context-awareness, machine learning, and Digital Twins (DTs) have substantially improved the built environment's ability to address future challenges more effectively while enhancing comfort and well-being in buildings. This work introduces a novel method that circumvents the extensive effort typically required for a systematic and comprehensive review aimed at untangling complex interactions across various subtopics. Instead, it presents a framework that employs Artificial Intelligence and Machine Learning (AI/ML) to extract meaningful insights from existing research. By building on the high-level architecture of Digital Twins, this study uses a clustering approach to investigate key elements such as Indoor Environmental Quality, Energy Efficiency, and Occupant Comfort—essential components influencing indoor building performance. This innovative method aims to deepen our understanding of the interrelations among these critical aspects by leveraging AI/ML techniques and the strategic framework of Digital Twin architecture.

Keywords: Indoor Environmental Quality, comfort, Digital Twins, Artificial Intelligence, Machine Learning, Building Environmental Performance

Blackjack and the Kelly bet: A Simulation Assessment of Selected Playing Strategies

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In the paper we explore the efficacy of rival strategies / bet size options for playing blackjack using Monte Carlo simulation. Strategies selected for the modelling are 'Blind gambler', 'Never bust' and 'Imitating the dealer'. Corresponding bet size choices include the Kelly bet and a number of non-Kelly alternatives. Resultant analysis yields a wealth of insights – not least the potentially perilous nature of adopting a 'pure' Kelly approach to playing the game.

Keywords: Blackjack, Kelly criterion, Monte Carlo simulation.

Implementation of Two-way Factorial Analysis for Categorical Characteristics of Material or Object

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Legitimate operations between categorical nominal (qualitative) characteristics of an object or a material are "equal/unequal" and for ordinal (semi-quantitative) characteristics also "less than/greater than". Therefore, the methods developed for quantitative (continuous) variables cannot be applied straightforwardly. Here we focus on two-way factorial analysis for responses of experts of *different* laboratories (one factor) participating in an interlaboratory comparison as well as *another* factor (for example: technician experience), classifying a material or an object according to its categorical characteristics. To answer, 'if a consensus (test of homogeneity) of participating laboratories achieved or not?' an alternative method for two-way ANOVA (analysis of variance) should be implemented. The recently developed two-way CATANOVA method for nominal variables and two-way ORDANOVA method for ordinal variables are used. The proposed approaches, included a detailed decomposition of the total variation, testing hypotheses about homogeneity of the between-laboratory and within-laboratory variation components, and consider possible interaction between the two independent factors. The consensus power is taken to be the power of the homogeneity test. Examples of operation of the proposed methods for categorical variables are from the fields of macroscopic examination of weld imperfections, comparison of odor intensity of drinking water, and comparison of sensory (ordinal) characteristics of a sausage. The developed tool, based on Monte Carlo simulations is an Excel spreadsheet with macros, will be presented.

Keywords: Nominal characteristics, Ordinal characteristics, Material, Object, CATANOVA, ORDANOVA, Homogeneity test, Power.

The Efficient Determination Criterion for Partition Markov Model Estimation

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In this research, we delve into the Efficient Determination Criterion (EDC) introduced by Zhao et al. (2001) [1], aiming to estimate the partition of a Markov chain, a notion introduced by García and González-López (2017) [3]. Our investigation uncovers a metric closely linked to the EDC criterion, offering applicability for obtaining the partition by implementing clustering algorithms. Noteworthy is the fact that the EDC criterion extends the Bayesian Information Criterion (BIC) (presented in Schwarz (1978) [2]). Distinguishing itself from the BIC, the EDC criterion substitutes the penalty term $\{\ln(n)\}$ with $\{c(n)\}$. This paper further explores the EDC criterion, using a penalization term of order $\ln(\ln(n))$. Our findings reveal that using this specification, the EDC yields a consistent estimation of the partition of a Markov chain. To illustrate the practical implications of our exploration, we apply these concepts to model DNA genetic sequences in Fasta format. This study contributes to a nuanced understanding of the EDC criterion, broadening its potential applications and enhancing its effectiveness in partition estimation for Markov chains.

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Keywords: Markov Processes; Model Selection; Consistent Estimation

A bi-level DEA Model for Targeting Setting in a Stochastic Environment with Potential Applications in Banking and Healthcare

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In the domain of large enterprises and organizations, the efficient allocation of resources and the establishment of targets emerge as pivotal factors with substantial implications for operational efficacy. The changing business landscape, coupled with uncertain data, underscores the need for agile strategies to maximize profits and augment organizational efficiency. This study presents an innovative approach to confront these challenges, employing a Bilevel Data Envelopment Analysis (DEA) framework tailored for resource allocation and target setting under a stochastic environment. The proposed model there exist central decision-making units who oversee subordinate decision-making units (DMUs) and the model integrates a stochastic framework, enabling the adjustment of uncertain parameters by incorporating scenarios accompanied by occurrence probabilities. The model uses an upper-level problem concentrating on the maximization of organizational profitability, alongside a lower-level problem dedicated to optimizing the efficiency of DMUs. It also includes input and output bounds, as well as lower bounds on DMUs' efficiencies thus facilitating actions in response of uncertainty conditions contributing to a more flexible and effective overall strategy. Potential applications discussed in the presentation include the banking and/or healthcare sectors.

The research work was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the "First Call for H.F.R.I. Research Projects to support Faculty members and Researchers and the procurement of high-cost research equipment grant" (Project Number: 3154).

Keywords: Data Envelopment Analysis, Bi-level, Resource allocation, Stochastic environment, Banking, Healthcare.

Textual Data Analysis Applied On A New Context: Deaf People French Literacy

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We present a data analysis concerning the syntax of deaf scripters in texts written in French. This analysis is a first because the corpus called Alpha collected in secondary schools from 2019 from 66 deaf adolescents is the only one of its kind. An expert collaborative annotation grid has been invented to collect the scripters errors. We also have numerous metadata. We enriched the initial annotations with new syntactic expert linguistics variables. We then used automatic data analysis and classification methods to build a typology of the scripters grouped according to their own syntactic characteristics, including errors. The analysis revealed four profiles characterised by different syntactic errors in the POS, or significantly over-represented or absent subordinates, presence of unusual connectors or significant presence of parataxis ; the syntax may be significantly marked as deriving from LSF (French Sign Language) syntax etc. By studying the statistically significant links between the four resulting linguistics profiles and the metadata, we observe the central role of the scripters linguistics environment and the language used in the first exchanges between mother and child. Through a data driven approach we discovered that, contrary to common opinion on the subject, deaf people are not uniform in terms of their relationship with the French written language. In fact, we have identified four clearly discriminated classes.

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Keywords: Classification, Data Driven Approach, Deaf People, French Syntax.

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Linear Inverse Modeling of Metabolic Systems: Deterministic Optimisation Versus Markov Chain Monte Carlo

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Gathered under the name of metabolic networks, trophic, biochemical, and urban networks are here handled as a single field. In the Linear Inverse Modeling framework, these highly complex objects of research are all mathematically represented by weighted oriented graphs whose vertices are compartments and edges the flows of matter or energy. All the flows that satisfy realistic constraints belong to very anisotropic high dimensional polytopes that cannot be analytically determined. On the one hand, we determine a unique solution in the polytope by solving a convex optimization problem according to ecological network indices and information theory to be used as convex goal functions. Numerical results show that the method is fast and can be used for large systems. On the other hand, sampling the polytope yields a set of possible scenarios for the metabolic network. Comparing different Monte Carlo Markov Chain algorithms together with their most recent implementations led us to design an updated R package called {samplelim}. Compared to existing packages through statistical tests and indices, it proves to be reliable, efficient, and much faster. The mathematical and IT results on the underlying graphs and polytopes are enriched by the application to real data from the offshore wind farms of the Seine Bay.

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Queuing Models in which Service Patterns are conditioned by Arrival Outcomes – A Practical Application

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A real life example of a single server queuing system with an nonhomogeneous arrival rate and hypoexponential service time distribution is presented. Data from the application were analysed using an adapted form of the M(t)/M(h)/1 model with non-preemptive priority and FIFO discipline. In addition a Monte Carlo simulation of the data was undertaken. Results from these alternative approaches are contrasted and in the case of the simulation, the effects of introducing an additional server into the target operation, assessed.

Keywords: Hypoexponential distribution, Simulation, State-dependent Arrivals, Queuing theory.

Further Results on the Location Invariant Estimation of the Weibull Tail Coefficient

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Among the large variety of parameters of extreme events, we shall here emphasize the *Weibull tail-coefficient* (WTC), which can be defined as the index of regular variation of a regularly varying hazard function, $H(x) = -\ln(1 - F(x))$. The WTC is thus deeply linked to a positive extreme value index (EVI), the index of regular variation of $F(x) = 1 - F(x)$, and several estimators of a positive EVI, based on generalized means, which are generalizations of the classical Hill EVI-estimators in Hill [5], have recently been used for the WTC-estimation (Caeiro et al.[1],[2], Henriques-Rodrigues et al.[4]). Contrarily to the EVI and the WTC, most of those estimators are not location invariant. In this article, and in the lines of Gomes et al.[3], location-invariant WTC-estimators are considered. Those estimators are dependent on an extra tuning parameter, and are highly flexible. Adequate choices of the tuning parameters under play are here put forward, together with applications.

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Keywords: Extreme value theory, Peaks over random thresholds, Semi-parametric estimation, Weibull tail coefficient.

Resampling Methods in Extreme Value Estimation Procedures

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The catastrophes we have been witnessing lately, whether natural or financial, show that it is essential to take extreme events into account.} As the available data to base the estimates on is very sparse this calls for tailored estimation methods. When modelling extreme events there are a few primordial parameters among which we refer to the *extreme value index* (EVI), denoted, and the *extremal index* (EI), denoted by θ .

The EVI by ξ , measures the right tail-weight of the underlying distribution, and the EI characterizes the degree of local dependence in the extremes of a stationary sequence. Most of the semi-parametric estimators of these parameters present the well known type of behaviour: nice asymptotic properties but a high variance for small k , the number of upper order statistics used in the estimation, and an increasing bias with k . Some challenges have been developed by Extreme Value Theory (EVT) to obtain more reliable extreme value parameter estimates. Resampling procedures such as the jackknife have been used to improve parameters estimation in EVT. The objective of the talk is to review the use the jackknife and an algorithm for choosing k . An application to real data is presented.

Keywords: Extreme Value Theory; Extreme Value Estimation; Extreme Index; Extreme Value Index; Resampling Methods.

What can we learn from Malta?

An Exploration of Gender Disparities in Education, Work and Money in Europe

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This research delves into the dynamic evolution of gender disparities in different European countries over time, focusing on indicators in the fields of education, work and money. Using a temporal trajectory approach, transforming gender gaps were explored, shedding light on the path towards greater gender equality across the European Union. Furthermore, with the use of clustering, countries were grouped based on their dynamic path, obtaining groups of states with similar trends both in terms of position and evolution. Over the last 10 years there has been significant progress towards greater gender equality in Europe, but there are still significant challenges and inequalities to address.

Keywords: Gender disparities, Trajectories, Education, Work.

Organized Session:

A Statistical Learning Model for the Prediction of the EURO 2024 Tournament

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Conventional approaches that analyze and predict the results of international matches in football are mostly based on the framework of Generalized Linear Models. The most frequently used type of regression models in the literature is the Poisson model. It has been shown that the predictive performance of such models can be improved by combining them with different regularization methods such as penalization (see, e.g., Groll and Abedieh, 2013; Groll et al., 2015). More recently, also methods from the machine learning field such as boosting (Groll et al., 2018) and random forests (Groll et al., 2019) turned out to be very powerful in the prediction football match outcomes. Here, we propose our current modeling approach, which based upon our previous research is deemed to be most promising with regard to prediction performance. The model is fitted to match data from previous UEFA European Championships (EUROs) and based on the corresponding estimates all match outcomes of the EURO 2024 are repeatedly simulated (100,000 times), resulting in winning probabilities for all participating national teams.

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Keywords: Football, UEFA European Championships, Forecasting, Machine Learning.

Embedding Conditions for Specific Subsets of Markov Transition Matrices

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The initial formulation of the *continuous embedding problem* by Elfving in 1937 concerns the question of whether for a discrete-time Markov chain there exists a compatible continuous-time Markov process, i.e., whether for a stochastic matrix P there exists an intensity matrix R that satisfies $P = e^{R}$. If P is the estimated transition matrix based on available data on unit time intervals, stochastic matrix roots A of P contribute to insights into the transition probabilities on shorter time intervals. The *discrete embedding problem* addresses the question of whether for a stochastic matrix P there exists a stochastic matrix A that satisfies $P = A^n$ for $n \in \{2,3,\dots\}$. For both cases, continuous-time and discrete-time, necessary and sufficient embedding conditions have been investigated in previous work. Depending on the context of the system

under study, the transition matrix satisfies some specific properties and, therefore, belongs to a subset S of the set Π of stochastic matrices. In that case, also the matrix roots are expected to reflect these specific properties. Therefore, the aim is to find necessary and sufficient conditions for a transition matrix $P \in S$ to have a matrix root within S . We call this the *discrete embedding problem for the subset S* . Because in that case the discrete embedding problem, on the one hand, concerns a subset S of stochastic matrices P , and, on the other hand, imposes the additional condition that the matrix roots A must belong to $S \subset \Pi$, it is not obvious whether the embedding conditions for the subset S are less or more restrictive than the known embedding conditions for the set Π of stochastic matrices. Therefore, further investigation is needed. For example, Markov models for credit ratings are characterized by monotone credit rating transition matrices, where each row stochastically dominates each higher row. For the specific subset S of monotone transition matrices, the discrete embedding problem and embedding conditions are presented.

Keywords: Markov chain, Transition matrix, Parameter estimation, Embedding problem, Matrix root, Monotone matrix.

Financial Analysis of a Public Hospital. The case of the General Hospital of Corfu

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The purpose of this research is the financial analysis of the Corfu's General Hospital during the last decade, from the time of the financial crisis in Greece until the emergence of the Sars-CoV-2 pandemic. The Corfu's hospital is a regional hospital that serves the health needs of the island that has a large amount of permanent residents and visitors, as long as it is one of the most important tourist destinations in the country.

The evaluation has been done using indicators of liquidity, activity, efficiency and sustainability. The financial data used were taken from the hospital's published financial statements for the financial years 2012-2021. Given the adverse created conditions and the pressures faced by the health system as a whole, the research captures the progress of the hospital during the economic crisis and the COVID-19 pandemic on the liquidity, efficiency and financial structure of the hospital.

Modelling the Share of Women in University Education

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Historically, women's education began to grow in the second half of the 19th century, mainly in Western Europe and the US, while previously it was virtually non-existent. Nowadays the bare statistics of international organizations' publications are impressive in themselves. In many countries, gender parity has been approached, regarding attainment and graduation rates, or even more, the gender hierarchy has been inverted in favor of women. The interest in this paper is on modeling the evolution of women's share in the bodies of new entrants/enrolments and of graduates in universities. Motivated by the experience of a long series of data, we focus on specific classes of stochastic models, such as growth models. Some theoretical aspects of these classes are discussed before a numerical study of the proposed statistical methodology and the real-data analysis.

Keywords: University Education, Women's Share in Universities, Growth Models, Time Series.
Organized Session

Empirical Analysis of Option Pricing Models using Additive Processes and Heston-type Stochastic Volatilities

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In this paper, we conduct a comprehensive empirical analysis by calibrating several popular option pricing models to real market data. The models under consideration are Lévy Normal Tempered Stable processes, Additive Normal Tempered Stable processes and various Heston-type stochastic volatility models. We compare the calibration qualities and study the parameter behaviour of the chosen models using a large data set with options on EURO STOXX 50 market index and individual equity stocks. The data set covers the following distinct economic periods: December 2016 to December 2017, a phase marked by post-Brexit and US presidential election influences; November 2019 to November 2020, amidst the COVID-19 pandemic; and an extended recent period. We employ advanced calibration techniques, integrating both Variance Gamma and Normal Inverse Gaussian processes as the subordinators to the considered Lévy and additive models. This approach enables a nuanced understanding of model performance and parameter stability under varied market conditions, offering insights into the adaptability and robustness of these financial models.

Keywords: Lévy Processes, Heston-type Stochastic Volatility Models, Calibration, Additive Normal Tempered Stable Processes, Variance Gamma Process, Normal Inverse Gaussian Process.

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Exploring the degree of innovation's implementation in restaurants. The case of Athens

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Abstract. The purpose of this study was to explore the degree of innovation's implementation into Athenian restaurants, concerning attributes such as product, customer service, procedures, management and marketing, by applying suitable statistical techniques. The aforementioned restaurants attributes were evaluated, according to the managers' perceptions. In addition, the innovation attributes were assessed regarding the size and the years of operation of each unit. To fulfil this task a questionnaire with suitable questions was distributed to 135 restaurant managers in the central area of Athens, a main hub for tourists. The findings revealed that innovation is in general implemented, more in some items as contactless payments, free internet access, reservations through the internet and at a lesser degree to other as collaboration - networking and alternative ways of pricing. Furthermore, differences did appear towards the factor of company size, in new production methods, new ways of personnel management, new promotional techniques, as well as, towards the factor of years of business operation in new sales channels of the participating restaurants. Therefore, the restaurant management teams need to reconsider their innovation practices regarding the main features of their enterprise to compete successfully in an ever-changing and demanding business field as the food sector, especially in an area with a booming tourism wave as Athens.

Keywords: Tourism, Restaurant, Innovation, Athens.

EWMA Control Charts for Skewed Distributions

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This paper proposes the Skewness Correction EWMA (SC-EWMA) control chart and control limits for skewed distributions by applying the Skewness Correction method to the Exponentially Weighted Moving Average (EWMA). The performances of the SC-EWMA method are compared with those of the Weighted Variance EWMA (WV-EWMA), Weighted Standard Deviation EWMA (WSD-EWMA), and the classic EWMA control limits based on the degree of skewness and varying smoothing parameters. The comparison is made regarding type-I errors using the Monte Carlo simulation technique with data generated from the lognormal, Gamma, and Weibull distributions. The proposed new method is expected to produce good results and, therefore, can be used as an alternative to the commonly used Weighted Variance method.

Methods for Monitoring Non-Shows in Healthcare

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Abstract. A considerable proportion of individuals have been seen to schedule appointments at health facilities but, for a variety of reasons, fail to show up without providing notice. As a result, health units frequently find it difficult to fill up the time gaps that arise in their daily schedule, and a variety of issues spiral out of control. Aside from all the other issues, this situation causes an organization's expenses to rise significantly since resources are used during times when they are not producing any work, and at the same time, it causes their revenue to fall since clients are not showing up and they are unable to fill the voids with new appointments. For these reasons, several prediction models of possible no-shows have been created using various ML techniques and methods in recent years, aiming to monitor that issue.

Keywords: No-Shows, Machine Learning Techniques, Healthcare.

Assessing the Impact of Renewable Energy Sources on Energy Economics: A Non-Linear Regression Analysis of Hellenic Energy Exchange Market Clearing Prices

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The impact of Renewable Energy Sources (RES) on energy economics, specifically within the Hellenic Energy Exchange, stands as a crucial metric for the evaluation of the overall assimilation of RES into society's energy landscape. This paper strives to capture the correlation between the Market Clearing Price (MCP) of the Day-Ahead Market (DAM) and RES production through the application of non-linear regression techniques. The objective was accomplished with the use of data provided publicly by EnEx and the application of advanced algorithms. More specifically, this paper evaluates the performance of Variational Autoencoders and Sparse Autoencoders. The obtained results show the effectiveness of the adopted methodologies, offering insights that are invaluable for policymakers, energy market participants, and stakeholders alike.

Keywords: Renewable Energy Sources, Energy Economics, Day-Ahead Market, correlation, Variational Autoencoders, Simulation, Sparse Autoencoders.

Enhancing Energy Market Stability: Comparative Analysis of Forecasting Techniques for Market Clearing Prices in the Day-Ahead Market

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Forecasting the Energy Market's Clearing Price (MCP) contributes to price stabilization, crisis mitigation and, facilitating the smooth and reliable operation of the system. In this context, the paper endeavors to develop a robust forecasting technique tailored for the Day-Ahead Market (DAM), with the use of publicly available data as input to the methodology. This paper studies the performance of LightGBM/XGBOOST and Encoder-Decoder LSTM methodologies and compares their results with a typical linear regression model. The results prove the superiority of the advanced methods compared to the basic one, paving the way for more effective and efficient market operations, thereby fostering greater resilience and stability in the energy sector.

Keywords: Forecasting, Energy Market, linear regression, LightGBM/XGBOOST, Encoder-Decoder LSTM.

The utilization of Data Analytics and Artificial Intelligence: The case of Greece

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Abstract. The rapid expansion of information technology has sparked significant interest in data analytics and artificial intelligence (AI) among businesses in various industries over recent years. These technologies provide valuable insights that facilitate data-driven decision-making, predict future trends, and enhance customer experiences. Common applications include the

development of efficient sales and marketing strategies, the automation and optimization of supply chain operations, transportation, energy consumption, and quality control in production. Additionally, AI contributes to diverse areas such as human resources, risk management, fraud detection and prevention, market research, financial analysis, and sustainability initiatives. Companies typically customize their analytical methods and AI techniques to address their unique needs and objectives, leading to innovative applications, more informed decision-making processes, and increased competitiveness. This study presents initial findings from a research project examining the use of data analytics and artificial intelligence by Greek enterprises for strategic development. It aims to assess companies' familiarity with AI and data analytics, identify key factors driving the adoption of these technologies, and pinpoint major barriers to their implementation. The study analyzes how businesses utilize data, its primary objectives, and its role in informing decision-making processes.

Keywords: Data analytics, Artificial intelligence, Decision-making, Strategic development.

Reconsidering Thurstone Scales: A Novel Approach to Attitude Measurement

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This paper undertakes a reassessment of the construction of Thurstone scales, a historically challenging method due to difficulties in obtaining and analysing judges' data for question selection. We introduce a novel methodology for Thurstone scale construction by capitalizing on the convenience afforded by digital communication technology, specifically through platforms like Google Forms, and employing Crowdsourcing. Our primary focus is on measuring attitudes toward specific social groups, with a distinct emphasis on streamlining the collection of expert opinions and, consequently, data selection. Through the utilization of modern technological advancements, our objective is to overcome traditional impediments, presenting a more accessible and efficient approach to Thurstone scale formation. The paper delineates the digital methodology employed, highlighting its potential to update attitude measurement within contemporary social research practices.

Keywords: Thurstone scales, social research methodology, data collection methods, Google Forms, Crowdsourcing.

Characterizing Heat Waves' Impact using Coxian Phase-type Survival Trees

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Prolonged heat waves can negatively impact human health and well-being or even result in casualties. Coxian phase-type survival trees (CPST) are survival trees where each node is individually modelled as Coxian phase-type distribution (C-PHD) and have been successfully used in various applications, including analyzing the patient journey in a hospital. This research employs CPST-based analysis to characterize the impact of heat waves on mortality in a tiny island country. The weather data was collected from the Meteorological Office at Malta International Airport, and all-cause mortality data was obtained from 2017 to 2013.

Keywords: Heat waves, Ambient Temperature, Coxian phase-type distribution survival (C-PTS) trees, Mortality, Coxian phase-type distribution (C-PHD).

Combining medical tourism with data analytics for sustainable solutions and economic development

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Both the great expansion of the tourism industry and the shift to internationalization of the global medical sector combined with other factors such as demographic and technological developments can contribute to the formation of new medical tourism structures and services for Greece. Despite the fact that tourists' arrivals in Greece have increased by nearly 100 percent and tourists' receipts by 150 percent (Tornos, 2021), issues concerning Covid 19, the global recession and crisis in healthcare have affected tourism and travelling worldwide (Pappas N, 2023). In addition, factors such as transport and digital infrastructure, health and financial services are essential for the competitiveness and sustainability for rural tourism destinations resulting in positive impacts and closing the gaps in current services and infrastructure (World Tourism Organization, 2023). The challenges presented by Covid 19 and the expansion of digital technologies have raised concerns regarding the provision of Digital Solutions for the safe revival of international tourism. The World Travel & Tourism Council has provided guidance for adopting Digital Health Passes that were both interoperable (connecting operations around the world) and scalable (responding to increases in travelers' volumes). According to Jus N. et al (2022) countries could adopt one of the four internationally accepted solutions for Digital Health Passes enabling the immediate implementation, the electronic verification of COVID-19 certificates and the reduction of global complexity concerning healthcare issues. Moreover, the implementation of a national Digital Travel Portal would enable tourists to share more easily their COVID certificates with another country and countries to articulate the health entry requirements in a certain location. Based on results from Global Wellness Institute (Yeung O., Johnston K., Callender T., 2021), the global wellness economy grew from \$4.3 trillion in 2017 to \$4.9 trillion in 2019 indicating a growth rate 6.6% annually, significantly higher than the global economic growth (4%). The COVID-19 pandemic has highlighted the importance of wellness for consumers all around the world. The Global Wellness Institute predicts that wellness economy will expand its share in consumer spending and the global economy. Population aging, the growing middle class globally, the rise in chronic diseases, the awareness and expanding interest of healthy behaviors constitute the driving forces for consumer spending and global economic growth. The structure of this article is as follows: first, the importance of medical tourism internationally with special reference to Crete in Greece is highlighted; second, a connection between sustainable tourism development and healthcare sustainable development is presented; third, the paper will develop directions on how new technology and platforms could enhance the results for sustainable solutions and economic development; and, finally, challenges concerning issues regarding healthcare and tourism that must be faced are presented.

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Saving Resources due to the Operation of the Centralized Cytostatic Preparation Unit (CCPU) in Greek Hospitals: The Case of the CCPU in the Hospital Evangelismos

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Purpose: The purpose of this study is to investigate the economic impact of the operation of a centralized cytostatic preparation unit (CCPU) for the dissolution of cytostatic drugs with real data from the greek General Hospital of Athens “Evangelismos”. Avoiding the preparation of chemotherapy regimens in each nursing department separately provides a financial benefit in the calculation made at the end of the year and thus reduces government expenditure on drugs.

Materials and Methods: The study was carried out at the General Hospital of Athens (GNA) "Evangelismos" (1st Health Region, HYPE), following the approval of the Competent Body of the Hellenic Open University (HOU), the Scientific Council (SC) and the Director of the Hospital, with the assistance of responsible pharmacist of the central pharmacy. In total, the data collected and analyzed in the present study pertain to the five-year period from 2018 to 2022 are related to the chemotherapy regimens prepared per year and per clinic, the stocks of cytostatic drugs in the pharmacy warehouse per year, as well as the returns of intact vials to the central pharmacy per year in physical units.

Results: It was estimated that the Hospital saved: in 2018 an amount of 696.094,23 euros by administering 13.997 chemotherapy regimens, in 2019 an amount of 915.873,97 euros by administering 15.296 chemotherapy regimens, in 2020 an amount of 555.676,21 euros by administering 14.113 chemotherapy regimens, in 2021 an amount of 356.544,10 euros by administering 13.113 chemotherapy regimens, in 2022 an amount of 426.607,93 euros by administering 14.871 chemotherapy regimens.

Conclusions: The study highlights mostly the economic benefits of the operation of the CCPU at “Evangelismos” General Hospital of Athens, which primarily result from the return of unused vials of cytostatic drugs from the unit to the central pharmacy. For the studied five-year period (2018-2022), the savings are estimated about €2.950.796, 44. Furthermore, through the unit, there is an improvement in the quality of services provided to patients and resource management, reducing healthcare expenditure waste. Additionally, it provides a safe and more organized and controlled working environment for the operators of dissolutions.

Keywords: Oncology patients, Chemotherapy, Cytostatic drugs, Pharmacy, Centralized Cytostatic Preparation Unit (CCPU), GNA Evangelismos.

Periodic Time Series Forecasting with ANFIS – An application on an ECG Signal

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This paper investigates the performance of the Adaptive Neuro Fuzzy Inference System – ANFIS in periodic time-series forecasting as well as the significance of modeling and forecasting data of an electrocardiogram (ECG) signal, which is essentially a time series of the electrical activity in the heart. Analyzing and modeling the ECG Signal has numerous clinical and technological applications, such as forecasting immediate rhythm abnormalities (short-term forecasting), predicting future trends of the signal to monitor the progression of heart conditions (long-term forecasting), detection of deviations of the rhythm from normal patterns (anomalies such as arrhythmias or other cardiac events), as well as improving the functionality of wearable health monitors. The signal data were obtained from the PhysioNet database, a repository of medical research data and complex physiological signals. The ANFIS model was created, tuned and evaluated using different parameters, clustering techniques, membership functions as well as different training and testing sets derived from the same datasets – 4 ECG signals from patients with arrhythmia. The different ANFIS models are then evaluated and compared with other usual forecasting algorithms, such as AR, Box-Jenkins and Artificial Neural Networks models.

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A Comparative Study of Trends and Dynamics of Urbanization Across Africa

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This study examines the urbanization trends in 50 African countries over five decades (1950s to 2015). The innovation of current research lies to the combination of criteria related to urbanization and agglomeration in African countries throughout a wide period which enables the synthetic analysis of urbanization while investigating the reasons and motives for this phenomenon. Throughout the current study the findings are compared with those of Chakwizira et al. 2024 regarding secondary cities in west and south Africa. The findings underscore the complex dynamics of urbanization in the area, influenced by factors such as population growth, migration patterns and economic development. Understanding these trends is essential for policymakers and urban planners to address the challenges and opportunities associated with rapid urbanization, and to promote sustainable urban development across the continent. All data are retrieved from OECD (The Organization for Economic Cooperation and Development).
Keywords: Urbanization, Africa, Urban, Rural, and Regional Economics, Regional Migration, Regional Labor Markets, Population, Neighborhood Characteristics, Agglomerations
JEL Classifications: R10, N97, P25, R23

Examination of European Union Digital Economy and Society Index Dimensions Using PCA and Cluster Analysis

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Data related to digitalization and competitiveness in European Union (EU) countries assist governments and municipalities in formulating policies and adjusting priority areas. The Digital Economy and Society Index (DESI) is a composite index that summarizes 34 relevant indicators on EU digital performance. Our research focuses on analyzing the four official Dimensions of the DESI: Digital skills, Digital infrastructure, Digital transformation of firms, and Digitalization of public services. By applying Principal Component Analysis (PCA) to DESI Dimensions, we demonstrate the associations between the 4 Dimensions and the 34 included Indicators. Next, we employ Cluster Analysis to classify the EU countries into groups using the first 2 Principal Axes of PCA. The groups in the 4 DESI Dimensions demonstrate the vulnerabilities and advantages of European Union member states in relation to digitalization. Also these results allow us to make conclusions on the effective utilization of DESI data for policy analysis and evaluation in the European Union and its member countries.

KeyWords: Digital Economy and Society Index (DESI), European Union (EU), Principal Components Analysis (PCA), Cluster Analysis, Digitalization

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An analysis of Gender Gap in Students' Performance: Preconception or Reality?

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In recent years, exploring the determinants that may influence students' achievement has received much attention. Empirical studies have found that the most important factors which affect student performance are students' characteristics, family background, school attended, and regional residence. This paper aims at investigating the differences in students' performances among Science, Technology, Engineering and Mathematics (STEM) courses by using regression models, in order to capture the gender gap. To measure performance (university success), we focus on the number of ECTS credits earned during the first year, since it represents an important moment in the students' path at university. The analysis concerns students enrolled at 3-year STEM degrees in a university located in the South of Italy during the last 5 years, with a focus on the number of university credits earned during the first year (a good predictor of the regularity of the career). In particular, the main purposes are i) to estimate the probability of getting at least a certain number of credits at the end of the first year and identify the factors which might affect it, and ii) to capture if there are any differences in performance between men and women, and which factors might affect these differences.

Keywords: Gender, University performance, Regression analysis, STEM.

Organized Session:

Title: Gender Inequalities in Educational Contexts

Organized by Adele H. Marshall and Mariangela Zenga

Educational Data Mining for Predicting Students' Success

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Educational Data Mining (EDM) is an emerging research field that focuses on the application of techniques and methods of data mining in educational environments. The focus is on "student success", intended as the ability of students to close a given educational level successfully. It is a crucial element of evaluation, and it is often used as a criterion to assess the quality and performance of educational institutions. Early detection of the "students at risk" (with a high probability of dropping out of the educational institution) and the adoption of preventive measures can help decision-makers to provide and plan proper actions for improving students' performances (and consequently their success), and eventually revise the educational project. The aim is to explore the main differences in students' performance among bachelor's degrees by using regression models. The analysis concerns students enrolled at 3-year degrees in an Italian university (located in the South of Italy) during ten academic years. Student success is measured in terms of the number of ECTS credits earned during the first year. Hence, the main purposes are to i) estimate the probability of getting at least a certain number of credits at the end of the first year, ii) identify which students' features might affect it, and iii) classify students according to their churn risk.

Keywords: Educational Data Mining (EDM), Student success, ECTS credits.

Organized Session:

Statistical Methods for Education

Organized by Adele H. Marshall, Mariangela Zenga

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Double Laplace Transform applied to the PDE of the Non-ruin Probability in Case of a Bivariate Polya-Aeppli Counting Process and Exponentially distributed Claims

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This research is based on the extended Bivariate Pólya-Aeppli process. We derive a two-dimensional partial differential equation of third order with constant coefficients that the non-ruin probability satisfies in the case of the exponentially distributed claims. It is transformed by a double Laplace transform. Though the resulting operator equation is algebraic and the solution is a rational function we easily restore the original solution by using the Riemann-Melin formula. Then we discuss the achieved solution of the obtained partial differential equation.

Acknowledgments

The research work of Meglana Lazarova is supported by the Bulgarian National Science Fund under Project KP-06-M62/1 "Numerical deterministic, stochastic, machine and deep learning methods with applications in computational, quantitative, algorithmic finance, biomathematics, ecology and algebra" from 2022.

Keywords: Bivariate Polya-Aeppli counting process, Non-ruin probability, Exponentially distributed claims.

Male Fertility Rates and their Implications

Nan Li

With more data on the fertility of men available, more male fertility rates can be calculated and they will always be different from those of the females. We analyze two issues related to increasingly available male fertility data: Can we ignore male fertility data? And if not what are the implications of male fertility data? Using probabilistic total fertility rate (TFR) and hypothesis test, we obtain a suggestion to the first issue: When the differences between male and female TFRs are statistically significant, they are unlikely random fluctuations, and male fertility rates should not be ignored. Subsequently, male fertility rates raise the issue about indicating fertility level: Which one, female TFR or male TFR, should be used to indicate the fertility level of a population? Besides short-period fertility level, there are long-term implications of male fertility rates, which we discuss using one-sex stable population models and one-sex renewal population projections. In general, male and female stable populations cannot coexist in the long run. Moreover, male fertility rates lead to male-renewal population projections. Compared to the female-renewal population projections issued by the Governments and the United Nations, male-renewal population projections use the same method but provide different results. The long-run inconsistency of male and female stable populations is not just an academic concern, it will cause discrepant female-renewal and male-renewal population projections. The increasing discrepancy between female-renewal and male-renewal population projections will raise practical problems because various socioeconomic programs cannot decide which population projection to use. Using the data for the years around 2015, we found that the differences between female and male TFRs are statistically significant at 5% level for all the G7 countries except for France. Moreover, the median discrepancy between the annual births of the female-renewal and male-renewal population projection is about 11% in 2100. These results indicate that the short-period and long-term implications of male fertility rates are common. To address these implications, fertility rates that cover both females and males, stable populations that include both men and women, and population projections in which both husbands and wives contribute to producing births are required. We believe the increasing availability of male fertility data will not only cause the problems discussed in this paper but also bring opportunities to improve the methods and materials of demography.

Keywords: Male fertility rates, Probabilistic TFR and hypothesis test, one-sex population renewal model, one-sex renewal population projection.

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Analysis of the Impact of Implicit Family Education Investment on Fertility Decisions—Predictions Based on the Two-Sex Population Model

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Under the condition of population decline, the core foundation for promoting high-quality population development is to enhance birth rates and boost the fertility desire among women. To better understand the impact of implicit family education investment on fertility levels, this paper constructs an extended overlapping generations model of family fertility, examines the mechanism of implicit family education investment on fertility levels, and discusses the fertility effect of grandparenting. Using predictions from the two-sex population model and data from the China Family Panel Studies (CFPS), we empirically test the influence of both implicit family education investment and grandparenting on fertility in urban and rural households. The study shows that the continuous increase in implicit family education investment greatly heightens the pressure on mothers' fertility decisions, significantly reducing the likelihood of having a second or third child. Grandparenting effectively increases the willingness of urban and rural residents to have a first or second child. Heterogeneity analysis reveals that the impact of implicit education investment is more pronounced on the first-time childbearing behavior of rural families. Mothers who are illiterate or semi-literate, or who have a college education or higher, are particularly susceptible to the influence of increased implicit education investment on the decision to have a second child. The facilitating effect of grandparenting on enhancing the

desire to have a first child in urban families is highlighted, and it also helps to strengthen the confidence of rural families in having a second child. This research identifies family fertility behavior under the continued pressure of increasing implicit education investment and the choice of grandparenting, providing a new analytical perspective for a better understanding of fertility intentions, human capital accumulation, and labor supply decisions among urban and rural families in China.

Keywords: Fertility decisions; High-quality population development; Implicit education investment; Overlapping generations model.

Asymptotic Results for Compound Sums in Separable Banach Spaces

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We prove large and moderate deviation results for sequences of compound sums, where the summands are i.i.d. random variables taking values on a separable Banach space. We establish that the results hold by proving that we are dealing with exponentially tight sequences. We present two moderate deviation results: in the first one the summands are centered, in the second one the compound sums are centered.

Mathematics Subject Classification: 60F10, 60G50, 60B12.

Keywords: Exponential tightness, Large deviations, Moderate deviations.

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Multi-population Mortality Models: Comparison of Methods for Identifying Common Trends in Populations Mortality Changes

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The study of mortality trends is particularly important for the selection of sub-populations for multi-population mortality models. A group of sub-populations with similar socio-economic conditions and close ties is always under consideration. These populations can be men and women in the same country, different regions in the same country, different countries in the same region, and so on. The definition of what constitutes a group is deliberately left vague and subjective. Although the framework is clearly defined – to allow differentiation between subpopulations in the short term and avoidance of divergence in the long term – historical regularities are perpetuated. Therefore, there are different methods to identify such a group for common modelling. This paper presents a critical review of methods used to select subpopulations for modelling joint mortality. Solutions used by national organisations in multi-population modelling and a variety of clustering methods are considered in the comparative analysis. The prevalence of the methods will be based on empirical data for Eastern and Western European countries, by sex, and using the multi-population model of Lee and Le (2005). The result of the work is a recommendation on the possibility of the use of multi-population modelling for Eastern and Western European countries, i.e. 1) modelling and predicting mortality jointly for both sexes within a country, 2) modelling and predicting mortality for a population based on a group of similar populations (other populations from Eastern and Western Europe) or 3) modelling and predicting mortality for a population with higher mortality based on a group of populations with low mortality (Western European countries), assuming that their mortality follows that of this group.

Keywords: Multipopulation modelling, Mortality trends, Clustering, HMD.

Generative AI Growing Role in Enhancing Corporate Sustainability Performance and Addressing Climate Change Risks

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Abstract. Generative AI represents a significant advancement in artificial intelligence, fundamentally altering the dynamics of human-machine interaction by empowering machines with the capacity for autonomous creativity. This transformation in technology holds considerable potential for addressing pressing issues related to corporate sustainability performance and climate change risks in order to achieve net zero emissions by around 2050 and fulfil the goals of the Paris Agreement. This work examines the current use of Generative AI to enhance climate-related processes and explores its potential applications across various sectors and industries, anticipating significant advancements in tackling the challenges posed by climate change in business world. By synthesizing existing knowledge and outlining future directions, this work contributes to the expanding conversation on utilizing Generative AI to provide a more efficient and standardized approach to assess and communicate climate-related financial risks. Finally, this research suggests several questions and concerns for future research associated with generative AI.

Keywords: Generative AI, Generative Deep Learning, LLM, Climate Change, Climate Risk, Sustainability Performance.

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Labour Market in Private Education Sector: Professional Skills and New Trends

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In labour market, the evaluation of attributes and attitudes of the candidates by recruiters in the hiring process appears to be pivotal. Numerous contributions in statistics literature focus the attention on the relationship between the recruitment process and the set of required skills for the position. These individual competences assume a decisive role to determine the competitiveness of the companies also revealing an important component in the wage. In this context, the presented study has the aim to define a dynamic link between professional figures and owned skills searching for new evidences in labour market. From a methodological point of view, this match has been achieved using a dynamic factor analysis. Using this technique, it is possible to create the professional trajectories of the selected figures and the presence of new emerging skills. In particular, the contribution involves job figures in Italian private education sector.

Keywords: Labour market, Soft skills, Multi-way analysis.

Organized Session:

Statistical Methods for Education

Organized by Adele H. Marshall, Mariangela Zenga

Gender and ICT Inequalities among Adolescents: A comparative analysis in PISA

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ICT literacy has become an important key driver regarding the competence for the adults, but even more for young people. As it was pointed out in 2003, ICT literacy is defined as “the interest, attitude, and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate, and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in society” (Lennon et al., 2003). Using data from Programme for International Student assessment (PISA), this work will show the gender differences in ICT literacy and discover differences in OECD countries.

Keywords: Gender, ICT, Multilevel analysis, PISA.

Organized Session

Title: Gender Inequalities in Educational Contexts

Organized by Adele H. Marshall and Mariangela Zenga

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Modelling COVID-19 Disease Dynamics and Impact of the Non-pharmaceutical interventions on the Northern Ireland Population Using the CP-ABM Approach

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This talk describes the CP-ABM approach which we introduced as a result of modelling the infection spread of COVID-19 for the Northern Ireland COVID-19 Modelling Group. The CP-ABM methodology combines the approaches of change point detection within that of an agent based model built to replicate the entire 1.8 million population of Northern Ireland (NI) which we run over two waves of the pandemic. In doing so, the CP-ABM has been able to successfully capture the COVID-19 infection dynamics in NI and quantify the impact of the NPIs of mandatory wearing of masks, and lockdowns (both local and national) on the virus spread reduction. It has also been able to accurately capture the that asymptomatic patients have on the spread of the virus and estimate their relative infectiousness. The proposed methodology is programming language agnostic.

What is the Current State of Mathematics Performance among Adolescents in the post-COVID-19 Era?

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This study presents a statistical analysis for evaluating education systems. It focuses on analyzing data from the Programme for International Student Assessment (PISA) 2022, which assesses the performance of 15-year-olds in various countries. Using multilevel analysis, the study compares math proficiency among students across schools within countries. This analysis identifies patterns, trends, and obstacles that affect student learning outcomes.

Keywords: Education, Math proficiency, PISA 2022, Covid-19.

Organized Session:

Statistical Methods for Education

Organized by Adele H. Marshall, Mariangela Zenga

Estimators for Extreme Value Index: Advancements in Tail Inference and Return Period Estimation

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In Statistics of Extremes, the estimation of the extreme value index is an essential requirement for further tail inference. In this work, we deal with the estimation of a strictly positive extreme value index from a Pareto-type model. Under this framework, we propose a new class of estimators, based on the probability weighted moments. These estimators offer a robust method for estimating the extreme value index, providing valuable insights into the tail behavior and allow the estimation of other tail parameters such as return periods. Return periods serve as a crucial metric in understanding the frequency and severity of rare events, aiding in risk assessment, infrastructure planning, and disaster preparedness. Understanding return periods enables decision-makers to mitigate the impacts of extreme events and enhance resilience against both natural and non-natural hazards. This research contributes to advancing our understanding of extreme value estimation and its applications in risk management and disaster preparedness efforts.

Keywords: Extreme Value Index, Pareto-type model, Probability Weighted Moments.

Semi-Markov Models for Process Mining in Smart Homes

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People are living longer but often alongside increased physical and mental impairment and disabilities. However, on the positive side, technology is becoming more powerful all the time, including the development of assistive technologies for older people, which offer much towards improving care and quality of life. Here, we focus on the completion of activities of daily living (ADLs) by such patients, using so-called Smart Homes and Sensor Technology to collect data, and provide suitable analysis to support management of these conditions. We here focus on modelling such ADLs as semi-Markov processes, where transitions between ADL states are recorded as sensor activations. This facilitates the extraction of key performance indicators (KPIs) in Smart Homes, such as duration of an important activity, as well as identification of anomalies in such transitions and durations. General knowledge and previous data suggest that such duration data are typically peaked and may also be a mixture of such peaks, representing heterogeneity in the underlying activities. We have therefore used mixed gamma distributions to represent durations in our semi-Markov models of the ADL-sensor network. This approach is illustrated and evaluated using a publicly available Smart Home dataset comprising an event log of sensor activations, together with an annotated record of the actual activities. Results suggest that the methodology is well-suited to such scenarios.

Statistical Control of the Distribution of Cells detected in Images of Aluminum Foam Samples

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The manufacturing process of metallic foams produces non-homogeneous cellular materials, and their structure is characterized by a certain morphology of the cells that are randomly placed. In this work, we measure cell diameter, cell circularity, and wall thickness by image analysis along the thickness of an aluminum metal foam produced via a powder metallurgy route. It is possible to see a slight structure in the direction of gravity, with values of lower cell diameters and perimeters near the outer skins, while larger pores are preferentially located in internal areas. Based on profile monitoring theory, this work aims to adapt a non-parametric profile monitoring methodology that integrates the use of regression support machines, profile characterization metrics and EWMA (exponentially weighted moving average) control charts based on ranges to control the distribution of cells along the thickness of the samples.

Keywords: Statistical Process Control, regression support machines, EWMA Control Chart.

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Systematic Identification and Forecast Assessment of the Long-term Evolution Characteristics of China's Negative Population Growth Based on the Two-sex Population Model (2024-2100)

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The decline in fertility rates has become a global trend, with the majority of the world's population now living in countries or regions where the total fertility rate is below the level of replacement fertility. China is currently experiencing a long-term negative population growth trend, accelerated aging and rapid growth of disability and dementia in the context of deep aging, severe drop in birth rates, and regional population growth disparity. Negative population growth is a prominent feature of China's current population development. To thoroughly understand and grasp the new situation of China's population development, it is necessary to deeply analyze the characteristics of the future long-term development stages of China's population and to evaluate the process and trajectory of negative population growth.

However, classic population projections are calculated from the perspective of female fertility and are rarely calculated from the male or two-sex perspective. This study conducts in-depth exploration of China's census data and comprehensively predicts China's future population from single-sex and dual-sex perspectives.

The calculation results indicate:

(1) Due to Chinese zodiac preferences and the end of the epidemic, there is a strong possibility of a small fertility peak during the years 2024-2026 (the Loong, Snake, and Horse years), while 2027 (Year of the Sheep) may see a fertility trough. Considering that the birth cohort of 1962 (a peak fertility year) will turn 65 in 2027, it can be predicted that China will enter a severe phase of low fertility and aging in 2027.

(2) China's TFR of male in 2020 is slightly lower than the TFR of female. However, the number of births calculated based on the male fertility rate is greater than the latter. This result is basically consistent with the conclusion obtained by the G7 countries, confirming the effectiveness of our method.

(3) The trend of China's future negative population growth is not yet fixed; there is still the possibility of positive population growth around the year 2040. However, from the middle of this century, even if China's total fertility rate reaches replacement level, China will still be in a long-term state of negative population growth.

(4) Over the next sixty years, China's elderly dependency ratio will generally be on the rise, and the deepening of aging is the main reason for the future negative population growth in China.

(5) Although China's population negative inertia spans a long time frame, its total population remains vast, with the probability of being between 1.035 billion and 1.265 billion by the year 2100. This result is consistent with the assessment by Professors Jian Song, Jingyuan Yu, and Zhenghua Jiang that China's population will be within the 0.7 billion to 1.6 billion range.

Based on the above results, it can be seen that the two-sex population model provides a theoretical basis and methodological innovation for in-depth evaluation of population development trends under China's new normal. It will also offer important reference value for future analysis of population changes in other countries.

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Keywords: Two-sex population model, Negative population growth, China.

Methods Comparisons for Fraud Detection in Auto Insurance

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Abstract. The detection of fraud in auto insurance holds significant economic and ethical implications. Studies suggest that fraudulent automobile insurance claims account for 10%-20% of total claims submitted in Central and Eastern Europe. The possibilities of leveraging unsupervised machine learning methods in tackling this problem are explored. Notably, this research area remains relatively unexplored within the insurance fraud detection literature, which predominantly focuses on a limited set of unsupervised machine learning methods. This work takes a much broader approach regarding the methods used, drawing inspiration from the more general and rapidly evolving domain of anomaly/outlier detection. Regarding the evaluation of these methods, it is conducted by means of a simulation study, as the scarcity of publicly available real-world data sets, due to their confidential nature, poses a significant challenge in researching auto insurance fraud. The choice of a simulation study is our way of circumventing this "roadblock". The simulated data sets are the outcome of a "synthetic reconstruction" of a real-world data set, which is used as a "seed" for the generation of typical/non-fraudulent data samples which are then augmented by several different types of parametrically created synthetic outliers. The culmination of this research is the performance comparison of almost thirty different outlier detection algorithms across five different synthetic outlier scenarios, which could provide new insights for combatting fraud in auto insurance using unsupervised machine learning.

Keywords: Fraud Detection, Unsupervised Machine Learning, Auto Insurance.

Sigmoid Growth Models: A Novel Interpretation

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Driven by the empirical pattern exhibited by extensive real-world data sets on the proportions of women in undergraduate university student populations, a sigmoid-type model is proposed to study the evolution of these proportions over time. In this context, a broad class of sigmoid growth models is considered, and a novel interpretation of the parameters is given under a competing cause scenario, similar to those used in event history analysis theory. Our focus is on identifying key commonalities in these two areas of statistical research, thereby highlighting potential avenues for future research.

Keywords: University Education, Women's Share in Universities, Stochastic Growth Models, Competing Cause Scenario.

Organized Session:

Statistical Methods for Education

Organized by Adele H. Marshall, Mariangela Zenga

Terence Mills

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(Virtual presentation)

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Analysing the Lombardy Region Wards for Older Individuals

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Across Europe healthcare systems are coming under increased pressure and scrutiny with governments requesting that hospitals deliver the highest standard of care to their citizens whilst achieving performance measures and managing tight budgets. This increased pressure is partially due to increasingly older populations with life expectancy increasing consistently. Within Europe it is predicted that by 2030 almost 12% of Europeans will be over 75 years old (in 2019 the proportion of 80 year olds was 5.8%) (Eurostat, 2019). This will be particularly evident within Italy which has the world's third largest proportion of older people within their population. Modelling patient flow in a healthcare system is seen as an important aspect in understanding the system, with length of stay of patients used to help measure the usage of hospital resources and help managers run a more efficient and effective hospital. The Coxian phase-type distribution, (Neuts, 2009) and the Coxian continuous-time hidden Markov model will be applied to the Lombardy wards for older people. This will provide a more detailed understanding of the healthcare system for older people and enable healthcare providers to identify any potential issues with regards to the running of the healthcare system.

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Natural Resources and Economic Growth: Is there any Resource Curse?

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The Natural Recourse Curse Hypothesis states that those economies whose exports are highly dependent on natural resources, particularly oil and minerals, tend to have lower growth rates than others, where natural resources have a smaller share (Ross, 1999). A large literature was established to understand which aspects were responsible for such performance. Some researchers attribute the "phenomenon" of the resource curse to the vulnerability of natural resource prices in international markets, others to the proper management of revenues from the export of natural resources that refers to issues of good governance, bribery and corruption. In this paper using a sample of natural resource rich developed and developing countries and appropriate panel data econometric methods we are trying to investigate if there is any resource curse and where is this due to.

Keywords: Oil Rents, Economic Growth, Resource Curse, Governance, Resource abundance.
JEL Classification: O17, O43, O53, Q33, Q38.

An Optimal Investment Control Problem with Stochastic Volatility

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In this paper, considering a non-constant volatility, we construct a more realistic portfolio based on our assumptions. Some modifications of the Merton's investment-consumption optimal control problem are therefore performed. A related Hamilton-Jacobi-Bellman equation is derived and a numerical study is done by the use of Monte-Carlo simulations. Our results give an interesting starting point that can be improved by machine learning algorithms on real data.

Keywords: Optimal Control Problem, Stochastic Volatility model, HJB equation, Portfolio optimization, Dynamic programming principle.

Penalised Regression Analysis in Portfolio Management

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In this paper, we construct optimal portfolios composed by Americantype options. Fair option prices are obtained helped by the Longstaff-Schartz algorithm. We do a numerical study using Tikhonov estimation, LASSO estimation, Elastic Net estimation. The Grzelak-Oosterlee-Van Veeren model is considered and our optimal portfolios are presented.

Keywords: Optimal Portfolio, Penalized Regression, Portfolio optimization, Stopping Time.

A Splitting Finite Difference Method for Weather Derivatives Model

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We consider a weather derivatives problem that leads to a Multidimensional partial differential equation and we try to solve by considering a discretization method. The problem is modeled by a large system of equations at each time level, which brings an additional cost associated with the direct extensions of finite difference methods used for discretized one dimensional partial differential equations. An alternative numerical technique for the weather derivative pricing model, based on the splitting approach, is proposed in the paper. The two-dimensional problem is decomposed into a sequence of simpler one-dimensional problems. Then, the numerical schemes are applied to one dimensional equations. We include the analysis of stability and accuracy and we produce the solution of the original problem.

Keywords: Incomplete markets, Numerical methods, Partial differential equations, Splitting methods, Weather derivatives.

Graphical Models for Compositional Data

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Technological advancements have led to a significant increase in the availability of data, transforming the way information is collected and analyzed. One interesting class of data, referred to as compositional data, has the characteristic of representing parts of some whole. These data can be found in a wide variety of research areas such as geology, biology, medicine, and physics to cite a few. The analysis of compositional data cannot rely directly on traditional statistical methods, due to the fixed-sum constraint imposed by the simplex space. In particular, the analysis of the dependence and correlation structure of compositional vectors, which is fundamental for many statistical methodologies, is highly involved. Our project aims to develop a new statistical methodology specifically designed for compositional data that will give insight into the relationships among elements of a composition. This goal will be achieved using probabilistic graphical models within a Bayesian framework. The core idea of these models is to describe complex systems as composed of a set of nodes and a set of edges connecting adjacent nodes. Within our compositional data framework, the elements of the composition will assume the role of nodes, and we will provide an appropriate definition for forms of independence on the simplex. In particular, we will propose a new graphical model within the context of Gaussian models, named clustered graphical model, that is characterized by a clustered structure, i.e., being formed by the disjoint union of complete sub-graphs and it is estimated with a Bayesian approach. The effectiveness of the proposal will be illustrated with some simulation studies.

Keywords: Gaussian graphical models, Bayesian learning procedure, Neutrality, Simplex.

Composable Random Elements and Conditional Independences

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We define a new class of graphical causality models called composable random elements (CRE) which encompasses usual bayesian networks (BN) introduced by J. Pearl [5], dynamic BNs (DBN), continuous time BNs (CTBN) [4] and marked point processes. Components of a CRE are nodes of a directed graph with possible cycles. This makes it possible to model the

feedback in causal relations between variables. The elementary building blocks of a CRE are conditional-by-intervention probability distributions of single nodes given their parents. Nodes correspond to random variables or stochastic processes, as in [2]. The aim of our work is to express conditional independence relations between components of a CRE in terms of separability properties of the underlying graph. We show that many results on conditional independence and graph separation which are known in the classical setup of directed acyclic graphs (DAGs) can be generalised to CREs. This approach unifies and simplifies the theory. As a by-product it also reveals certain gaps in the existing results [3]. Apart from the observational independence we also consider causal or interventional (conditional) independence [1]. This is a notion relevant in many applications. In the setup of CRE, we are able to rigorously define meaning of the phrase ‘Y causally depends on X’ or more generally ‘Y causally depends on X when both are under the causal influence of Z’. We prove a theorem which characterises causal conditional (in)dependence in terms of the underlying graph.

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Keywords: Causality, Conditioning-by-intervention, Separability conditions, Directed graphs, Continuous Time Bayesian Networks.

A Data-Driven Approach for Health Budgeting

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Abstract. Accurate health budgeting is indispensable for optimizing the performance of healthcare systems, facilitating the delivery of high-quality, accessible, and sustainable healthcare services to populations. By serving as the foundation for strategic planning, emergency preparedness, and the implementation of innovative healthcare solutions, effective health budgeting contributes profoundly to the overall well-being of communities and populations, promoting resilience and progress in the face of evolving healthcare dynamics. Data-driven health budgeting refers to the use of comprehensive and accurate data to inform the allocation of financial resources in the healthcare sector. This approach involves leveraging data analytics, statistical models, and evidence-based insights to make informed decisions about budget priorities, resource allocation, and strategic planning.

The goal is to optimize the use of financial resources, improve healthcare outcomes, and enhance the overall efficiency of healthcare systems.

Keywords: healthcare, healthcare budgets, data, data driven approaches, healthcare services optimization, healthcare systems efficiency.

Analyzing the Influence of Covariates in Finite Mixture Models with trajER and Applications in Sociology

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Longitudinal data are the empirical basis of research on various subjects in the social sciences and in medicine. The common statistical aim of these various application fields is the modelisation of the evolution of an age or time-based phenomenon. Compared to subjective classification methods, finite mixture models have the advantage of providing a formal framework for testing the existence of distinct groups of trajectories. This method does not assume a priori that there is necessarily more than one group in the population. Rather, an adjustment index is used to determine the number of sub-optimal groups. Moreover, this method allows to evaluate the accuracy of the assignment of the individuals to the different sub-groups and to consider the variation of this accuracy in subsequent analyses. The R-package *trajeR*, developed by C. Noel (2021) allows to handle the extension by J. Schiltz (2015) of the basic finite mixture model of Daniel Nagin (2005) and test if group membership of the individuals is influenced by a static set of risk variables, as well as investigate the relationship between the trajectories and a time-dependent covariate. We highlight these two features by applications to sociology. First, we use sample data of the Montreal Longitudinal and Experimental Study (Tremblay, 2003). The original aim was to study the development of antisocial behavior from kindergarten to high school with a specific focus on the role of parent-child interactions. We will add to the authors results by analyzing the influence on the amount of schooling completed by the parents of the subjects on their group membership. We show that the amount of schooling of the mother does not have a significant influence, whereas the amount of schooling of the father has a protective effect in the sense that a high level of schooling of the father pushes the children in groups with a lower opposition score. The, we use a sample data of the Cambridge Study in Delinquent Development (Farrington 2005). It is a prospective longitudinal study of 411 London males. The aim of it is to study the development offending and antisocial behavior from childhood to adulthood. Here we study the influence of the number of yearly convictions on the trajectories of the three groups discovered by the authors. We show that for the first group, this longitudinal covariate has no effect while in the two others groups this covariate changes the typical group trajectories.

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Keywords: Generalized Finite Mixture Models, R package.

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Functional Limit Theorems for a Time-changed Brownian Motion

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A large deviation principle for the normalized time-changed Brownian motion is obtained using a weak convergence approach. This is motivated from the study of parabolic Cauchy problems with state-dependent intensity coefficient, for which the time-change method of Markov semigroups becomes relevant. Based on the duality between weak convergence theory and that of large deviations, we prove a large deviation principle for the superposition between the Brownian motion and the inverse process of the additive functional that determines the time change.

Keywords: Markov semigroup, Additive functionals, Inverse process, Exponential tightness, Large deviation principle.

Methodological Procedures for Assessing the Quality of Death Certificates for Unknown Causes

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A recurring problem when using death statistics from the civil or health registry information systems of a country or region concerns their quality, particularly with regard to causes of death. This problem is usually more acute in less developed regions. When the causes of death are unknown or not declared on death certificates, this can seriously restrict evaluations and analyses for population health planning purposes. The aim of this study was to outline a methodological approach to assessing the quality of declarations of causes of death applicable to any region. Mortality from unknown causes results from the combination of two factors: unregistered deaths (under-registration), whose causes of death are not known, and registered deaths, but whose underlying causes were poorly defined and/or classified as Garbage Codes. A mathematical model is shown on how the percentage of unknown causes of death can be measured through these factors (under-reporting, ill-defined and Garbage Code). Various procedures available in the literature to estimate or measure each of these factors are presented. The proposed model can be applied to any group or cause of death, region, sex or age group. This study provides illustrations for regions with high COVID-19 mortality.

Keywords: Vital Statistics, Evaluation of Data, Death Certificate, Mortality.

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Leveraging Generative Adversarial Networks (GANs) to Enhance Uncertainty Quantification in Agent-Based Models (ABMs) for Financial Market Simulation

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Agent-Based Models (ABMs) hold immense potential for simulating financial markets and analyzing investor behavior. However, a critical challenge lies in capturing the inherent uncertainties and complex dynamics of real-world markets. This study proposes a novel approach that integrates Generative Adversarial Networks (GANs), a powerful tool within the field of generative AI, with ABMs to enhance uncertainty quantification in financial market simulations. The proposed framework involves training a Conditional GAN (CGAN) on historical financial data. Unlike vanilla GANs, CGANs can incorporate additional information to guide the data generation process. In this case, the CGAN will be conditioned on various market factors like stock prices, interest rates, and investor sentiment. This allows the CGAN to learn the intricate relationships between these factors and generate synthetic financial data that adheres to these real-world statistical dependencies. By incorporating this synthetic data with realistic uncertainty characteristics into the ABM, we can explore a broader range of possible market scenarios and assess the robustness of our model's predictions. This GAN-enhanced ABM can be used to:

- Analyze the impact of unforeseen events (e.g., economic crises, black swan events) on market stability.
- Evaluate the effectiveness of different risk management strategies under various market conditions.
- Design more robust trading algorithms that can adapt to

changing market dynamics. This research aims to contribute to the field of financial modeling by demonstrating a novel application of generative AI, specifically CGANs, to improve uncertainty quantification in ABMs. The proposed framework has the potential to provide more realistic and informative simulations of financial markets, leading to better-informed investment decisions and risk management strategies. Keywords: Agent-Based Modeling, Generative Adversarial Networks (GANs), Conditional GANs (CGANs), Generative AI, Uncertainty Quantification, Financial Market Simulation, Risk Management

Visualizing Temporal Dynamics in Time Series Topics: A Convex Hull Approach

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Abstract. Topic modeling is an efficient technique for quickly extracting the essence of a textual dataset, making it easier to navigate the complexity of large amounts of text. In this work, topic modeling is also used to identify changes and trends within a given topic over different time periods, aiding in the understanding of the evolving landscape of scholarly discourse and knowledge dissemination. To accomplish this, a document visualization approach is initially employed. This visualization helps to comprehend subtopics, their relationships, and similarities by extracting significant geometric characteristics from the areas defined by the documents of each subtopic and comparing them across different periods. These geometric characteristics are related to the area of each convex hull defined for each subtopic, providing numerous insights into the development and significance of each topic over time. In this study, abstracts related to the domain of time series are collected from two distinct periods. Specific subtopics of interest are identified, enabling the investigation of potential variations across different temporal intervals.

Keywords: Topic modeling, principal coordinates analysis, convex hull.

Analyzing Fluctuations in Sex Ratio at Birth using Time Series Models: A Comparative Study of 38 Countries

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Forecasting trends in the Sex Ratio at Birth (SRB) is a pivotal pursuit within demographic research, offering insights into evolving population dynamics. This study presents a comprehensive investigation into the selection and evaluation of optimal forecasting models for SRB data. Drawing on historical SRB records from 39 countries, we meticulously assess various models, including Autoregressive Integrated Moving Average (ARIMA) and Autoregressive (AR) models. Through empirical analysis, we unveil the dominance of the AR(2) model in capturing intricate SRB dynamics. Our findings underscore the AR(2) model's efficacy, arising from its parsimonious complexity, empirical validation, theoretical alignment, and superior statistical performance. With projections extending to 2070 for Germany, our study not only provides foresight into future SRB trends but also contributes a robust methodology to the wider field of time series analysis.

Combating Housing Exclusion in Europe: Critical Reflections

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Before the financial crisis in 2008, most governmental strategies in Europe mainly concentrated on diminishing unemployment rates and boosting employment opportunities. Only recently came into surface the significance of affordable housing as a basic prerequisite to independence. Preventing and combating homelessness constitutes a major challenge among the counties of Europe. The purpose of current study is to emphasize on the importance of international research and its contribution to the documentation and explanation of the homelessness and housing exclusion levels across Europe. The study focuses on inequality levels between poor and non-poor households regarding housing cost overburden rate during the period 2009-2014, as well as the examination of the house price to income ratios during the years from 1999 to 2015. Moreover, amongst others, the current study shows the changes in exposure to market according to poverty status for the years 2009-2014, as well as the gap between them and the market. Public measures and investments regarding housing construction and housing subsidies between 2008 and 2018, as well as the housing costs for the period 2009-2019 are researched. The results indicate the need for closer attention and greater focus, so that mutual European policies could lower the lever of income inequalities and increase the opportunities for economic growth.

Keywords: Housing Demand, Housing Supply and Markets, Poverty, Housing exclusion, Europe, Homelessness.

Jel Classifications: R21, R31, I30

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Health Status and Suicide Rate in the Europe: 2019-2022

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Background: This study conducts a comprehensive analysis of the health status in the Czech Republic over the last five years, with a particular focus on the impact of Covid-19 and suicide rate during pandemic. Aims: First of all, the primary aims include review existing health status measures and calculate the new one; the second aim is comparison the suicide rate and health status in Europe.

Materials and methods: The methodology involved a thorough literature review, primarily is the WHO. Results: The health status indicator are reviewed and the; the relation between health status and suicide rate are studied. Conclusion: Measurement results may serve as recommendations towards social and health sector.

Keywords: Covid-19, Czech Republic, Europe, Health Status, Suicide Rate.

Mortality among Young People during the Pandemic in Moscow, other Russian Cities and Rural Areas

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Death rate of people aged 20-34 decreased after 2005 in all settlements. Leading death cause among youth is external causes, the share of which in 2019 among Muscovites was significantly lower compared to other young people. The share of undetermined conditions of death was

significantly higher in Moscow. During the pandemic, youth mortality from mental disorders increased many times in Moscow and decreased in other territories. Mortality of Muscovites from nervous diseases, external causes and endocrine diseases also increased to a greater extent. Change in structure of death causes among youth within classes of causes is primarily due to use of alcohol and drugs. In Moscow, there was an increase in mortality of youth from all causes related to alcohol from 2015 to 2021, while in other cities and rural areas this mortality decreased and increased only in 2022. Youth drug-related mortality increased fourfold in Moscow and doubled in other territory from 2019 to 2022. So, change in social situation due to the pandemic provoked stress among youth, which was relieved not only by traditional Russian method of alcohol abuse but also by consuming drugs. Despite more favorable living conditions in the capital, the reaction of young Muscovites to difficulties was more acute. Incomparably greater opportunities for creative realization and entrepreneurial activity among the capital's youth were not sufficient for complete resistance to social tension.

Keywords: Mortality among young people, Mortality; Mortality cities and rural areas.

Suicide Mortality in Russia and Specific Features of its Registration

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Suicide is an ever-increasing challenge. According to WHO, it's the fourth leading death cause among population aged 15-29. Purpose: to identify age-related specifics of suicide mortality in Russia in the post-Soviet period and verify a hypothesized underestimation of suicide-related deaths due to latent suicides. The analysis used Rosstat data on deaths from suicide and injury of undetermined intent (IUI) in 1989-2021 by age and gender. The Russian suicide mortality age pattern has drastically changed over 30 years: in the 1990-s, males developed a sigmoidal mortality curve with a peak in middle ages; in mid-crisis (mid-1990s) the maximum was registered in ages 50-54. In the 2000s, the peak was gradually leveling with its maximum among the senile. After 2010, the profile continued to normalize, plateauing in working ages. The COVID-associated crisis neither changed the positive trends in suicide mortality nor age profile of the suicide mortality curve. There are critical gender differences in the 1990-s: against the background of a male sigmoidal mortality curve, the female mortality age profile was characterized by a stable growth with a peak in the mid-1990s among females aged 50-54. It took the female suicide mortality curve about a decade to gradually normalize by 2010. Recently, the suicide-related age profile has acquired its maximum gender similarity, as evidenced by the rank correlation coefficients of 0.9. Comparative analysis of the suicide-related mortality age profile and IUI mortality has confirmed the hypothesis that a substantial share of suicides is disguised by hangings and jumps from a height with undetermined intent. In 2011-2021, overestimation of the actual number of suicides versus official level was registered across all ages, equaling to 80%-1.5-fold in males and two-fold in females. Changes in IUI mortality suggest that suicide-related deaths have been systematically underestimated due to their latent forms throughout the post-Soviet period.

Keywords: Suicide, Suicide mortality, Gender differences of mortality.

The Impact of Big Five Personality Traits on Physical Health of Older Europeans: An Analysis based on SHARE Data

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Exploring the role of Big Five personality traits in relation to various health outcomes is an issue of major importance widely studied in the literature. The impact of “Big Five” on physical health is here examined for older Europeans, and although past research has already supported a significant relation of big five traits with age, the present study further focused on examining age groups differences, making meaningful comparisons through the classification of three age groups for risk stratification purposes. This methodological approach revealed the impact of “Big Five” across the life span and outlined an apparent relationship between personality traits and better physical health, and age-related differences as well. Neuroticism was the most significant predictor of physical health for all age groups under consideration, while extraversion, agreeableness and openness were not found to significantly affect the self-reported physical health levels of younger adults aged 50 up to 64. Mature adults aged 65 up to 79 were prone to openness whereas the oldest old individuals aged 80 up to 105 were mainly affected by openness and conscientiousness. For this research purposes, the study sample included 378500 respondents derived from the seventh data wave of Survey of Health, Aging and Retirement in Europe (SHARE). The physical health status of older Europeans was estimated by constructing an index considering the combined effect of well-established health indicators such as the number of chronic diseases, mobility limitations, limitations with basic and instrumental activities of daily living, and self-perceived health as well. This index was used for an overall physical health assessment, for which the higher the score for an individual, the worst health level. Further, through a dichotomization process applied to the retrieved Principal Component Analysis scores a two-group discrimination (good or bad health status) of SHARE participants was obtained as regards their physical health condition, allowing us to further construct logistic regression models to assess the predictive significance of “Big Five” and their protective role for physical health. The odds of reporting a better/worse physical health status in relation to age and each personality trait are estimated here, and such findings provide generic answers about how personality psychology should be translated to allow personalizing preventive health care and medicine for patients.

Keywords: Big Five Personality Traits, Older Europeans, SHARE, PCA, Logistic Regression.

Life Expectancy Recovery after Catastrophic Events

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We aim to estimate the time of life expectancy (e_0) recovery after mortality crises and quantify which age groups drive observed post-crisis trends. We focused on major European pandemics and wars during the 19th and 20th centuries. Data was retrieved from the Human Mortality Database (HMD). Regarding descriptive statistics across time, we identify the most considerable ten losses in e_0 . Afterward, auto ARIMA's models for every selected case are used to forecast e_0 had the crisis not happened, we analyzed the time it would take to recover. The events are divided into Pandemics and Non-pandemics, and several statistical tests are carried out. World Wars were the events that caused the most considerable losses. Statistical terms show no significant differences by kind of event and sex. Finally, children are the primary age group contributing to recovering life expectancies.

Keywords: Life expectancy, Pandemic, Wars, Mortality

Monitoring Multivariate Poisson Processes

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Abstract. Statistical process monitoring (SPM) includes a variety of statistical techniques to analyse and control process variations, in order to ensure efficient operations in healthcare, manufacturing, and other industries. However, the challenging part of SPM is dealing with batch processes. In this scenario, finite quantities of products are manufactured in batches over a specific period of time. Unlike regular processes that model data using a continuous distribution, batch processes are assumed to follow a discrete distribution. The current work focuses on problems related to monitoring bivariate Poisson data arising from batch processes in the food industry. More specifically, supposing that a process produces batches of products, a sample of these products is taken, and the number of events (e.g., bacteria) is measured. The aim is to identify possible increases during the production.

Keywords: Statistical Process Monitoring, batch process, count data, Bivariate Poisson distribution.

Machine Learning Applications in Sports Data

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Abstract. This work presents machine learning applications in sports, which had significant growth recent years. The purpose of this study is to understand the research on application of sport analytics and its emerging fields in business. Overall, professionals utilize sports data applications to enhance their performance, while spectators use them to enhance their viewing experience. As technology continues to improve, cutting-edge technologies like computer vision improve sports analytics. The investigation of machine learning applications in sports data uncovers unexplored possibilities, encouraging the development of novel approaches and improving many fields like athletic performance analysis.

Keywords: Sports Data, applications, algorithms.

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Modeling School-to-Work Transitions in Greece and the Impact of Dual Crises (Economic and COVID-19) Using EU-LFS Data (2006-2022)

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This paper aims to enhance the current body of knowledge by presenting a methodology for assessing successful transitions into the labour market. The study utilizes data from the EU Labour Force Survey (EU-LFS) spanning the years 2006 to 2022, focusing on individuals up to 29 years old, to estimate school-to-work transition probabilities in Greece. The methodology employed allows for the derivation of a sequential representation of these probabilities, providing insights into the dynamics of the labour market entry process. Furthermore, the paper investigates the impact of two major crises – the economic downturn and the COVID-19 pandemic – on these transition trends throughout the study period. By modeling and analysing tendencies in the transition probabilities, the research sheds light on the influence of external economic shocks on the pathways from education to employment. This examination contributes valuable empirical evidence to the ongoing discourse on the intersection of economic downturns and global health crises with young individuals' successful integration into the labour market. The findings offer relevant implications for policymakers and researchers seeking to understand and address challenges associated with labour market transitions during times of

economic and public health crises. Moreover, this study goes beyond sequence analysis by detecting the determinants of successful school-to-work transitions.

Keywords: School-to-work transitions, EU-LFS, Labour market entry.

Social Dimensions of Food Insecurity in Greece

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Contemporary socio-economic conditions have dramatically increased the cost of living and put livelihoods at risk, disproportionately affecting the most vulnerable population. Increases in food prices, combined with shrinking purchasing power, limit people's access to adequate and nutritious food. This results in the deterioration in their living standards, affecting their food insecurity and locking them into poverty. This study examines the conditions that increase people's risk of food insecurity and how these issues link to poverty and social exclusion. Therefore, the profile of the people affected and the development of relevant coping strategies will be investigated. To do this, secondary data analysis was carried out from the "Income and Living Conditions (EU-SILC)" and "Household Budget Survey" surveys of EUROSTAT and ELSTAT, and the relevant indicators were analyzed. Moreover, field research was carried out in food charities within Attica, Greece to conclude the overall situation and the dimensions of food insecurity affecting the population, emphasizing the collection of data regarding the social and demographic profile of the beneficiaries.

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Conservative Decisions with Optimal Cutoff Interval in Prostate Cancer Diagnosis

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In binary classification applications, conservative decision-making that allows for abstention can be advantageous. To this end, we introduce a novel approach that determines the optimal cutoff interval for risk scores, which can be directly available or derived from fitted models. Within this interval, the algorithm refrains from making decisions, while outside the interval, classification accuracy is maximized. Our approach is inspired by support vector machines (SVM), but differs in that it minimizes the classification margin rather than maximizing it. We provide the theoretical optimal solution to this problem, which holds important practical implications. To investigate and illustrate our approach, we conduct both simulation studies and a real-world case study in the context of diagnosing prostate cancer.

Organized Session:

Title: Harnesses Data Science Methods in Demographics Research

Data science, as an interdisciplinary field, harnesses scientific methods, processes, algorithms, and systems to extract knowledge and insights from diverse data sources, including noisy, structured, and unstructured data. Its applications encompass a broad range of domains, featuring predictive analytics, data mining, machine learning, statistics, artificial intelligence, and big data. Despite the widespread application of data science across various fields, it has yet to gain significant traction in Demographics research. This Invited section aims to address this gap by inviting four internationally renowned data scientists with expertise in distinct application fields: clinical study, automatic intelligent modeling, and forensic science.

A Bayesian Asymmetric Approach to Modelling Volatility on Portfolios with Many Assets

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This study proposes a Bayesian approach for estimating and forecasting asymmetric GARCH models with Student's t-distributed errors for a hedge fund portfolio with 106 assets from various European exchanges, where the dimension of the dataset is reduced using dynamic principal component analysis (DPCA). MCMC methods simulate the posterior distribution of the model parameters and the resulting predictive distributions allow us to obtain risk measures. The current study follows a similar study by two of the authors where a Bayesian GARCH (1,1) approach with t-distributed errors was taken in which asymmetry was not accounted for. Asymmetry in GARCH models can be an important inclusion in modelling financial volatility due to their capability of capturing the leverage effect scenarios where negative shocks have a stronger impact on volatility than positive shocks. A GJR-GARCH model approach is used to cater for asymmetry. The performance of the proposed method is evaluated using an extended time horizon of real data as a test period. By comparing with aforementioned results on the Bayesian GARCH (1,1) model, we aim to determine whether catering for asymmetry when analysing hedge fund portfolio risk is advantageous for our case study.

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SIR Endemic Model in Semi-Markov Media: Averaging and Diffusion Approximation

Mariya Svishchuk

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This research is devoted to the development of diffusion approximation principle for the Endemic SIR Model in Semi-Markov media. The population under investigation is divided into subgroups with different rates of disease spreading. Randomness is introduced through the coefficients of the model: the coefficients are directed by the Semi-Markov process which serves as a switching process. Contacts between subgroups are modelled by transition probabilities. Averaging and diffusion approximation have been investigated and simulated.

Investigating the Importance of Food Waste Management in Costing in the Tourism Sector in Greece

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The purpose of this study is to investigate how food waste is managed by food service enterprises in the tourism sector in Greece and how they deal with the relationship between food waste and the cost of operating their food service divisions. The survey is conducted in a large number of enterprises in the tourism sector in Greece, both in the hotel sector and in the catering sector in general.

Keywords: Waste management, Costing, Managerial accounting, Tourism.

Homogeneity Test on Error Rates from Ordinal Scores and Application to Forensic Science

Larry Tang

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The Receiver Operating Characteristic (ROC) curve is used to measure the classification accuracy of tests that yield ordinal or continuous scores. Ordinal scores are common in medical imaging studies and, more recently, in black-box studies on forensic identification accuracy (Phillips et al., 2018). To assess the accuracy of radiologists in medical imaging studies or the accuracy of forensic examiners in biometric studies, one needs to estimate the ROC curves from the ordinal scores and account for the covariates related to the radiologists or forensic examiners. In this talk, we propose a homogeneity test to compare the performance of raters. We derive the asymptotic properties of estimated ROC curves and their corresponding Area under the Curve (AUC) within an ordinal regression framework. Moreover, we investigate differences in ROC curves (and AUCs) among examiners in detail. We construct confidence intervals for the difference in AUCs and confidence bands for the difference in ROC curves for performance comparison purposes. First, we conduct simulations on data where scores are assumed to be normally distributed, and the features include both categorical and continuous covariates. Then, we apply our procedure to facial recognition data to compare forensic examiners.

Organized Session

Title: Harnesses Data Science Methods in Demographics Research

Data science, as an interdisciplinary field, harnesses scientific methods, processes, algorithms, and systems to extract knowledge and insights from diverse data sources, including noisy, structured, and unstructured data. Its applications encompass a broad range of domains, featuring predictive analytics, data mining, machine learning, statistics, artificial intelligence, and big data. Despite the widespread application of data science across various fields, it has yet to gain significant traction in Demographics research. This Invited section aims to address this gap by inviting four internationally renowned data scientists with expertise in distinct application fields: clinical study, automatic intelligent modeling, and forensic science.

Quantitative Modelling of the Demographic Aging Process

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With the development of medical technology and improvements in healthy lifestyles, human life expectancy is increasing; consequently, the number of elderly people is also growing. The growth rate of the elderly population in Korea is the highest in the world. The aim of this paper is to attempt to describe the changes in the boundaries initiating an individual's old age. An indication of the structural changes taking place in the senior group, including double ageing in Europe and Poland. The study undertook the task of describing the current trends in structural change in the senior group. Additionally in this study we use multiple regression analysis for indicating changes in the structure of age groups in the senior group. The analyses were conducted for selected European countries.

Keywords: Multivariate modelling, Aging trends, Regression analysis, Double aging.

The Impact of the COVID-19 Pandemic on the Life Expectancy of the Population of Greece at National and Regional Level: 2020-2022

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The onset of COVID-19 in Greece caused a significant effect on the mortality and morbidity of the population and created major problems for the country's health services. In this work, we construct Life Tables by Cause of Death with particular reference to COVID-19 to estimate the impact of the pandemic on the life expectancy of the population; the analysis is performed at national as well as regional level considering the 13 administrative regions of the country. For the purpose of the study, we employ population counts based on the 2021 census and diagnosed deaths of COVID-19 compiled by the National Organization of Public Health (EODY) during the period October 2020 to March 2022. The results show that the pandemic reduced the life expectancy of the country's population by two years; the effect was greater for men (2.2 years) and slightly smaller for women (1.9 years). At regional level, the impact of the pandemic on life expectancy was lowest in islands (1 year or less). On the other hand, the effect was particularly pronounced in the regions of Macedonia, Thessaly and Thrace where, due to the pandemic, life expectancy at birth was apparently reduced by at least 2.1 years. Future research will focus on the interpretation of these early results employing socioeconomic attributes and on assessing the interaction between COVID-19 mortality and selected causes of death which tend to shape observed health-related outcomes.

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Anonymization with no Gender Information Loss: Investigating the Demographic “Profile” of Diligent Greek Students belonging to Vulnerable Social Groups of the 2019-20 Academic Year

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Efficient data anonymization has become a matter of great concern nowadays since sharing data and microdata without revealing sensitive information is imperative. National public organizations collect data usually containing personally identifiable information (PII). Although there are treasuries of rare data accessible under special permissions for their strictly research use, applying data anonymization techniques to such data frequently leads to information loss. The motivation behind this study is to present two different algorithmic techniques inspired by optimizing language models to obtain gender information before applying data anonymization. The analysis was based on raw data of the diligent Greek students belonging to vulnerable social groups of the 2019-20 academic year who applied for a financial support scholarship program offered by the State Scholarships Foundation (IKY) and funded by the operational programme “Human Resources Development, Education and Lifelong Learning” Partnership Agreement for the Development Framework (2014-2020). Additionally, the demographic “profile” based on a random sample of 90% of the beneficiaries of the diligent Greek students belonging to vulnerable social groups of the 2019-20 academic year program is to be presented. This methodological study aims to contribute to the continually growing field of data anonymization techniques applied to large microdata datasets with less information loss in harmony with the PII data protection principles.

Keywords: Data anonymization, Information loss, Large microdata datasets, IKY.

A way of eliminating a nuisance parameter with the use of an independent sample

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Abstract. The estimation of the structural parameter in the presence of a nuisance parameter is an old and challenging problem. The usual estimating method is the plug-in likelihood method, using the same set of data for estimating both the structural as well as the nuisance parameters. The aim of this paper is to provide an optimal estimating function for the estimation of the parameter of interest using the plug-method, when an estimator for the nuisance parameter is available independent of the sample used to estimate the structural parameter.

Keywords: Estimating function, nuisance parameter, adaptive score function, optimality criteria

Algorithms for Estimation of Multivariate Alpha-stable Distribution

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The area in which a multivariate α -stable distribution could be applied is vast; however, a lack of parameter estimation methods and theoretical limitations diminish its potential. Traditionally, the maximum likelihood estimation of parameters has been considered using a representation of the multivariate stable vector through a multivariate normal vector and an α -stable subordinator. This presentation introduces an analytical expectation maximization (EM) algorithm for the estimation of parameters of symmetric multivariate α -stable random variables. Our numerical results show that the convergence of the proposed algorithm is much faster than that of existing algorithms.

Keywords: EM algorithm, α -stable distribution, Stochastic simulation.

Non-stationary Financial Risk Factors and Macroeconomic Vulnerability for the United Kingdom

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Monitoring and quantifying systemic stress in the financial system is a key exercise of macroprudential policy. Tracking the build-up of financial vulnerabilities is a basic component of financial stability. One way to do this is by the creation of indices that act as a signal for the policy maker. A common way to create such measures is by compressing available information into a few factors. While factor modelling in finance and economics has a rich history, most of the applications tend to focus on stationary factors. This paper proposes deviating from this trend by proposing a non-stationary factor model. The key advantage of non-stationary factor modelling for financial stability, is that financial stress is characterized by a high degree of inertia. Modelling this with a stationary framework will only allow us to track sudden surges in financial stress, which is equivalent to tracking the start of a financial crisis. Furthermore, due to its stationary nature, such measures tend to revert to the mean very quickly unless one allows for heteroskedasticity. Moving away from the stationary paradigm will tackle this without the need to include heteroskedasticity in our model. Furthermore, a non-stationary model would allow for tracking of gradual build-up of stress, which a stationary model would not necessarily be able to. Furthermore, while some popular measures of financial stress are describing the variance-covariance structure of the financial stress indicators, the new index can capture the tails of the distribution that is higher moments of it. In turbulent periods that is in times of high financial stress values of the indicators are often tail events. We argue that this a key advantage

of our construction. While the advantages of a non-stationary factor model for tracking financial vulnerabilities is clear, it is not trivial to construct such a measure. The reason for this is the concept of spurious regression and correlation which has been known for about 80 years. It is also clear that a limit theorem is needed to relate them, which may not exist if the variables are nonstationary. In particular, the empirical mean and variance of non-stationary time series need not be constant. This paper will offer an overview of how to construct non-stationary dynamic factors of financial stress. We will then use the non-stationary factor modelling framework to construct the UK Financial Stress Index (UKFSI) for the United Kingdom.

Keywords: Systemic stress, Financial Stress Index, Dynamic Bayesian Factor Model, Financial System, Macroprudential Tool-kit, Mixed-frequency, Non-stationary Factor Model.

Generalising Maintainability to State Re-union Maintainability for Discrete-time Homogeneous Semi-Markov Systems

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The study of maintainability for Markov models [1] is well documented, while maintainability for semi-Markov models was first introduced in [2]. Yet, the concept of maintainability in semi-Markov models demands further investigation. In response, this paper examines maintainable population structures for discrete-time homogeneous semi-Markov models and introduces the novel concept of State Re-union maintainability (SR-maintainability). We demonstrate that under specific conditions, the seniority-based paths linked to SR-maintainable structures converge. This property enables the characterization of the convex set of SR-maintainable structures. For semi-Markov and Markov models estimated on a same data set, the connection between the SR-maintainable region and the maintainable region is investigated.

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Keywords: Markov model, Semi-Markov model, Maintainability, State re-union maintainability, Control theory, Manpower planning.

Mobbing and Leadership in Healthcare Professionals in the Prefecture of Messinia

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The incident of moral harassment (Mobbing) is often found in recent years, and especially in the field of healthcare. An important factor for appearance of mobbing in a healthcare organization, is the quality of leadership and its components. The purpose of this study is to investigate the frequency of mobbing in relation to the quality of leadership in health professionals of public health structures in the prefecture of Messinia. The research population is based on healthcare professionals who work at the hospitals of Kalamata and Kyparissia, the Health Centers and the three Local Health Units of the Prefecture of Messinia. In these structures, 250 questionnaires were distributed to completion. The research tool is a questionnaire consisting of the Negative Acts Questionnaire (NAQ-R) and Copenhagen Psychosocial Questionnaire - COPSOQ (Copenhagen Psychosocial Questionnaire Version III). Based on similar surveys in the Greek area, we expect there to be a percentage of mobbing incidents among health professionals with the quality of leadership moving in corresponding

percentages. It is also expected to observe a difference in the frequency of mobbing incidents between nursing institutions and primary health care structures.

Keywords: Mobbing, Leadership, Quality, Health professionals, Healthcare

Going Concern Audit Opinion: The case of Athens Exchange

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Purpose: The auditor's going concern opinion is essential for information users regarding the company's situation, continuity and sustainable development. The present study examines the determinants of this opinion.

Design/methodology/approach: Our study uses (secondary) data obtained from annual reports, as well as independent auditors' reports that accompany firms' financial statements for the Athens Exchange in Greece. The final sample is composed by 90 non-financial firms for a six-year period between 2017 and 2022. We analyzed the data using logistic regression in the statistical analysis software of EViews.

Findings: The results indicated that leverage positively explains going concern audit opinion; whereas, audit quality, profitability and liquidity negatively affect it. The firm size and audit lag do not have any statistically significant impact upon opinion.

Originality/value: This study comes in contrast to similar studies for stock exchanges from other European countries. This indicates the different nature of the Athens Exchange compared to Europe.

Keywords: Athens Exchange, Greece/Hellas, Going concern, Audit opinion, Financial statements, Leverage, Profitability, Liquidity.

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Seasonal Mortality Patterns in the Czech Republic: The Influence of Climate, Epidemics, and Other Factors

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This paper focuses on a comprehensive analysis of seasonal mortality in the Czech Republic and the identification of key influences shaping this dynamic. We investigate the relationship between seasonal fluctuations in climate, epidemics, and other factors to gain a better understanding of mortality patterns and trends. The exploration employs statistical methods and data from a long-term perspective to pinpoint seasonal variations in mortality and attribute them to specific climatic and epidemiological events. Special attention is given to periods of increased mortality, examining whether there is a correlation with particular climatic conditions or epidemic occurrences. The results of our analysis will provide valuable insights for public health and epidemiological practice. Enhanced understanding of seasonal mortality patterns will enable better planning and implementation of preventive measures, especially during times of heightened risk associated with extreme climatic conditions or epidemic events. Through this paper, we contribute to the discussion on a comprehensive perspective regarding the relationship between the environment, health, and the seasonality of mortality. Our findings may serve as a crucial foundation for future research and intervention strategies aimed at safeguarding public health in the Czech Republic.

Keywords: Mortality, Seasonality, Health, Environment, Czech Republic.

Time Series Analysis – Traditional Statistical Approach or Machine Learning Approach

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Time series forecasting holds a pivotal role in statistical learning and machine learning (ML), with wide-ranging applications in sectors like supply chain and financial industries. Precision in forecasting is crucial for optimizing resource allocation, refining decision-making processes, and tackling dynamic challenges posed by evolving data trends over time. Recent advancements in time series forecasting, particularly with Automatic Machine Learning (AutoML), have proven highly effective for both short-term and long-term univariate time series forecasting. This efficacy extends even further in the case of multivariate time series forecasting. This presentation will delve into these advancements, showcasing the enhanced accuracy compared to traditional statistical learning approaches like Autoregressive Integrated Moving Average (ARIMA) or Vector Autoregression (VAR). While AutoML demonstrates its superiority, it's essential to note that traditional statistical approaches remain the method of choice in certain applications. This presentation will elucidate how to judiciously select learning methods based on the specific requirements of different applications, providing valuable insights for informed decision-making in the field of time series forecasting.

Keywords: Auto ML, Time Series Forecasting, ARIMA, and VAR.

Organized Session:

Title: Harnesses Data Science Methods in Demographics Research

Data science, as an interdisciplinary field, harnesses scientific methods, processes, algorithms, and systems to extract knowledge and insights from diverse data sources, including noisy, structured, and unstructured data. Its applications encompass a broad range of domains, featuring predictive analytics, data mining, machine learning, statistics, artificial intelligence, and big data. Despite the widespread application of data science across various fields, it has yet to gain significant traction in Demographics research. This Invited section aims to address this gap by inviting four internationally renowned data scientists with expertise in distinct application fields: clinical study, automatic intelligent modeling, and forensic science.

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Fuzzy Trend Model with Intervals of Varying Length

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An estimation problem of trends is important in time series analysis. In this study we propose an extended fuzzy trend model for estimating a trend in univariate time series when a seasonal component is absent. In previous fuzzy trend models, it is assumed that location parameters of membership functions are equally spaced. This assumption can lead to a large number of parameters. In a new model this assumption is relaxed to reduce the number of parameters. An identification procedure is also provided and examined by simulation studies. Furthermore, the proposed method is applied to time series of anisakis infection numbers in Japan.

Keywords: Time series analysis, Trend estimation, Fuzzy system.

Convolutional Neural Networks and Surplus Production Models adjusted to the Jack Mackerel Fishery in the Southeast Pacific Associated with Environmental Conditions

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This work studies jack mackerel fishery in Southeastern Pacific (SEP) from 1973-2022, under single-stock unit assumption, and the following variables: 1) total SEP catch (C); 2) catch per standard unit of effort (CPUE) as abundance index of industrial purse-seine fleet off central-southern Chile; 3) standard fishing effort ($E = C/CPUE$); and 4) NOAA sea surface temperature (SST) between 32° - 42°S and 71° - 80°W. The approach proposes modelling and simulation procedures for both surplus production models and deep-learning-based models with environmental variability integration. The implementation of surplus models was performed using CLIMPROD 5.2 software, proposing several ad-hoc models; the deep learning approximation, considers sets of convolutional neural network architectures. Selected models were used for simulation of environmental and fisheries management scenarios resulting in different maximum sustainable yields (MSY). The surplus model considers E and SST as explaining variables: $CPUE = ((a \text{ TSMb}) + d E) (1/c-1)$, assuming landings containing 5-year age classes, recruitment at 2 years age, and environment affecting abundance, with good performance ($R^2 = 0,87$ $p < 0.01$; R^2 Jackknife = 0,86; test Jackknife = good, for the 4 parameters of the model). Two environmental scenarios are then proposed, using SST average from 1999 to 2014 (cold), and from 2018 to 2021 (warmer), obtaining a MSY of 779,151 t and 991,139 t for both scenarios respectively. Regarding the deep learning approach, using monthly data (1973-2021), an autoregressive multivariate convolutional neural network is implemented that considers 36-months lagged SST and fishing effort, obtaining good performance ($R^2 = 0.84$), and capture simulations that range from 504,848 t (SD = 179.556 t) to 1,165,582 t (SD = 147,556 t), on different scenarios. The latter models consider longer autoregressive periods and long memory properties of time series, this approach could be used for short to long-term forecasts, helping with national to international fisheries sustainability-based policies.

Keywords: Convolutional neurals network, CLIMPROD models, MSY, Jack Mackerel, Southeastern Pacific.

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Investigating the Mediating Role of Religious Services Attendance in the Relationship between Religion Variables and Social Class Perceptions

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In the literature, social class is considered important in all aspects of life. However, its relation to religion has not been adequately researched. In this respect, the purpose of this study is to explore the mediating role of attending religious services in the relationship between religious values, beliefs and practices and social class perceptions as measured in the World Values Survey (WVS) questionnaire that classifies respondents into five class categories: upper, upper middle, lower middle, working and lower class. The analysis was based on the 2017-2020 7th wave of WVS datasets for four countries: Germany, Greece, the Russian Federation and the United States. In all four countries, the separate path analysis models provided adequate model fit. In all countries, social class perceptions were positively predicted by religious services attendance, except in the case of Greece where the reverse was true. However, weak total effect of religious services attendance on subjective social class was observed in all countries. The findings showed only in certain cases significant but weak mediation effects of religious values, beliefs and practices and subjective social class by religious services attendance. These results indicate that further research is necessary.

Keywords: Path analysis, Subjective social class, Religious values, Religious beliefs, Religious practices, World Values Survey (WVS).

A Note on Spectral Risk Measures when Systemic Risk is Present

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This paper is devoted to Systemic Risk (from now abbreviated SR) and its potential depiction in the risk spectrum of Spectral Risk Measures. At first, we propose a fundamental way to quantify the existence of SR. Second we argue with common practice which suggests that risk spectrum should solely portray the utility function of the investor-regulator and thus be constructed only according to it. In addition we present and justify two conditions that the risk spectrum should satisfy in regard of the existence of SR and to our knowledge such conditions have not been suggested by another academic or a practitioner. Moreover, we call the Spectral Risk Measures that have a risk spectrum that satisfy those conditions systemic risk aware and we discuss their practicality and applicability.

Keywords: Spectral Risk Measures, Systemic Risk, Complete Measures, Adapted Measures, Coherent Measures.

Analysing Modern Fertility Trends in Greece

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In the period 2000-2021, the TFR of the population fluctuated at very low levels, far below the level of replacement of generations. Between 2000 and 2009, the TFR showed a small increase, approaching a maximum of 1.5 children per woman. Thereafter, it followed a decreasing trend until the time of the coronavirus pandemic, remaining at its lowest low levels. This paper aims to analyse these trends by modelling the age-specific fertility schedule, applying two polynomial functions and estimating crucial changes in the fertility curve, i.e. the age inflexion points. These points signal changing attitudes in women's reproductive behaviour and are not dependent on pre-determined points of fertility curves; hence, they can dynamically and efficiently describe the prevailing trends as well as their changes over time. As the inflexion points change over time, so does the partial contribution of the segments of the human reproductive cycle delineated by them to the overall fertility. This paper proposes a new and innovative way of understanding reproductive behaviour and its adaptations over time.

Keywords: Greece, Fertility modelling, Partial fertility, Inflexion points.

Three Years of Mortality and Health Experience under the Influence of the COVID-19 Pandemic

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The first COVID-19 case appeared in Greece in February 2020. More than four years later, the problem of SARS-CoV-2 infections persists in the country. This paper aims to estimate the effects of the pandemic on the mortality and health of the population living in Greece by comparing the existing mortality regimes and applying a method originating from stochastic analysis for evaluating the health trends. Data comes from the EUROSTAT database in the form of population estimations by age and gender, along with the relevant number of deaths.

Results indicate the pandemic's vast effects, utilising data from 2020-2022. These effects indicate the vast decrease in life expectancy at birth, the differential effects of the pandemic per age and year and finally, and quite expectedly, the high burden of the disease on population health.

Keywords: Greece, Covid-19, Mortality, Health.

Estimates of Stability with Respect to the Number of Summands for Distribution of Successive Sums of Independent Identically Distributed Vectors

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Let X_1, \dots, X_n, \dots be i.i.d. d -dimensional random vectors with common distribution F . Then $S_n = X_1 + \dots + X_n$ has distribution F^n (degree is understood in the sense of convolution).

Let $\rho_{Cd}(F, G) = \sup_A |F\{A\} - G\{A\}|$,

A

where the supremum is taken over all convex subsets of \mathbb{R}^d . Basic result is as follows. For any nontrivial distribution F there is $c_1(F)$ such that

$$\rho_{Cd}(F^n, F^{n+1}) \leq \frac{c_1(F)}{\sqrt{n}}$$

for any natural n . The distribution F is called trivial if it is concentrated on a hyperplane that does not contain the origin. Clearly, for such F $\rho_{Cd}(F^n, F^{n+1}) = 1$.

A similar result for the Prokhorov distance is also obtained. For any d -dimensional distribution F there is a $c_2(F) > 0$ that depends only on F and such that

$$(F^n)\{A\} \leq (F^{n+1})\{A^{e_2(F)}\} + \frac{c_2(F)}{\sqrt{n}}$$

$$\text{and } (F^{n+1})\{A\} \leq (F^n)\{A^{e_2(F)}\} + \frac{c_2(F)}{\sqrt{n}}$$

for any Borel set A for all positive integers n . Here A^ϵ is ϵ neighborhood of the set A .

Keywords: Sums of independent random vectors, Proximity of successive convolutions, Convex sets, Prokhorov distance, Inequalities.

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New Methods of Constructing Confidence Intervals of a Sensitive Proportion in Survey Statistics

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Dealing with sensitive features is an important problem in survey statistics. To elicit truthful responses from respondents, several methods of indirect questioning have been devised, among them Item Count/Sum Technique (ICT/IST), [4]. For a binary sensitive feature, the target

of a survey is the population proportion. Estimators of this proportion are accompanied by standard confidence intervals (CI) based on normal approximation. However, in practice the actual coverage probability of such CIs is not sufficiently close to the nominal level of confidence. We propose two new methods of constructing CIs for a sensitive proportion in ICT/IST surveys. One of these methods uses a parametric bootstrap and the Expectation-Maximization algorithm as in [2]. The other one is based on a completely different idea, namely on computing an exact CI in a parametric model and then substituting a method of moments estimate in place of the nuisance parameter [1]. We use a Poisson distribution to model the answers to the masking neutral question, following [3].

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Keywords: Sensitive questions, Item Count Technique, Exact confidence intervals, Expectation-Maximization, Bootstrap.

Spreading Diseases Models under Vaccination

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To understand how an epidemic spreads, it becomes necessary to analyze and test epidemiological models. Mathematical epidemiological models can contribute to disease reduction and control, thereby aiding real-time decision-making during an epidemic.

In this work, a series of epidemiological models were analyzed in order to control the spread of infectious diseases in a population. The analysis of the models SEIVR, SIRV that take vaccination into account, aim to investigate the effectiveness of vaccination in the population. The results of this analysis showed us that as the number of vulnerable people decreases, the number of recovered people increases. The population of the exposed shows a mobility similar to that of the infected, showing a slowdown in the population of the latter. The addition of the vaccinated compartment led to a decrease in the number of infected as the number of vaccinated increased.

Keywords: Spreading diseases models, Vaccination, Epidemiological modelling.

Sustainable Cultural Routes in Crete – A Stated Preferences Discrete Choice Experiment

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National and regional governments around the world are increasingly promoting cultural routes tourism development (Council of Europe, 2012). Cultural routes represent a recent policy initiative, originating from the Council of Europe in 1987 in order to promote, inter alia, cultural entrepreneurship, cultural heritage and sustainability (Zouridaki et al. 2022). Cultural heritage routes have also been associated with a number of positive benefits affecting local populations and visitors alike (WTO, 2017). As a result, there are currently more than 35 certified Council of Europe cultural routes. Despite their increasing popularity in both the literature and as a tool for tourism development and entrepreneurship, there is a notable gap as far as the absence of empirical evidence regarding policy initiatives shaping their future orientation and evolution (Loulanski and Loulanski, 2011). In other words, there is a paucity of hard proof to support evidence based policy development in this dynamic aspect of tourism activity. Addressing this gap, the current paper presents the empirical findings from a stated preferences discrete choice modelling experiment to visitors in the island of Crete regarding future and hypothetical policy initiatives pertaining to the development of a thematic cultural route along the island. More specifically, a survey questionnaire was administered to a sample of 500 visitors across the island, asking participants to state their preferences for a number of future and/or hypothetical cultural route policy initiatives. These future and/or hypothetical policy initiatives were described in the form of attributes regarding route management, marketing and promotion, sustainable mobility, spatial connections, attitudes towards waste and prices. The preliminary empirical findings from the homogeneous preference specification model indicate that respondents have strong and positive preferences for cultural heritage routes managed by local communities, they are very keen on developing a wider understanding of the cultural route in relation to other national cultural attractions in Greece (provision of context), as well as the existence of a dedicated application to guide them throughout the route. On the other hand, they expressed strong and negative preferences for the creation of a route web-site, and the potential for the route to be managed by the ministry of culture (central administration).

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Keywords: Stated preferences discrete choice modelling, Crete, Cultural routes, Homogeneous preferences.

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Age Peculiarities of the Russian Population Excess Mortality during a Pandemic

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During a pandemic of a new coronavirus infection (COVID-19), mortality increased both directly due to infection and due to indirect losses associated with the organization of medical and anti-epidemic measures. According to preliminary estimates, life expectancy has decreased from 73.4 in 2019 to 71.5 years in 2020 against the background of a long downward trend in mortality in Russian Federation. In 2020, the number of deaths in the Russia significantly increased compared to 2019, the excess deaths exceeded 324 thousand people (18.1%). Direct losses from COVID-19 constitute a third (36.3%) of the value increment deaths. They include two

parts: deaths due to COVID-19 as the underline cause (32.1% of all losses) and due to other causes with COVID-19 as the aggravating factor which is indicated as a co-morbidity on the medical death certificate (4.2 % of all excess deaths). COVID-19 is the most dangerous for people of older age groups, therefore direct losses are formed mainly by their mortality. Indirect losses are determined by cases when death from diseases occurred as a result of non-provision of medical care, a decrease in its availability, a lack of medicines, changes in the lifestyle of the population and other factors which, presumably, should affect all age groups. The final age distribution of excess losses is of interest. Based on the preliminary data of the Russian Federal State Statistics Service for 2020, the increase in age-specific cases of death was calculated (Fig. 1). Excess mortality increases significantly with age starting at the age of 40. Girls at the time of puberty (10-14 years old) also show a significant increase in mortality. The maximum increase in the number of deaths was recorded in the age groups 70-74 years for women and 80-84 years for men. To understand the way the mortality shifts in certain ages have influenced changes in life expectancy the authors use the decomposition method which presents the results obtained in a demographically understandable form. Based on preliminary data on deaths in 2020, life expectancy at birth was obtained at 66.60 for men and 76.48 for women, which is 1.97 and 2.0 years less than in 2019, respectively (68.27 and 78.20). The results of applying the decomposition method are shown in Figure 2.

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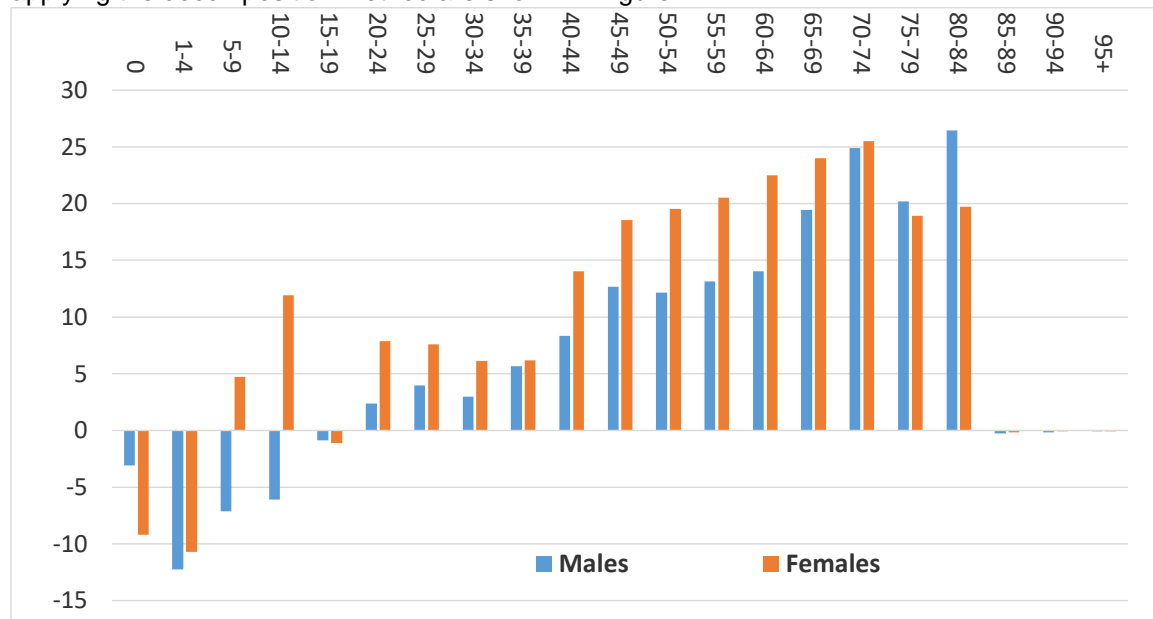


Figure 1 – Increase (decrease) in age-specific number of death in 2020 compared to 2019 in Russia, %

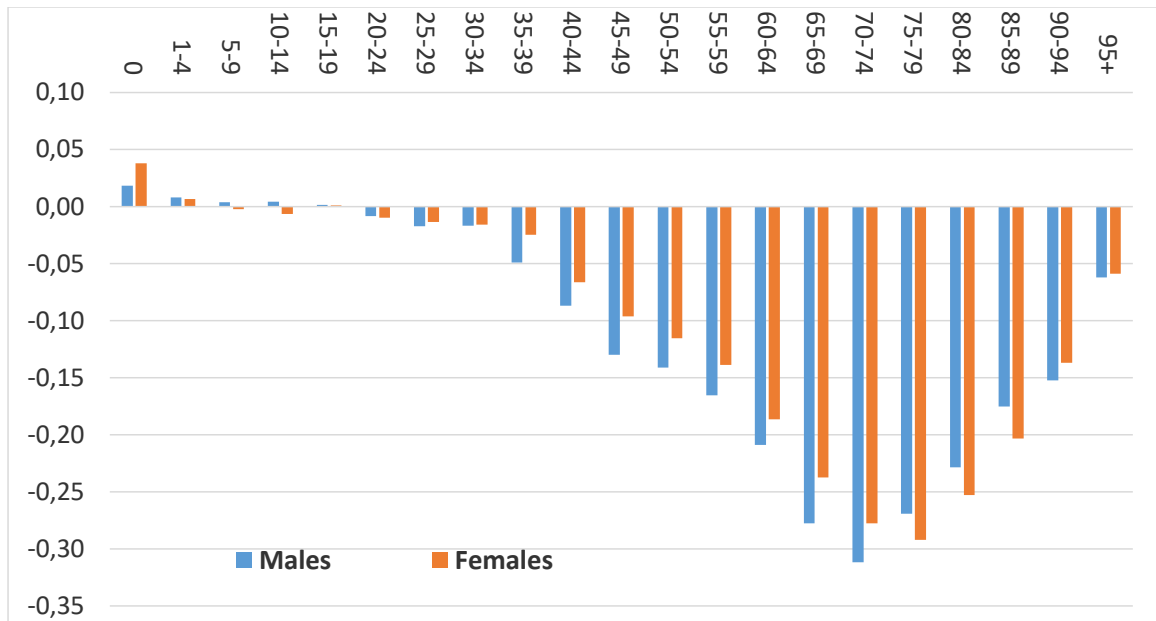


Figure 2 – Contribution of age groups to changes in life expectancy in 2020 compared to 2019 in Russia, years

Mortality in the 70-74 age group made the most negative contribution to the decrease in life expectancy of males, while the maximum increase in their death numbers was registered in the 80-84 age. This is due to the high loss of life expectancy among those aged 70-74 compared to those died over the age of 80. In women, on the contrary, the greatest negative contribution was made by mortality in the age group of 75-79 years, with the largest increase in the number of deaths at the age of 70-74. This difference is associated with a significant increase in the number of deaths of women over the age of 74, while the number of deaths in men decreases after 69 years. Another effect can be exemplified by child mortality. Reduced infant mortality resulted in a gain of 0.02 years for men and 0.04 years for women. At the same time, a more pronounced decrease in mortality among children aged 1-4 years turned out to be almost null in terms of life expectancy dynamics. Thus, despite the fact that the share of direct losses is only one third, excess losses are formed by the death of persons in older age groups. The greatest contribution to super mortality in men was made by persons aged above the life expectancy of 2019, and in women, persons in the age group corresponding to their life expectancy. During pandemic of COVID-19, mortality increased both directly due to infection and due to indirect losses. Direct losses are formed mainly by death of elderly people while indirect losses should affect all age groups. The final age distribution of excess losses is of interest. In 2020, life expectancy in Russia was decreased by 2 years compared to 68.3 in men and 78.2 in women in 2019. Excess mortality increases with age starting at the age of 40. Girls at the time of puberty also show increase in mortality. The maximum increase in the number of deaths was recorded in the age groups 70-74 years for women and 80-84 years for men. The most negative contribution to the decrease in life expectancy were made by death of males in the 70-74 age group and by females of age group of 75-79 years.

Conclusion. Despite the fact that the share of direct losses is only one third, excess losses are formed by the death of persons in older age groups. The greatest contribution to super mortality in men was made by persons aged above the life expectancy of 2019, and in women, persons in the age group corresponding to their life expectancy.

Posters

Solving the Inverse Shortest Path Problem for Earthquakes' Motion

Jeremy Farrugia

Mechanical Engineer, University of Malta

With its wide range of applicability, inverse optimization has been generating a lot of interest recently. One of the very first problems considered in this area was that of the inverse shortest path problem, whereby Burton and Toint (1992) paved the fundamentals of this problem.

This research delves into the concepts of inverse shortest path problem with a thorough discussion of its theory and fundamentals. An application in geophysics will also be considered. According to Fermat's principle, earthquakes follow the path of least resistance. Hence, statistical and machine learning algorithms will be used to obtain the values of the weight matrix to form the mathematical program that defines the shortest path taken by seismic waves. The seismic events that will be considered are the ones that occurred near the Maltese Island and Sicily recently.

A Study of Mobility or Trend of Educational Statuses of Females: A Cohort Analysis from a Large Scale Survey Data in Some Part of India

Barun Kumar Mukhopadhyay

Population Studies Unit, Indian Statistical Institute (retired)

In the present paper, an attempt has been made to analyse the present educational statuses of females, in particular because of their importance in relation to many social aspects of populations and their trend not through usual time series data rather some cohort analysis. Mobility of educational statuses of daughters with respect to their mothers in a way by matrix formation as follows: First of all the subscript (i) is for daughter and the same for mothers is (j) and the entire mobility of education between them is constructed in the matrix format:

1. Percentage of daughters in education level of (i) when mothers' education level is (j) Percentage of daughters who have education level i and the same for mothers and the Sum of diagonal elements of the matrix correspond to same status.
2. Percentage of daughters who have level of education, (i) and the same for mothers is (j) and the summation of all the elements in the upper diagonal matrix indicating higher educational statuses of daughters with respect to their mothers.
3. Percentage of daughters who failed to acquire educational level, (i) of their mothers (j) and the sum of elements of the matrix above the diagonal is lower than mothers

The study based on the above matrix method of educational level of daughters and mothers is conducted in respect of different socio economic classifications obtained from the large scale sample surveys. The present statuses of educational level of females and then the trends among the different social classification have been studied. Moreover, for finding the significant factors the analysis of variance (ANOVA) technique has been done after transforming $\sin^{-1} \sqrt{p}$ (Arc SIN) the proportional (bi-variate) data to statistical (multivariate).data. The final findings are to be completed in course of time.

Keywords: Education mobility, Cohort analysis, Social classifications.

Social Events Schedule



Half Day Excursion

Visit to the Archaeological Museum of Chania and the National Research Foundation “Eleftherios Venizelos”. The continuous history of Crete. Walking tour to Halepa, old aristocrat and industrial area.

When: Wednesday, 12 June 2024

Departure time: 14:15 pm

Meeting point: Conference venue (Cultural Center of Chania, 74 Papandreou st)

Includes: Guide, transportation, entrance fee to the museums, light food and drinks.

Everybody returns by himself / herself

Conference Dinner

When: Thursday, 13 June 2024

Departure time: 19:30

Duration 19:30- 24:00

Meeting point and drop off: Conference venue (Cultural Center of Chania, 74 Papandreou st)

Includes: Transportation, Dinner

Venue: to be announced

Archaeological Museum 15 Skra Str., 731 33, Chalepa | Chania

*History.*¹

The Archaeological Museum of Chania was founded in 1963 and up until 2020 it was housed in the former Venetian Monastery of Agios Fragiskos on Halidon Street, in the Old Town of Chania. In the fall of 2021, the New Archeological Museum of Chania is opening its doors to the public in the historic neighborhood of Chalepa, following a difficult and demanding transfer of all the collections to their new location. The new, contemporary museum boasts 6.000m², it is designed according to the bioclimatic principles and sustainability and will be housing around 3.500 archeological findings (1.000 more than the older building).

The collection of the museum includes findings from excavations in several areas of the city that have been performed during the last 50 years. The exhibits cover the cultural history of Chania from the neolithic period till the Roman Empire. One may find exhibits from the prehistoric period as well as from the

¹ <https://amch.gr/en/history/>

geometric period until the Roman Empire. All of the findings are exhibited according to subject or the location they were excavated. The Archaeological Museum of Chania organizes several, temporal exhibitions, educational programs and various cultural events throughout the year in order to highlight the cultural and historical richness of Chania.

Collection² From the Palaeolithic Age to Roman times.

The permanent exhibition of the Archaeological Museum of Chania

In the first gallery, the exhibition narrative opens with artefacts from the island of Gavdos, dated from as early as the Palaeolithic period. There follow finds from Neolithic sites in the Chania region, and a presentation of life in caves and prehistoric settlements. The Minoan past of West Crete and the importance of the palatial centre of Kydonia, present-day Chania, are revealed through ancient objects and reconstructions.

In the second gallery, the exhibition continues into historical times and the founding of the city- states of West Crete from the 8 th century BC onwards, the most prominent being Kydonia and Aptaera. Special mention is made of the Koinon of the Oreoi, the league of highland cities that was established in the 3 rd century BC. Particular emphasis is placed on coinage, productive activities and trade, as well as the alliances and disputes of the Cretan cities.

In the third gallery, aspects of everyday life unfold through artefacts and the reconstruction of a house that was destroyed in the great earthquake of 365 AD. Sanctuaries, religious customs, the Asklepieion of Lissos, funerary practices and representative examples of sculptures and funerary monuments complete the narrative of life in West Crete up to the 4th century AD.

On the upper floor is exhibited a large part of the Konstantinos, Marika and Kyriakos Mitsotakis Collection, with objects ranging from the 4th millennium BC to the 3rd century AD. The exhibition is enriched by digital presentations, tactile exhibits (copies of ancient objects) accompanied by Braille captions, and an audio guide.

Accessibility

Tactile exhibits accompanied by Braille captions for the visually impaired are presented in specially designed areas in the Museum galleries.

Accessible lifts [semi-basement – ground floor – upper floor].

Accessible Toilets

Wheelchairs. Two free manual wheelchairs are available for persons with disabilities or reduced mobility.

² <https://amch.gr/en/collection/>





Services. Internet and WiFi access, Audio Guide, Gift Shop, Cloakroom and lockers, First Aid Post.

*General Visiting rules*³

✚ Leave any bulky items (including luggage) measuring over 40x40x20 cm and sports

equipment (tennis rackets, etc.) in the cloakroom.

- ✚ Do not bring objects dangerous to the safety of visitors and public health and safety into the Museum.
- ✚ Do not eat or drink except in the areas of the Museum reserved for this purpose.
- ✚ Keep your mobile phone on silent mode while touring the Museum galleries.
- ✚ Smoking and vaping are not permitted inside the Museum

Resource of the pictures: <https://amch.gr/en/collection/>

The National Research Foundation “Eleftherios K. Venizelos”⁴

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The National Research Foundation has been an old objective of Irineos Galanakis, former Metropolitan of the provinces of Kisamos and Selino. It was the result of many years of efforts by the society of Chania and Crete to establish a foundation of national recognition, a centre for research and study of the work and the era of Eleftherios Venizelos, in the hometown of the greatest Greek statesman of the 20th century.

It was founded on the 26th of March 2000.

Source of the picture: <https://www.venizelos-foundation.gr/en/museums/museum-venizelos-residence/a-modern-museum/>



The Foundation premises are located in the residence of Eleftherios Venizelos in Elena Venizelou square in Halepa, Hania. The residence was built in 1877 and it took its present form in 1927, when Eleftherios Venizelos undertook its thorough renovation. In March 2002, the Greek state assumed the ownership of the Venizelos residence, and then ceded it to the Foundation. Today the Venizelos residence is a museum. Since November 2005, the Vloom mansion, which has been restored and is located opposite Venizelos residence, accommodates the Administrative and Scientific Services of the Foundation. In August 2007, the building was renamed into “Metropolitan Irineos Galanakis” Mansion, in the honor of the Foundation Chairman.

Projects – Research

³ <https://amch.gr/en/plan-your-visit/#access>

⁴ <https://www.venizelos-foundation.gr/en>

One of the declared aims of the Foundation is its orientation towards a digital era, through the documentation and the electronic dissemination of the information. In this context it has successfully implemented a significant number of scientific projects (projects of research and education) with the use of new technologies.

The result of this action is, inter alia, the creation of a single digital archive for one of the major political figures of the 20th century, a virtual archive for Eleftherios Venizelos, which allows the historians and anyone interested in history, to navigate, in the globalized world of the society of the information, to an important source of historical knowledge.

*Digital collections*⁵

E-library. Specialized library with recent and rare editions, series of official publications, newspapers and magazines, diplomatic documents, treaties, albums, studies, conference proceedings. The Library has already collected 5.000 titles and the gradual collection of 15.000 titles is estimated.

Digital archive. The archive consists of manuscripts, graphic material (postal cards and lithographs – posters), photographic and cartographic material in order to achieve its main goal: the research and study of the era and work of the great Greek statesman (starting at the mid 19th century until the end of the 1960s). The archive collections of 80.000 records are accessible through the link Digital Archive of the Foundation.

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*A modern museum*⁶

The Residence – Museum “Eleftherios K. Venizelos” is classified as an authentic (documentary) home, since it is recounting the life of a personage and it is preserving authentic items, most of them in their original position. The Residence-Museum is not just a building containing collections or the original furniture of a bygone era, but as a result of a collective and integrated museological project, has developed the ability to recall the past, which in turn gives to the monument great social and political significance.

The Museum – Residence of Eleftherios Venizelos consists of 3 floors and has a total of 18 visitable rooms – stations in its route, which all include authentic museum material. The ground floor and part of the first floor is exactly as delivered to the Foundation by the Venizelos Family and much like when he was living in it himself. Subsequently, five rooms are presenting the action of Venizelos divided into the following topics: “The Rebel”, “The Politician,” “The Diplomat”, “The Man,” and “The Myth” completed with visual material and original museum objects from the Collection of the Foundation. Finally, two “stations” present the murder attempts against Venizelos, respectively in 1920 and 1933 with original documents of the era and visual material. Furthermore, in the attic of the residence the visitor is guided through an interactive –

⁵ <https://www.venizelos-foundation.gr/en/library-archive/digital-collections/>

⁶ <https://www.venizelos-foundation.gr/en/museums/museum-venizelos-residence/a-modern-museum/>

educational exhibition, donated by Stavros Niarchos Foundation, which aims to bring the visitor closer to the world of history fulfilling in this way the museum experience as well as the uptake of information.

The power of a museum is to communicate with its guests. The whole of this effort is clearly aiming not only at gaining the maximum of knowledge one can drain from a place ground on its memories, but mainly on the essential and fecund interaction with the past. This objective becomes even more powerful to the extent that appeals to young people and students who are visiting the Venizelos residence while in contact with the Modern Greek history.

The guests coming face to face with the past have the opportunity to create a strong link between collective and personal memory. A (historic) house is more than a memorial to update the lost past. It is a place where people lived their lives.

About Chania

Chania has always been an alluring spot on this amazing planet of ours⁷. It is the second largest city of Crete and historically a maritime crossroad of three continents. Chania is an enchanting destination which tantalizes all senses. Its main assets are the unparalleled natural landscape, to this day largely unspoiled, combined with the rich cultural heritage which is filled with colors, scents, flavors, music and most of all big and open hearts. The historical, natural, cultural uniqueness and abundance of Chania entices travelers and globetrotters all year round. This cultural melting pot is ceaselessly attracting people from every corner of the world, who wish to experience the essence of Crete and Cretan life. In this human mosaic of residents, locals, foreigners and tourists, everyone leaves their footprint with their personal story tangled in a web of human connections. Each of these stories is worth being told and shared as it speaks volumes about their love for

In a nutshell

The city of Chania is the capital of the Prefecture, extending along the coastal, Northern axis, at the West side of Crete and counts more than 140.000 residents. Since the construction of the Minoan city/state "Kydonia", the city counts 4.000 years of presence in the Greek territory. For as long as there are historical records, Chania, has been a pole of attraction for political forces, economic interests and commercial exchange. The modern name "Chania-Al Hanim" was given during the Arab occupation (9th B.C.-10th B.C.), while during the Venetian era (13th b.c.-17th b.c.) it is renamed to "La Canea". For centuries, the city serves as a nautical crossroad between three continents, a pole of attraction for powerful trade transactions and for Empires driven by intentions of conquest and expansion. Romans, Arabs, Venetians and Ottomans have marched, conquered and left a deep footprint, creating a modern, cultural mosaic on the architectural outlook of the city and a cosmopolitan feel at this remote corner of the Mediterranean.

The plethora of points and landmarks of interest in Chania is vast and spread throughout the history of mankind. From the Minoan civilization to the Venetian era, the sociological and architectural heritage is vivid to this day.

Most popular sightseeing

The most featured picture of Chania is the Egyptian Lighthouse, standing tall since the 16th century A.C facing the Old Town's, Venetian Harbor and the mosque Yali Tzamii (17th Century A.C.). The serpentine alleys of the old town seem like they aim to lure you to a treasure hunt, where around every corner, monuments like the St Nikolas Minaret, the Municipal Market and the Venetian Shipyards (Neoria), religious temples such as the Metropolis Church, the Cathedral temple of Holy Mary Assumption, the Jewish Synagogue, as well as museums like the Archeological Museum, the Nautical Museum of Crete at the Firkas fortress entrance, the Folcloric, the Byzantine collection and the Municipal Library, reveal themselves before you. Other worth mentioning city spots are the Venizelos Memorial Tombs and Museum, the Municipal Garden,

⁷ <https://www.chaniatourism.gr/a-city-of-many-tales/>

Tampakaria area as well as the waterfront districts of Koum Kapi and Nea Chora.

Love affair for life

Chania is an enchanting destination that stimulates all senses. The unparalleled, natural environment, composed by the White Mountains, the countless gorges (Samaria Gorge), the river valleys, the olive & orange groves, the infamous and annually awarded sandy beaches with the turquoise waters like Balos, Falassarna, Elafonissi, Kalathas, Seitan Liman, Golden Sand, Marathi, Sougia, along with a rich avifauna and the worldwide unique indigenous Cretan mountain goat, constitutes a concentrated, small scale, typical Mediterranean ecosystem that attracts naturalists and hikers from all over the world.

This blessed land, so rich in colors, scents, tastes and music all year round, nourishes the body, soothes the soul, elevates the spirit and unlocks the heart. Indeed the open-hearted Cretan hospitality that welcomes you with a shot of tsikoudia, local traditional pies and a short local poem (madinada), leaves no one unmoved. Don't be too surprised if the last thing you will do before you travel back home is to promise yourself a quick return. We will greet you like family and we'll share our stories in this City of Many Tales!



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Witness first-hand the world-known, iconic treasures of Chania. The Egyptian Lighthouse, The Venetian Arsenalia, the Mosque of Kioutsouk Hassan, the Municipal Market and the Municipal Gardens with the tower clock, the Venizelos Tombs and many more city landmarks are there for you to discover.

Byzantine Walls

Address: Karaoli Dimitriou Street, Old City of Chania

The city is fortified during the Byzantine era

The Byzantine Wall surrounds the hill of Kasteli, where the first inhabiting of the city is located. It was built in the 12th century and its outline is irregular with a longitudinal axle from East to West, where its two central gates were located. The Wall consists of rectilinear parts, interrupted by small oblong or polygonal towers and it was built on top of ruins of an older fortification of the Hellenistic period. The wall is easily visible during a typical tour around the old city of Chania.

Gate and Rampart Sabbionara

Address: Epimenidou side road, Old City of Chania.

The gate of the sand, an exit to the shore.

The rampart Sabbionara that still preserves its Turkish name "koum – kapi (Kum Kapisi = the Gate of the Sand), is located on the northeast corner of the Venetian walls and is completely constructed on the shoreline. On the front of the rampart, the circular Venetian emblem of the lion of Agios Marcos is still

preserved. Its external side had been modified during the Turkish period and it remains the only preserved gate up to this day. The old harbor of Chania has preserved its character and historic footprints since it is occupied solely by small sized fishing boats, because of shallow waters.



Byzantine and post-byzantine collection

Address: 78 Theotokopoulou Street, Old City of Chania. Tel.: +30 28210 96046

The collection is housed at the north-west, interior part of the fortification walls that was renamed to Monastery of Saint Salvatore. The exhibition is focused on the historical and artistic identity of the region of Chania during the Byzantine and Post-Byzantine period.

The exhibits have been separated in units according to their category (Mosaics, Signs, murals, ceramic, sculptures, coins etc.) and are displayed in chronological order.

Nautical museum of Crete

Address: Akti Kountourioti, Venetian Port of Chania, Tel.: +30 28210 – 91875,

The great Cretan nautical tradition through the centuries

The Nautical Museum of Crete is located at the entrance of the historical fortress “Firka”. It was founded in 1973 in order to honor the nautical traditions and history of the island. The Museum collaborates and interacts with other Nautical Museums of Greece and abroad.



The permanent exhibition includes 2.500 items, such as relics, objects found in the bottom of the sea, paintings, maps, photographs, models of ships, nautical equipment etc. The exhibits are organized in units, in chronological order from the Copper Age until today. There is also a special exhibition of maritime ecosystems, with a rich collection of shells from different places of the world.

An important step of growth and significant addition was the creation of a permanent exhibition of ancient and traditional shipbuilding. The main exhibit of the museum is the reconstructed Minoan ship “Minoa”. It is an experimental model, faithful copy of the original ancient commercial ship. Other exhibits are the tools and the materials that were used for its manufacture, some photographs and a map of its experimental travel.

Municipal art gallery of Chania.

Address: 98-102 Halidon Street, Chania, Tel.: +30 28210 92294 / +30 28210 36190, info@pinakothiki-chania.gr, www.pinakothiki-chania.gr

A vivid collection of fine art from the last three centuries. The Municipal Art Gallery of Chania hosts works of painting, engraving and sculpture of Greek

and local artists, that date back from the 18th century until today. The main collection of artwork that is displayed was donated by Lykourgos Manoysakis at the end of the 50s.

In the years that followed, more important donations came to light, as that of Kostas Ioannidis and Panagiotis Grabbalos, as well as offers of individual works from many artists, natives and foreigners. The Municipal Art Gallery of Chania operates as a pole of a wider cultural development; it creates significant editorial activity while it organizes and hosts exhibitions, speeches, meetings, educational programs and other activities, throughout the year.

Historical archive of Crete. All the details of the rich history of Chania
Address: 20 I. Sfakianaki Street, +30 28210 52606, mail@gak.chan.sch.gr

The Historical Archive of Crete is one of the first archiving services of Greece. It was founded in Chania in 1920, with the initiative of the General Governor of Crete; today it is a public inter-prefecture service, a decentralized department of the General Archives of the State and it is under the jurisdiction of the Ministry of Education.

It includes approximately 1.000.000 historical documents. Great historical collections, as the official correspondence during the Cretan Revolution, many private collections of Rebels and other distinguished individuals, the archives of Cretan Fighters, the archives of the Turkish Administration in Crete, of the Central Translation Office of Crete, of the Cretan Government from German Occupation, are all included in the Archive. Together with the archival material that it possesses, the Historical Archive of Crete has created a historical and folklore department. In the first room of the museum department, personal souvenirs of the ethnarch Eleftherios Venizelos are exposed.

There are rooms dedicated to the Cretan Fights, the Cretan State, the Battle of Crete and the Resistance of the Cretan people. In addition, the folklore department offers the visitor, the opportunity to see a representation of a typical Cretan house (loom, furniture, embroideries, handicrafts, etc.). Aim and mission of the Archive is the meditation, rescue, classification and protection of every kind of archives and heirlooms that concern the History of Crete, as well as to make them available, without restrictions, to researchers, students and visitors.

Museum of the Greek national football team

Address: 40 Tsouderon Street, +30 30 28210 44713, www.galanolefkosfaros.gr
Unique exhibits for the sports-oriented

The Museum of the Greek National team is unique in Greece and one of the few that exist worldwide at national team level. Inside this museum, the history of the Greek National football team comes to life again and the visitor can learn more about it through the hundreds of objects and shirts of the current National team, as well as of their predecessors.

Some of the most popular objects that somebody can enjoy in the Museum are the shirts of the International Greek Team from historical games and more, the replica of the Cup from the European Championship 2004, the ticket of the final game Greece-Portugal, the ball from the game Greece-Nigeria 2-1, the unique victory of the National Team in the World Cup etc.

Center of Mediterranean Architecture (Grand Arsenal)

Reinventing old uses in a spectacular way.

The Grand Arsenal is the last of the 17 Neoria to the west. Its construction started in 1585 by the Intendant Alvise Grimani. A new era began for the Grand Arsenal with the addition of the second floor, in 1872, during the Ottoman era. The building hosted several, important public services and authorities. From a roofless, abandoned site, today the building has given a second chance to life by being converted into a remarkable multipurpose space for events and expositions. After its restoration in 2002, it is now the Center of Mediterranean Architecture, hosting important cultural events, scientific and political symposiums, artistic exhibitions, international venues with special emphasis on architecture.

Churches & Monasteries

The Greek Orthodox Church in Crete and across the Greek nation played an instrumental role in preserving the Hellenic identity during the Venetian and Ottoman occupation.

The Holy Metropolis of Kydonia and Apokoronou is headed in Chania city and includes the peripheral areas of Chania and Apokorana in the Chania prefecture. Christianity in Chania dates back from the 1st brought by Cretan converts favoring Judaism. During the first Byzantine period (330-825A.C.), the battle known as Iconoclasm between the iconoclasts and those favoring the icons led to the annexation of the Cretan Church to the throne of Constantinople. However because of the oppression coming from Constantinople, it gave leverage to the Arabs and the gradual Arabic occupation by the Saracens in 823-827A.C. leading to the Islamization of a big part of the population. The second Byzantine period, which was signaled by the reoccupation of the island by general Nikiforos Fokas in 961A.C. essentially, signaled also the reestablishment of Christianity and the reorganization of the Cretan Church by creating new parishes.



After 1204, a large part of Crete was occupied by the Genoese and by 1211 the Venetians had occupied the entire island. Despite their strong efforts, they failed at uprooting the Greek Orthodox Church. In the centuries that followed, the clergy in Crete was considered a place for opportunities, political rise and lobbying. Being a remote part of the Mediterranean, most clerks and priests were uneducated, ignorant and mostly corrupted. However the lay people of Chania resisted the Catholic doctrine and kept their fatherly heritage alive.

Cathedral of Mary (or Trimartiri) – Chania old City (the cover picture)

Chania, Halidon Street, Entrance: Free (with appropriate clothes) +30 28210 43082

The Metropolis of Chania in the heart of the Old Town.

At the center of Chania, dominates the historical Trimartiri, the Cathedral Temple of Chania or else, the Temple of Eisodion of Theotokos. The Temple of Eisodion, as Cathedral and Metropolitan and Protector of the City, concentrates the religious and generally devotional interest of godly population of Chania.

During the 150 years of its life, the Temple has been identified with the fate, the life and the history of the City and has been valorized as one of the most remarkable historical monuments of Crete. According to historical testimonies, on the spot where the Cathedral Temple is located today, a small Temple existed since the beginning of the 11th century, dedicated to Eisodia of Theotokos. The Venetians demolished this small Temple and replaced it with a big storehouse for the needs of their Monastery, located across Halidon Street. Later on, when the Ottomans enslaved Crete (1695), they transformed this Catholic storehouse into a soap making workshop that operated up to 1850. The construction of the new Cathedral was completed in 1860.

The Temple of Eisodion is also known with the alter name "Trimartyri" because it is designed having three aisles. The central, where Eisodia of Theotokos are honored, the right, where the Three Hierarches, Fathers and protectors of Greek Language are honored, and the left, where Agios Nikolaos is honored, compensating for the homonym

Practical Information

Basics

Time (GMT) +2 hours

Power 220v 50AC

Emergencies call 100

Top speed 100-120 km/h

Currency

Greece' currency is Euro. Banks' hours 08:00- 14:30. For currency conversions please visit <http://www.xe.com/>.

ATMs are located everywhere in Chania, but the first you can find is in the airport. Get served directly and easily. Cash or credit cards make your moves easier and help you to arrange any outstanding issues even shortly before departure or after your arrival at the airport.

Weather in May⁸

In [May](#), [Chania](#), [Greece](#) embraces the wide-armed warmth of spring. Average high temperatures rise to a comfortable 22.9°C (73.2°F), complemented by a further decline in rainfall to 18mm (0.71") over roughly 8 days. The number of bright, sunny days increases, and with a sea temperature at a welcoming 19.1°C (66.4°F), May formally ushers in the beach season in Chania. Hiking trails through gorges and around the mountains are best tackled during this time, providing astounding views of the city resplendent under the spring sun.

- ✚ *Temperature.* May signals a minor shift in the average high-temperature, moving from [April](#)'s enjoyable 18.8°C (65.8°F) to an agreeable 22.9°C (73.2°F). An average nighttime temperature of 15.4°C (59.7°F) is observed in Chania during May.
- ✚ *Humidity.* The average relative humidity in May in Chania is 65%.
- ✚ *Rainfall.* In Chania, during May, the rain falls for 8 days and regularly aggregates up to 18mm (0.71") of precipitation. Throughout the year, there are 119.3 rainfall days, and 509mm (20.04") of precipitation is accumulated.
- ✚ *Sea temperature.* In May, the average sea temperature is 19.1°C (66.4°F).
Daylight. The average length of the day in May is 14h and 2min. On the first day of May in Chania, sunrise is at 06:31 and sunset at 20:10. On the last day of the month, sunrise is at 06:09 and sunset at 20:33 EEST.
- ✚ *Sunshine.* In May, the average sunshine is 11.3h.
- ✚ *UV index.* In Chania, Greece, the average daily maximum UV index in May is 6. A UV Index value of 6 to 7 symbolizes a high threat to health from exposure to the Sun's UV radiation for average individuals.

Getting there

By Air.

⁸ <https://www.weather-atlas.com/en/greece/chania-weather-may?c,mm,mb,km>

Airport "Ioannis Daskalogiannis" <https://www.chq-airport.gr/en>

From the airport to Chania:

- ✚ By Public Bus. More information may be found at the following link: <https://www.e-ktel.com/en/>
- ✚ By Taxi. TAXI service is available at the Airport. TAXI stand is located across the "Arrivals B" area.
- ✚ Car Rental from the airport. https://www.chq-airport.gr/en/category-detailed/ctg_id-84/nd_id-466

Police Authority of the airport. +30 28210 63033, Address: Mouzouras, Chania.

By Ferry.

Regular ferry services run from Piraeus (Athens) to the port of Chania. Ferries usually leave in the evening and arrive the following morning. The main ferry firms serving Crete are:

- ✚ ANEK Lines, Information: <https://www.anek.gr/en/>

Piraeus +30 210 4197510, pr-pir@anek.gr

Chania, Plateia Sofokli Venizelou, +30 28210 27500-4

- ✚ Minoan Lines, Information: <https://www.minoan.gr>

- ✚ Blue Star Ferries, Souda Square, +30 28210 80050

Sofokli Venizelou Square, +30 28210 27500

- ✚ Seajets, 210 710 7 710

Port ticket office, Souda Port, +30 28210 81276

Souda port authority: t +30 28210 89240

Chania port authority: +30 28210 98888

Port office: 108

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Roads

Roads are good but Crete is a very large island. A major expressway runs the length of the island east/west while roads going north/south are mostly single carriageway and snake over impressive mountains and through dramatic gorges.

The main highway runs the length of Crete following the north coast. It's not dual carriageway but it is wide, well maintained and well signposted, providing easy access to the north coast beach resorts. Roads over the mountains are generally excellent but the winding roads often mean journey times are longer than expected from reading a map.

Road Help ELPA (OVELPA) 104

Road Help Express Service 154

Road Help Hellas Service 1057

Road Help Interamerican 168

Road Traffic Police

Transportation in the city and around

City Buses (blue) serving city and the areas around, from the city to Kalamaki, Suda bay, Kounoupidiana, Nea Chora, Agioi Apostoloi bay etc.

T. +30 28210 27044, chaniabus@gmail.com, <http://www.chaniabus.gr>

Intercity Buses (green) which links Chania to the whole prefecture of Crete.
Address: 73-77 Kydonias st, Chania, +30 28210 93306, +30 28210 93052

post@bus-service-crete-ktel.com, <http://www.bus-service-crete-ktel.com>

Chania Bus Service: +302821093305

Taxi services. There are a lot of taxis available in the city of Chania. Best way to find a taxi is:

- ✚ To call: 18300, +30 28210 98700, +30 28210 94300, +30 2821098770, +30 2821094144, +30 2821098701
- ✚ to call What's up: +30 6986731880 or
- ✚ to call Vodafone: +30 6947618300,
- ✚ to book at booking@chaniataxi.gr .

Useful phone numbers

- ✚ Organization of Telecommunication 11888
- ✚ Hellenic Meteorological Service 14944
- ✚ Municipality of Chania: +30 28213 41600
- ✚ Police of Chania: +30 28210 25856
- ✚ Police 100
- ✚ Chania Tourism Bureau, Mylonogiani 53, 73 100 Chania, Greece, T. +30 2821341665-6, tourism@chania.gr, <https://www.chaniatourism.gr>
- ✚ Ambulance 166
- ✚ Fire Department 199
- ✚ Chania Hospital "Saint George", Mournies Chania. +3028213 42000
- ✚ European emergency number: 112