

BOOK OF ABSTRACTS



**10TH INTERNATIONAL CONFERENCE ON
ADVANCES IN STATISTICS
APRIL 19 - 21, 2024**

ICAS CONFERENCE

INTERNATIONAL CONFERENCE ON ADVANCES IN STATISTICS

APRIL 19 - 21, 2024

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Dear Colleagues,

On behalf of the Organizing Committee, I am pleased to invite you to participate in 10th International Conference on Advances in Statistics which will held in Budapest – Hungary on the dates between 19 – 21 April 2024.

All informations are available in conference web site. For more information please do not hesitate to contact us. info@icasconference.com

We cordially invite prospective authors to submit their original papers to ICAS-2023

- Panel Data Modelling and Analysis
- Performance Analysis in Administrative Process
- Philosophy of Statistics
- Public Opinion and Market Research
- Quality Control
- Reliability Theory
- Sampling Theory
- Simulation Techniques
- Spatial Analysis
- Statistical Software
- Statistical Training
- Statistics Education
- Statistics in Social Sciences
- Stochastic Processes
- Supply Chain
- Survey Research Methodology
- Survival Analysis
- Time Series
- Water and Statistics
- Other Statistical Methods
- Applied Statistics
- Bayesian Statistics
- Big Data Analytics
- Biostatistics
- Computational Statistics
- Data Analysis and Modeling
- Data Envelopment Analysis
- Data Management and Decision Support Systems
- Data Mining
- Econometrics
- Energy and Statistics
- Enviromental Statistics
- Entrepreneurship
- Mathematical Statistics
- Multivariate Statistics
- Neural Networks and Statistics
- Non-parametric Statistics
- Operations Research
- Optimization Methods in Statistics
- Order Statistics

Selected papers will be published in Journal of the Turkish Statistical Association.
<https://dergipark.org.tr/en/pub/ijtsa>

We hope that the conference will provide opportunities for participants to exchange and discuss new ideas and establish research relations for future scientific collaborations.

Conference Website : <https://icasconference.com>
E Mail: icasconference.academic@gmail.com

On behalf of Organizing Committee:
Conference Chair
Prof. Dr. İsmihan BAYRAMOĞLU
Izmir University of Economics

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19 APRIL 2024 FRIDAY

09:00 – 16:00

Registration

09:45 – 10:15

Opening Ceremony with Live Music Performance

COFFEE BREAK 10:15 – 10:40

Welcome Speech

10:40 – 11:00

:Prof. Dr. Ismihan BAYRAMOGLU, Izmir University of Economics
Conference Chair

SESSION A (11:00 – 12:40)

SESSION CHAIR: Prof. Dr. Ismihan BAYRAMOGLU

11:00 – 11:20

PAPER TITLE : Residual Lifetimes of Dependent Components After System Failure

AUTHOR(S) : **Anna DEMBINSKA**

11:20 – 11:40

PAPER TITLE : Discrete Approximations and Counterparts of Continuous Random Variables

AUTHOR(S) : **Alessandro BARBIERO**

11:40 – 12:00

PAPER TITLE : Discrete Time Three-State K-Out-Of-N System's Failure and Numbers Of
Components in Each State

AUTHOR(S) : **Krzysztof JASINSKI**, Agnieszka GORONCY

12:00 – 12:20

PAPER TITLE : Characterization of the I-Binomial process

AUTHOR(S) : **Leda MINKOVA**

12:20 – 12:40

PAPER TITLE : Reliability of Coherent Systems Characterized by Component Lifetime and Power
Level

AUTHOR(S) : **Ismihan BAYRAMOGLU**

LUNCH BREAK 12:40 – 13:30

Lunch is included into Full Package Registration. Participants who registered as Light Package and/or want to purchase extra ticket should contact to conference registration desk

SESSION B (13:30 – 15:00)

SESSION CHAIR: Prof. Dr. Ugur BAC

13:30 – 13:40 (POSTER PRESENTATION)

PAPER TITLE : Evaluation of Earthquake Insurance Posters From Consumer Perspective
AUTHOR(S) : **Ahmet UYAR**, , Muhammet KOTAN

13:40 – 14:00

PAPER TITLE : Prioritizing The Problems in a Production Area Using Mathematical Model Based Kemira-M
AUTHOR(S) : **Aysenur YURTSEVER**, Pelin TOKTAS , Gulin Feryal CAN

14:00 – 14:20

PAPER TITLE : Comparison of the Latest Inventory Management Technologies and Material Handling Optimization
AUTHOR(S) : **Ugur BAC**

14:20 – 14:40

PAPER TITLE : Progress of Renewable Energy Use in Eu Countries - Statistical Analysis of Trends and Factors
AUTHOR(S) : **Sonia CHIPEVA** , Ventsislava STOYANOVA

14:40 – 15:00

PAPER TITLE : Assessment of A Company's Beverage Production Facilities in Various Countries For Sustainable Production Performance Using Spc-Aroman Integration
AUTHOR(S) : **Gulin Feryal CAN**, Aysenur YURTSEVER, Pelin TOKTAS

COFFEE BREAK 15:00 – 15:20

SESSION C (15:20 – 17:30)

SESSION CHAIR: Prof.Dr. Turan Erman ERKAN

15:20 – 15:40

PAPER TITLE : A Risk Assessment Approach Proposal Based on Lopcow and Eatwos Methods
Integration

AUTHOR(S) : **Pelin TOKTAS**, Gulin Feryal CAN, Aysenur YURTSEVER

15:40 – 16:00

PAPER TITLE : A Nonparametric Test for Network Independence with Distance Correlation

AUTHOR(S) : Kwun Chuen Gary CHAN ,**Pok Him CHENG**, Hok Kan LING, Phillip YAM

16:00 – 16:20

PAPER TITLE : Feature Selection Approach Based on Tuna Swarm Optimization Algorithm

AUTHOR(S) : **Eda OZKUL**

BREAK 16:20 – 16:30

16:30 – 16:50

PAPER TITLE : Efficiency Evaluation of Electricity Distribution Companies in Turkey in 2022 by Data
Envelopment Analysis

AUTHOR(S) : Etkin Ekin KARADAG , **Turan Erman ERKAN**

16:50 – 17:10

PAPER TITLE : GLM with Clustering and Its Application in InsurTech

AUTHOR(S) : **Junyou LI**

17:10 – 17:30

PAPER TITLE : Comparison of Wages in the Czech Republic and Slovakia Depending on Various
Factors

AUTHOR(S) : **Lubos Marek**, Stanislava Hronova, Richard Hindls

Dinner & Live Music at Vadaspark - Budapest

Courtyard Marriott Hotel Departure: 19:00

Dinner is included into Full Package Registration. Participants who registered as Light Package and/or want to purchase extra ticket should contact conference registration desk

20 APRIL 2024 SATURDAY

SESSION D (11:00 – 12:20)

SESSION CHAIR: Prof.Dr. Beyza AHLATCIOGLU OZKOK

11:00 – 11:20

PAPER TITLE : Comparison of The Results of Various Fuzzy Analytic Hierarchy Process Methods
And A Software To Facilitate The Calculations

AUTHOR(S) : Baris Tekin TEZEL, **Ayşe Ovgu KINAY**

11:20 – 11:40

PAPER TITLE : Predicting of Carbon Dioxide Emissions by Machine Learning Methods

AUTHOR(S) : Batuhan OZKAN, **Zeynep YUCESoy**, Fatma NOYAN TEKELI

11:40 – 12:00

PAPER TITLE : A Hybrid Fuzzy Approach to Analyze Patient Satisfaction Considering Hospital
Technical Requirements

AUTHOR(S) : **Beyza AHLATCIOGLU OZKOK** , Elif YAFEZ

12:00 – 12:20

PAPER TITLE : Actuarial Analyzing Symmetric-Asymmetric Dependence for Joint Lifetimes and Its
Application to Insurance Data

AUTHOR(S) : **Emel KIZILOK KARA**, Tugba AKTAS ASLAN

LUNCH BREAK 12:20 – 13:20

Lunch is included into Full Package Registration. Participants who registered as Light Package and/or want to purchase extra ticket should contact to conference registration desk

SESSION E (13:20 – 15:00)

SESSION CHAIR: Prof.Dr.Burcu HUDAVERDI

13:20 – 13:40

PAPER TITLE : The Assessment of Risk Premium for Archimedean Copulas

AUTHOR(S) : **Kubra DURUKAN**, Emel KIZILOK KARA

13:40 – 14:00

PAPER TITLE : Reliability of Stress-Strength Models Based on Bernstein Copula Approach

AUTHOR(S) : **Burcu HUDAVERDI**, Selim Orhun SUSAM

14:00 – 14:20

PAPER TITLE : Determining the Optimal Number of Clusters: Adjusted Silhouette Coefficient

AUTHOR(S) : Fatih Emre ÖZTÜRK, **Neslihan DEMIREL**, Engin YILDIZTEPE

14:20 – 14:40

PAPER TITLE : Investigation of the Factors Quiet Quitting and Quiet Firing With the Structural Equation Modelling: A Pilot Research On Health Professional's

AUTHOR(S) : **Merve AKBAS** , Ali Mertcan KÖSE

14:40 – 15:00

PAPER TITLE : Reliability Analysis of a Complex Safety-Critical System With Heterogeneous Components Having Proportional Hazard Rates

AUTHOR(S) : Teega Venkateswara RAO, Ruthwika BOYAPALLY, **Sameen NAQVI**

COFFEE BREAK 15:00 – 15:40

SESSION F (15:40 – 17:30)

SESSION CHAIR: Prof.Dr. Tugba OZKAL YILDIZ

15:40 – 16:00

PAPER TITLE : Binary Chernobyl Disaster Optimization Algorithm for Feature Selection

AUTHOR(S) : **Ozge TEZEL**

16:00 – 16:20

PAPER TITLE : Utilizing Ranked Set Sampling With Varying Probabilities for the Nonparametric Estimation of the Distribution Function

AUTHOR(S) : **Tugba OZKAL YILDIZ** , Yusuf Can SEVİL

16:20 – 16:40

PAPER TITLE : Can Independent Metropolis Beat Crude Monte Carlo?

AUTHOR(S) : **Petros DELLAPORTAS**

16:40 – 17:00

PAPER TITLE : Assessing The Impact Of Non-Pharmaceutical (NPI) Interventions and the Role of Mutations On The SARS-Cov-2 Virus Spread in India Using a Discrete Renewal Process

AUTHOR(S) : **Arindom CHAKRABORTY**

17:00 – 17:10 (POSTER PRESENTATION)

PAPER TITLE : For Dependent Observations: To Generalise the Nearest Neighbour Method

AUTHOR(S) : **Mehmet Siddik CADIRCI**

END OF THE CONFERENCE

21 APRIL 2024 SUNDAY

Budapest - Vienna Transfer with Bus

Hotel Departure 08:00

This service is only for the participants who are willing to travel to Vienna to enjoy city. Bus will drop guests at Vienna city center and no return arrangement will be done. For registration and information please contact conference welcome desk

RESIDUAL LIFETIMES OF DEPENDENT COMPONENTS AFTER SYSTEM FAILURE

Anna DEMBIŃSKA¹

¹Faculty of Mathematics and Information Science, Warsaw University of Technology, ul. Koszykowa 75, 00-662
Warsaw, Poland, e-mail: dembinsk@mini.pw.edu.pl

Abstract

During the talk, I will consider coherent systems composed of homogeneous and possibly dependent components. My aim will be to study residual lifetimes of components which survived the breakdown of the system. Under the quite general assumption that the joint distribution of component lifetimes is absolutely continuous and exchangeable, I will provide a formula describing the joint distribution of the residual lifetimes of interest. Then I will use a copula to model the dependence structure among components and will express the formula for residual lifetimes in terms of this copula. Next, I will look more closely at the residual lifetimes in the special case of Clayton copula and standard exponential marginals. In particular, I will examine the influence of the dependence among components on the residual lifetimes of the surviving ones. I will demonstrate that the results obtained under the assumption of dependence and independence may differ significantly, especially when the system breaks down just after it started working.

The results I will present were obtained jointly with Katherine Davis from McMaster University and can be found in [1].

Key Words: *coherent system; residual lifetime; reliability theory; exchangeability; copula*

References

[1] Davies K, Dembińska A (2024) On the Residual Lifetimes of Dependent Components Upon System Failure, *submitted*.

DISCRETE APPROXIMATIONS AND COUNTERPARTS OF CONTINUOUS RANDOM VARIABLES

Alessandro BARBIERO¹

¹Department of Economics, Management and Quantitative Methods, Università degli Studi di Milano, Milan
(Italy), alessandro.barbiero@unimi.it

Abstract

Approximating an absolutely continuous random variable (rv) through a finite or countable number of mass points is a long-standing problem in probability, which finds possible applications in multiple fields, such as scenario generation in stochastic optimization. The first attempts at defining an approximation to a continuous rv were based on the easily understood criterion of moment matching: the values and probabilities of the k support points of the discrete approximating rv can be found by matching as many integer moments as possible of the continuous rv [6]. An alternative way of approximating a rv through a finite number of points was suggested by [5]: for a fixed k , the so-called “principal points” are those values $x_1, x_2, \dots, x_k$ minimizing the expected squared distance of the continuous rv from the nearest x_j . [4] proposed a discretization approach strictly connected to that of [5], preserving both the mean and the variance of the parent continuous rv. Other authors focused their attention on the cumulative distribution function (cdf) and proposed finding a discrete counterpart (or approximation) of the continuous rv by matching the values of the continuous cdf at integer values [3] or by minimizing some statistical distance between the continuous and the step-wise cdfs over the whole real line [1,2]. In this work, we review these different approaches, trying to highlight their advantages and limitations, paying attention to both theoretical and computational issues. Several parametric distributions, including the exponential, are examined, and for each of them, different discrete approximations or counterparts are constructed and compared.

Key Words: *approximation; discretization; distance minimization; moments; survival function*

References

- [1] Barbiero A, Hitaj A (2021) A new method for building a discrete analogue to a continuous random variable based on minimization of a distance between distribution functions. In 2021 International Conference on Data Analytics for Business and Industry (pp. 338–341)
- [2] Barbiero A, Hitaj A (2023) Discrete approximations of continuous probability distributions obtained by minimizing Cramér-von Mises-type distances. *Statistical Papers* 64(5):1669–1697
- [3] Chakraborty S (2015) Generating discrete analogues of continuous probability distributions - A survey of methods and constructions. *Journal of Statistical Distributions and Applications* 2:6 <https://doi.org/10.1186/s40488-015-0028-6>
- [4] Drezner Z, Zerom D (2016) A simple and effective discretization of a continuous random variable. *Communications in Statistics-Simulation and Computation* 45(10):3798–3810
- [5] Flury AB (1990) Principal points. *Biometrika* 77(1):31–41
- [6] Miller AC, Rice TR (1983) Discrete approximations of probability distributions. *Management Science* 29(3):352–362

Discrete time three-state k-out-of-n system's failure and numbers of components in each state

Krzysztof Jasiński, Agnieszka Goroncy²,

¹Nicolaus Copernicus University, Chopina 12/18, 87100 Toruń, Poland, email: krzys@mat.umk.pl

²Nicolaus Copernicus University, Chopina 12/18, 87100 Toruń, Poland, email: gemini@mat.umk.pl

Abstract

We consider three-state k-out-of-n system composed of components which lifetimes are modelled by independent and identically distributed discrete random variables. The primary focus is the random vector representing the numbers of components in each state. We derive its joint distribution. For illustration, we provide examples of the systems with components with geometrically distributed lifetimes following the Markov degradation process.

Key Words: *multi-state system; k-out-of-n system; reliability theory; discrete lifetime distribution; order statistics*

References

[1] Jasiński K, Goroncy A (2024) Discrete time three-state k-out-of-n system's failure and numbers of components in each state, under review.

Characterization of the I-Binomial process

Leda Minkova

Faculty of Mathematics and Informatics
Sofia University "St. Kl. Ohridski"
e-mail: leda@fmi.uni-sofia.bg

Abstract

In this paper we consider the I-Binomial process. We define the process as a compound Binomial with geometric compounding distribution, and as a discrete time birth process. We show that the definitions are equivalent. Then, using the definitions, we give three characterizations of the process. Some properties and possible applications are given.

Reliability of coherent systems characterized by component lifetime and power level

Ismihan BAYRAMOGLU,

Izmir University of Economics, Faculty of Art & Science, Department of Mathematics,
ismihan.bayramoglu@izmirekonomi.edu.tr

Abstract

The reliability of coherent systems characterized by the lifetime and power level of the components is studied. In the considered n -component coherent system the contribution of each component to the system is characterized by the physical lifetime and power level of the component. The lifetimes of such systems are modeled by the physical degradation times of the components and the power levels of the components that decrease with time. The reliability of these systems is studied through the concomitants of order statistics.

Key Words: reliability, order statistics, coherent system

EVALUATION OF EARTHQUAKE INSURANCE POSTERS FROM CONSUMER PERSPECTIVE

Ahmet UYAR¹, Muhammet KOTAN²,

¹AKÜ/BUBFA ahmetuyar@aku.edu.tr

²AKÜ/BUBFA mkotan@aku.edu.tr

Abstract

The study tries to evaluate earthquake insurance posters with the help of consumer perspective. The problems experienced in earthquake in recent years increase the importance of this issue. In this study, posters on earthquake insurance are evaluated from the consumer's point of view and it is investigated how to follow a more effective way in this regard. In the study, Eye tracking and GSR devices were used to analyse the Earthquake posters and a survey was applied to the participants. The data obtained were compared with each other and both neuromarketing devices and survey data were used in the research. The data obtained in the study were analysed with SPSS software, t test, frequency and percentage distributions were calculated. In addition, GSR value averages of the participants, heat maps, attention and fixation values were calculated from the eye tracking device. As a result of the study, it was concluded that earthquake posters attracted attention, participants tended to look at the centre of the posters, and the attention values of different posters were different.

Key Words: Nöromarketing, Insurance Posters, Consumer Behaviour

PRIORITIZING THE PROBLEMS IN A PRODUCTION AREA USING MATHEMATICAL MODEL BASED KEMIRA-M

Ayşenur YURTSEVER¹, Pelin TOKTAŞ², Gülin Feryal CAN³

¹Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
aysenur@baskent.edu.tr

²Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
ptoktas@baskent.edu.tr

³Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
gfcen@baskent.edu.tr

Abstract

Many problems occur during production because of machine setting errors, operator carelessness, program errors, etc. These reasons leads to a loss of cost and time for the enterprise. Determining which measures should be taken first in order to minimize the losses in question is a problem with a multi-criteria decision-making structure and is a strategic business decision. This decision should be based on several criteria, such as the cost, the number of parts scraped, the amount of lost time, etc. This study utilized a hybrid approach based on mathematical modelling and the Kemeny Median Indicator Rank Accordance-Modified (KEMIRA-M) method to prioritize the problems.

The KEMIRA-M method considers experts' preferences related to the priorities of criteria and the values of these criteria in the evaluation process. The Kemeny Median approach aggregates the criteria ranking of each expert to obtain the median priority components. Then, the criteria weights are assigned according to the median priority component. In the literature, many methods were suggested to improve the weighting procedure of KEMIRA-M based on the selection of weight combinations. In this study, a mathematical model was proposed to determine the weights in the KEMIRA-M method, and the weights were optimized. In this way, the best weight combination of criteria was found with the help of the mathematical model.

The proposed approach was implemented at a company operating in the defense and aerospace sectors. The production problems comprised the alternatives. The costs and losses have formed the criteria. As a result, the most important problem was determined, and the measures were identified.

Key Words: *KEMIRA-M; Mathematical Model; Multi-criteria Decision Making; Productivity; Quality.*

References

- [1] Delice, E. K., Can, G. F. (2020). A new approach for ergonomic risk assessment integrating KEMIRA, best–worst and MCDM methods. *Soft Computing*, 24, 15093-15110.
- [2] Kosareva, N., Zavadskas, E. K., Krylovas, A., Dadelo, S. (2016). Personnel ranking and selection problem solution by application of KEMIRA method. *International Journal of Computers Communications & Control*, 11(1), 51-66.

COMPARISON OF THE LATEST INVENTORY MANAGEMENT TECHNOLOGIES AND MATERIAL HANDLING OPTIMIZATION

Ugur BAC¹

¹ Department of Industrial Engineering, Faculty of Engineering, Atılım University, 06836 Ankara/TURKEY, ugur.bac@atilim.edu.tr

Abstract

This study examines the issue of inefficient material handling and storage systems used in the warehouse of a mass production factory and systematically compares the feasibility of using the latest inventory management technologies and mathematical layout optimization to solve the problem and enhance efficiency. The current inventory and material handling systems are causing several problems, such as high employee dependency, excessive movements for item retrieval and placement, fluctuations in material handling times, and inefficient storage capacity utilization. The latest inventory management technologies being used in the solution of similar problems include robots with Artificial Intelligence (AI) systems based on machine learning [1], Radio Frequency Identification (RFID) systems to determine the location of raw materials [2], and infrared (IR) cameras that monitor the movement of raw materials to overcome random placement problems [3]. All of these technologies have different investment and operating costs and in addition to the cost of these systems, each has different advantages and disadvantages to the company in practical use. Even though any of these systems would have been purchased inventory area should be planned accordingly to achieve the highest efficiency gain from the technology adopted. Since the layout of the inventory should be arranged in any case mathematical optimization of the current layout should also be considered as an alternative solution approach to be evaluated for the solution of the mentioned problem [4]. For this purpose, real-life data has been collected from one of the largest mass production facilities in its sector in Turkey, and the proposed solutions approaches have been evaluated under various performance metrics to determine the best approach. A hybrid decision model that considers both objective and subjective criteria has been used to make the comparison of inventory management technologies. By using this decision model AI-based robots, RFID systems, IR camera systems, and mathematical layout optimization alternatives have been compared under cost, ease-of-implementation, security, sustainability, efficiency, and flexibility criteria by the evaluations of a group of experts. The results of the analysis showed that layout optimization is the best approach for the solution of the current problem. According to the findings of the decision model, a mixed integer programming model that considers the real-life constraints of the mass manufacturer company was formulated to increase the efficiency of material handling and inventory management operations in the warehouse by reducing the movements and loss of time to locate the materials and hence reducing the cycle times and costs. The findings of the proposed mathematical model can be used to design an efficient inventory plan for the existing warehouse. The results of the model showed that the total material handling movements can be reduced by more than half. By doing so, the efficiency and productivity of the inventory operations can be improved drastically.

Key Words: *AI Robots; IR Cameras; RFID; Layout Optimization; Inventory Management*

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PROGRESS OF RENEWABLE ENERGY USE IN EU COUNTRIES - STATISTICAL ANALYSIS OF TRENDS AND FACTORS

Sonia CHIPEVA¹, Ventsislava STOYANOVA²,

¹University of National and World Economy, dep.of Statistics and Econometrics
sonia.chipeva@hotmail.com

²University of National and World Economy, dep.of Statistics and Econometrics
ventzislava@abv.bg

Abstract

The use of renewable energy sources is an important aspect of economic development throughout the world, including Europe, as it provides clean energy and contributes significantly to environmental transformation. The shift towards to energy provided by renewable sources leads to a reduction in both greenhouse gas emissions and dependence on traditional energy sources such as coal, oil, etc. The share of renewable energy in gross energy consumption is a key indicator of Eurostat, the increase of which indicates a reduction in the negative impact of energy use on environmental pollution.

The research is devoted to analyze the progress of the share of renewable energy in gross energy consumption (SRE) of EU countries for period 2004-2022. Two approaches are applied in the analysis. Hierarchical cluster analysis was used to statistical clusterization of the EU members. Three clusters are identified concerning trends of their progress in 2004-2022. The effects of a range of factors (government and business expenditures on R&D, final energy consumption, net GHG emissions, air emission intensity, energy import dependency, energy productivity and else) on the SRE in total as well as in transport, electricity and heating&cooling sectors in the EU countries for 2004-2022 are analyzed developing econometric models based on panel data. Panel models developed allow to identify some specifics of the impact of the factors on the share of energy of renewable sources in countries' economies.

Key Words: Share of renewable energy, Ecological transformation, Cluster Analysis, Econometric Models, Panel Data Models

ASSESSMENT OF A COMPANY'S BEVERAGE PRODUCTION FACILITIES IN VARIOUS COUNTRIES FOR SUSTAINABLE PRODUCTION PERFORMANCE USING SPC-AROMAN INTEGRATION

Gülin Feryal CAN¹, Ayşenur YURTSEVER², Pelin TOKTAŞ³

¹Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
gfcen@baskent.edu.tr

²Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
aysenur@baskent.edu.tr

³Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
ptoktas@baskent.edu.tr

Abstract

Sustainable production means carrying out today's activities with less environmental harm. Sustainable production aims to increase the efficiency of resources, prevent environmental degradation, improve the quality of the product, promote sustainable structure, and prevent any waste generation that may occur during the production phase.

In this context, sustainable production has become an important responsibility for firms, both for themselves and for society. In this study, ten facilities (Türkiye, Jordan, Kazakhstan, Azerbaijan, Pakistan, Kyrgyzstan, Tajikistan, Turkmenistan, Iraq, and Uzbekistan) of a beverage firm in different countries are evaluated in terms of their sustainable production performances, and by determining the facility with the highest sustainable production performance index, it is aimed to give feedback on the aspects in which other facilities need to improve themselves. This aim is required to solve the Multi-criteria Decision-Making (MCDM) problem. There is more than one facility, and these facilities are evaluated considering different sustainability criteria. In this context, the Symmetry Point of Criterion (SPC) and Alternative Ranking Order Method Accounting for two-step Normalization (AROMAN) integration is proposed to determine the production facility that has the highest sustainable production performance index. The SPC and AROMAN methods are preferred because both methods produce results using more than one approach. Additionally, the advantages and disadvantages of the methods performed are debated to determine future research related to these two methods. Ten facilities as alternatives are evaluated to implement the proposed integrated approach, considering 15 sustainability criteria. These criteria were classified as consumption-related, environmental effect-related, education-related, work health and safety-related, and production-related.

As a result of the study, the most important criteria that effects sustainable production performance of facilities was determined and the facility at the first rank in terms of production sustainability performance was identified.

Key Words: *Sustainable production, Multi-criteria Decision Making, SPC, AROMAN, Beverage Company*

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A RISK ASSESSMENT APPROACH PROPOSAL BASED ON LOPCOW AND EATWOS METHODS INTEGRATION

Pelin TOKTAŞ¹, Gülin Feryal CAN² and Ayşenur YURTSEVER³

¹Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
ptoktas@baskent.edu.tr

²Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
gfcen@baskent.edu.tr

³Başkent University, Faculty of Engineering, Industrial Engineering Department, Ankara, 06790, Türkiye,
aysenur@baskent.edu.tr

Abstract

Occupational health and safety (OHS) studies aim to create a healthy and safe work environment by eliminating risks that may harm employees' mental and physical integrity. Human error is the primary cause of most work accidents, according to studies in the literature. It is possible to prevent these occupational accidents caused by human error with occupational safety training. Employers must provide employees with OHS training before they start working.

The most fatal work accidents in Turkey occur in the construction sector. This study proposes a new approach for risk assessment at construction sites. The aim is to determine which construction site has the highest OHS risk and then prioritize precautions for the relevant site. The proposed risk assessment approach was applied to nine construction sites established in different regions of Turkey. The eleven criteria derived from OHS records used in the proposed method are divided into two groups: five are inputs, and six are outputs. The criteria are described as follows: The inputs are the average time spent for OHS training (in hours), the average number of workers educated for OHS, the number of OHS inspections, the average experience time (in years), and the number of employees. The outputs are the average number of accidents, the number of dead, the number of workers with continuous incapacity, the number of occupational diseases, the number of injured workers, and the average lost time (in hours). The input and output criteria weights were determined using the LOGarithmic Percentage Change-driven Objective Weighting (LOPCOW) method. Then, the efficiency of the construction sites was measured using the Efficiency Analysis Technique With Output Satisficing (EATWOS) method. Since all the output criteria are cost-type, the construction site with the highest efficiency parameter was determined to be the riskiest. As a result, improvement suggestions were made to construction companies, starting with the riskiest construction site.

The study can contribute to the literature in terms of gaining a new perspective on the risk assessment process with MCDM and using the integration of the LOPCOW and EATWOS methods.

Key Words: *LOPCOW; EATWOS; Risk Assessment; MCDM; Occupational Health and Safety*

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A Nonparametric Test for Network Independence with Distance Correlation

Kwun Chuen Gary CHAN¹, Pok Him CHENG², Hok Kan LING³, Phillip YAM⁴

¹kcgchan@uw.edu

²pokhimcheng@link.cuhk.edu.hk

³brian.ling@queensu.ca

⁴scpyam@cuhk.edu.hk

Abstract

Network models have received increasing popularity in recent years because of the growing availability of large-scale social network data and the need to model complex systems such as meteorology and biology. First, the distance covariance of a set of random vectors in a network is discussed by extending the existing work on distance covariance, where the latter has the crucial feature that it equals zero if and only if two random vectors are independent and thus can detect arbitrary types of non-linear associations. The proposed measure includes special cases such as the auto-distance covariance in time series and random fields. Based on the new measure, a new test for the independence of network data is developed. In particular, a Ljung-Box-type test for associative autocorrelation in a graph-structured network setting is proposed. Extensive simulation studies with various dependency structures illustrate the test's usefulness. The proposed method often outperforms many prevalent ones in the literature, especially when the data exhibits a non-linear relationship. The asymptotic distributions of the test statistics are established under different network structures with the aid of U-Statistics. We show that our asymptotic results are so general that they can be reduced to many existing results. The test is applied to study the goodness-of-fit of a fitted network model based on the residuals. An example is demonstrated using England and Wales's climate wind speed data, fitted by a generalized network autoregressive model with spatial and temporal components.

Key Words: *diagnostics, network data, nonparametric methods, spatial statistics, U-statistics*

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Feature Selection Approach Based on Tuna Swarm Optimization Algorithm

Eda ÖZKUL

Karadeniz Technical University, Faculty of Science, Department of Computer Sciences, Trabzon/Turkey
eda.ozkul.gs@gmail.com

Abstract

Feature selection, which is widely used in data preprocessing, is a challenging problem since it involves hard combinatorial optimization. The high dimension of the data obtained from the sources is encountered as an issue in many issues such as computation cost. For this reason, eliminating the unnecessary ones among the data and choosing the appropriate ones makes it possible to evaluate the information correctly. Feature selection has been proven to effectively remove irrelevant and redundant features. In addition, feature selection techniques extract the most recognizable features to improve the performance of classification methods. Recently, due to the advantages of simplicity and easy implementation, many meta-heuristic algorithms have shown effectiveness in solving hard combinatorial optimization problems. In this study, the tuna swarm optimization (TSO) algorithm inspired by the cooperative foraging behavior of tuna swarms is used in feature selection. However, the TSO algorithm has not been systematically applied to feature selection problems yet. Therefore, a binary version of the tuna swarm optimization, called BTSO, is improved to select the optimal feature subset that maximizes the classification accuracy and minimizes the feature subset length. To demonstrate the efficiency and superiority of the proposed BTSO algorithm, benchmark datasets from the UCI repository are employed. The classification accuracy, the fitness values, the number of selected features, sensitivity, specificity, and convergence curves are reported for BTSO and its competing algorithms. The results show the ability of the BTSO algorithm in searching the feature space and selecting the most informative features for classification tasks.

Key Words: *Feature Selection; Tuna Swarm Optimization; Binary Tuna Swarm Optimization Algorithm*

Efficiency Evaluation of Electricity Distribution Companies in Turkey in 2022 by Data Envelopment Analysis

Etkin Ekin KARADAĞ¹, Turan Erman ERKAN²,

¹Atilim University, Graduate Student etkinekin@gmail.com

²Atilim University, Dept of Industrial Engineering, erman.erkkan@atilim.edu.tr

Abstract

Electricity consumption is increasing day by day. While various techniques are used for electricity generation today, currently electricity production mostly depends on finite resources. Therefore, not only the production and consumption but also distribution of electricity is crucial. Due to this, concerns related to electricity distribution alarmingly increasing. Consequently, as electricity consumption increases, the responsibilities of electricity distribution companies are also growing. In this paper, the activities of the companies operating in the electric distribution field have been examined to understand their roles in the existing market and draw conclusions about their efficiency. The main goal in the research was finding out which aspect electricity distribution companies have been lacking and how those lacking aspects can be enhanced. To conduct the analyses, data envelopment analysis has been chosen. In Data Envelopment Analysis, the evaluation of relative efficiency is contingent on the careful selection of input and output variables. While there is flexibility in choosing these variables, decisions should prioritize expressing the research goals effectively to yield logical results. Data Envelopment Analysis is a non-parametric, linear programming-based method with the primary objective of comparing similar units and establishing an efficiency frontier to describe the situations of these units [1]. Data envelopment analysis enables the comparison of different, functionally unrelated variables within a single model, offering a robust evaluation without the need for complex mathematical expressions. The fundamental strength of this analysis lies in its ability to present an efficiency ratio and identify areas that lack efficiency, offering insights into potential enhancements. In the research, as a Data Envelopment Analysis method, Charnes, Cooper and Rhodes model had been assigned by the reason of Charnes, Cooper and Rhodes model is more suitable for electricity related studies [2]. The model was input oriented, input-oriented models, where decision-making units aim to achieve specific output quantities with the least possible input. It is noteworthy that electricity distribution companies lack the authority to select their customers, obliging them to serve all individuals in their assigned areas. While deciding which variables to use in the research, the 'Rule of Thumb' is considered. This rule states that the number of decision-making units should be at least twice the total number of input and output variables [3]. In the model, area measurement (kilometer-square), investment amount (in million-Turkish liras), total transmission line length (in kilometers), and the number of permanent employees had been chosen as input variables. Total number of consumers, and Consumption of Consumers Connected to Distribution (Megawatt-hour) were chosen as output variables. If there are too many input and output variables in the equation, more decision-making units than desired would be defined as efficient [4]. All the data is obtained from the Energy Market Regulatory Authority. Using these values, the relative efficiencies of 21 operating companies were calculated for the year 2022.

Key Words: Data Envelopment Analysis; Efficiency; Electric Distribution Companies; Operational Research; Linear Programming

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GLM with Clustering and Its Application in InsurTech

LI Junyou

¹The Chinese University of Hong Kong lijy@link.cuhk.edu.hk

Abstract

Generalized linear model (GLM) is widely used in actuarial pricing and financial modelling because of its flexibility in modelling response distribution, linear structure of covariates and many other properties. An essential problem in applications is that some significant effect cannot be measured directly, presenting heterogeneity of risk even after removing the effect of all collected covariates, for instance, there is no way of knowing a driver's complete driving habits in the pricing of auto insurance. Under some practical assumptions, we propose an alternative optimization algorithm to estimate the parameters in GLM and to detect the underlining risk cluster simultaneously: the IRLS algorithm to estimate GLM is to solve a series of least squares until converges, in each iteration, we can also carry out k-means clustering by considering the least squares as loss function to assign each point to its closest centroid. Considering the credibility as a special GLM, we can also solve the credibility with hierarchical clustering structure using this method. Although the least squares cannot monotonically decrease like traditional Lloyd algorithm, we can show that the likelihood function monotonically increase to limiting solution rapidly by showing it being equivalent to an alternative Newton's method and the inner product of the parameter updating direction and the gradient of the log-likelihood function being non-negative over a convex set. Finally, we also illustrate the simulation performance of our proposed algorithm.

Comparison of wages in the Czech Republic and Slovakia depending on various factors

Lubos Marek¹, Stanislava Hronova², Richard Hindls³

¹ Prague University of Economics and Business, Department of Statistics and Probability, marek@vse.cz

² Prague University of Economics and Business, Department of Economic Statistics, hronova@vse.cz

³ Prague University of Economics and Business, Department of Statistics and Probability, hindls@vse.cz

Abstract

The aim of the article is to compare wage levels and to analyse the factors that influence them. We examined the influence of various factors and finally chose the 4 most important ones - gender, age, education and region. The comparison will be made using data for the Czech Republic and Slovakia. First we will perform the analysis for each country separately, then we will compare the situation in both countries and see if there are significant differences between them. We have data on average wages for the years 2000 - 2021. The data are monitored for 2 quarters of the year. This is due to the stable pool of working time in this quarter (there are the fewest public holidays and therefore a comparable number of working days in different years). The data are available in the form of a frequency distribution table. The width of the interval is 500 CZK (approximately 20 EUR), which is a fine enough granularity for the results to be accurate. Slovak data were converted from EUR to CZK at the Czech National Bank exchange rate. The dataset is very large, with the number of observations increasing each year and now covering more than 50% of the total of all wages in each country. In each year we have the basic characteristics - mean, median, lower and upper quartile, 10% and 90% quantile and standard deviation. However, because we have the original data, we can calculate other necessary characteristics - e.g. additional quantiles, etc. High wages (above EUR 4,000, approx. CZK 100,000) are playing an increasing role in the calculation of average wages. While these wages are relatively few (essentially 0% in 2000 and less than 2% in 2021) - they do raise average wages significantly. We also take this factor into account in our calculations. We will use basic descriptive characteristics, non-parametric level tests and time series analysis for our analysis. We have chosen non-parametric tests for the level comparison because the data did not meet the assumptions for the use of classical parametric tests. We used time series analysis to determine the trend of average wages in each category. We were able to show that all 4 factors have a significant effect on average wages. The results were the same for the Czech Republic and Slovakia. The comparison of wages in both countries shows that the effect of region is much stronger in Slovakia. The other three factors showed comparable influence in both countries. For calculations we used MS Excel and statistical package Statgraphics Centurion.

Key Words: wage, wage factors, analysis, nonparametric test, trend

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COMPARISON OF THE RESULTS OF VARIOUS FUZZY ANALYTIC HIERARCHY PROCESS METHODS AND A SOFTWARE TO FACILITATE THE CALCULATIONS

Bariş Tekin TEZEL¹, Ayşe Övgü KINAY²,

¹Dokuz Eylül University, Faculty of Science, Department of Computer Science, baris.tezel@deu.edu.tr

²Dokuz Eylül University, Faculty of Science, Department of Computer Science, ovgu.tekin@deu.edu.tr

Abstract

The Analytic Hierarchy Process (AHP) is a widely used method for solving Multi-Criteria Decision Making (MCDM) problems. Recently, there has been a growing interest in integrating fuzzy set theory with the AHP method to better express human judgments. For this reason, studies on how many methods respond in a fuzzy environment are increasing rapidly. However, this approach often leads to complex processes due to the representation of fuzzy numbers and related operators. In this paper, we demonstrate software to simplify the computations and compare the results of the three methods using published real-life problems. Another important aspect of the study is the statistical demonstration that our newly proposed method, the Magnitude Based Fuzzy Analytic Hierarchy Process (MFAHP)[1,2], both obtains accurate weight values and obtains these values faster than the known methods. For this purpose, the Modified Fuzzy Logarithmic Least Squares method (MFLLSM)[3] and Buckley's Geometric Mean (GM) [4] methods, which have been shown to give accurate results in many studies, were used. In addition, sensitivity analysis can be performed on the methods thanks to the software we proposed.

Key Words: *Fuzzy multi-criteria decision making; Fuzzy analytic hierarchy process; Magnitude based fuzzy analytic hierarchy process; Performance evaluation; Sensitivity analysis.*

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A Hybrid Fuzzy approach to analyze patient satisfaction considering hospital technical requirements

Beyza Ahlatcioglu Ozkok¹, Elif Yafez²,

¹ Department of Business Administration, Faculty of Economics and Administrative Sciences, Yildiz Technical University, Davutpasa, Istanbul, Türkiye

² Graduate Scholl of Social Sciences, Yildiz Technical University, Davutpasa, Istanbul, Türkiye

Abstract

Hospitals operate under the assumption that they can maintain a sustainable competitive advantage on the market through patient satisfaction (PS) in addition to delivering health services because of shifting global conditions. Hence, hospital managers cannot ignore implementing strategies that foster ongoing enhancement and elevate quality benchmarks, as these factors significantly influence the preferences of individuals for purchasing service. At this point, hospitals collect data through surveys to determine the satisfaction levels of their patients. In this study, we prioritized the survey data of outpatient, inpatient and emergency patients obtained from a private university hospital by using fuzzy Type 2 TOPSIS to determine the expectations of the patients. After determining this prioritization, we used Type 2 fuzzy Quality function deployment (QFD) to listen to the hospital's voice and assess how closely these two perspectives overlap regarding patient demands and how much they relate to the hospital's technical requirements to meet patients' expectations.

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Key Words: (*Times New Roman, 12pt, Bold-Italic*) Patient Satisfaction; Fuzzy TOPSIS; Fuzzy QFD; Type-2 Fuzzy Sets; Patient Survey.

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PREDICTING OF CARBON DIOXIDE EMISSIONS BY MACHINE LEARNING METHODS

Batuhan ÖZKAN¹, Zeynep YÜCESOY², Fatma NOYAN TEKELİ³

¹Bitlis Eren University, Department of Statistics e-mail: bozkan@beu.edu.tr

²Marmara University, Department of Environmental Engineering e-mail: zeynep.yucesoy@marmara.edu.tr

³Yıldız Technical University, Department of Statistics e-mail: fnoyan@yildiz.edu.tr

Abstract

Carbon dioxide (CO₂) emissions have emerged as a significant concern in the 21st century, representing the release of Carbon dioxide compounds into the atmosphere as a result of human activities and industrial processes [1]. These emissions are directly linked to the use of fossil fuels, energy production, industrial activities, and other anthropogenic factors [2]. High Carbon dioxide emissions can contribute to environmental problems by contributing to the accumulation of greenhouse gases and climate change [3]. This study aims to understand the complex relationship between carbon dioxide emissions, economic growth and energy consumption in major economies such as the United States, India and China, which are the world's largest energy consumers and CO₂ emitters. The variables examined in this study include CO₂ emissions (in million tons), Economic Growth (in constant 2015 US dollars), Renewable Energy Consumption (percentage of total final energy consumption), Petroleum Consumption (in million tons), Gas Consumption (in million tons of oil equivalent), and Coal Consumption (in million tons of oil equivalent). The dataset covers the years 1990-2020. Bayesian Network modeling, Random Forest, Decision Trees, Linear Regression, LassoCV, and ElasticNetCV methods were employed to examine the relationships between variables. By employing various machine learning methodologies, it aims to uncover the complexities of the examined relationships, providing valuable insights for policymakers and researchers concerned with sustainable development and climate change.

Key Words: Carbon dioxide emissions, machine learning, renewable energy, economic growth.

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ACTUARIAL ANALYZING SYMMETRIC-ASYMMETRIC DEPENDENCE FOR JOINT LIFETIMES AND ITS APPLICATION TO INSURANCE DATA

Emel KIZILOK KARA¹, Tuğba AKTAŞ ASLAN²

¹Kırıkkale University, Faculty of Humanities and Social Sciences, Department of Actuarial Sciences,
emel.kizilok@kku.edu.tr

²Kırıkkale University, Faculty of Humanities and Social Sciences, Department of Actuarial Sciences,
tugbaaktas@kku.edu.tr

Abstract

Our study aims to evaluate the impact of symmetric-asymmetric dependence on premium calculations for various annuity and life insurance products across diverse age groups. Initially, we obtained marginal survival probabilities for individual lifetimes at specific ages assuming the Gompertz mortality model. Subsequently, we derived joint survival probabilities, considering either independent or dependent future lifetimes for individuals within a group. Analytically, we computed the actuarial calculations for various parameter values. Here, the dependency structure was examined with Archimedean copulas and Khoudraji copulas, which are widely used in the relevant literature for symmetric and asymmetric models, respectively [1, 2].

Furthermore, actuarial computations were conducted using real data on dependent lifetimes sourced from a Canadian insurance company¹[3,4]. Here, the dataset was separated into three distinct populations based on the consideration of age sizes within married couples: scenarios where age differences were not considered, where males were older, or where females were older. The symmetric and asymmetric dependence structures of these populations were determined using an asymmetry test, then the best-fitting models were identified using maximum likelihood estimation and Goodness of Fit tests. Finally, actuarial computations were conducted on the dataset, and analytical solutions were found to be consistent with real calculations. Our findings indicate discrepancies in actuarial calculations depending on whether the data are dependent and symmetrical.

Key Words: *Dependence, asymmetry, copula, multiple life products, actuarial calculations*

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THE ASSESSMENT OF RISK PREMIUM FOR ARCHIMEDEAN COPULAS

Kübra DURUKAN¹, Emel KIZILOK KARA²

¹Kırıkkale University, Faculty of Humanities and Social Sciences, Department of Statistics,
kubraaba@kku.edu.tr

²Kırıkkale University, Faculty of Humanities and Social Sciences, Department of Actuarial Sciences,
emel.kizilok@kku.edu.tr

Abstract

Copula functions, which play an important role in insurance, finance, and risk fields, are used to explain the dependence of random variables [1,2]. These dependency structures are often modeled with Archimedean Copulas in the literature [3]. On the other hand, the risk aversion measure is a significant decision-making tool that insurance and finance companies use when calculating risk premiums [4,5,6].

This study focuses on determining bivariate risk aversion coefficients and comparing risk premiums for Archimedean copulas. For this purpose, firstly, bivariate risk aversion formulas were derived. Then, risk premium coefficients were calculated analytically for parameters corresponding to some Spearman correlations under dependency structures. Finally, a simulation study was carried out for Archimedean copulas at these parameter values. Risk aversion coefficients and risk premium values were numerically computed using the obtained simulation data. As a result, the risk aversion and risk premiums of an insurance company dealing with dependent risks were compared according to each copula family and the results were evaluated.

Key Words: *Dependence, Archimedean copulas, bivariate risk aversion, risk premium*

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RELIABILITY OF STRESS-STRENGTH MODELS BASED ON BERNSTEIN COPULA APPROACH

Burcu HUDAVERDI¹, Selim Orhun SUSAM²,

¹ Dokuz Eylul University, Department of Statistics, e-mail: burcu.hudaverdi@deu.edu.tr

² Munzur University, Department of Econometrics, e-mail: orhun.susam@munzur.edu.tr

Abstract

In this study, we present the reliability of a stress-strength model, defined as $R=P(X_1<Y<X_2)$ where the strength variable Y is between the dependent stress variables X_1 and X_2 . We investigate a copula-based modeling for the stress-strength reliability with bivariate stress. Our proposal involves utilizing a Bernstein copula approximation to evaluate R within the stress-strength framework. We present and compare empirical and maximum likelihood-based estimation procedures through Monte Carlo simulation.

We also investigate conditional reliability in stress-strength models which be defined as the probability that a system or structure will perform satisfactorily under specified conditions, taking into account the relationship between the applied stress and strength. A real data application is presented.

Key Words: *Stress-strength models; reliability; copula; conditional reliability*

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DETERMINING THE OPTIMAL NUMBER OF CLUSTERS: ADJUSTED SILHOUETTE COEFFICIENT

Fatih Emre ÖZTÜRK¹, Neslihan DEMİREL², Engin YILDIZTEPE²

¹Dokuz Eylul University, The Graduate School of Natural and Applied Science, Data Science, İzmir, Türkiye
ozturkfemre@gmail.com

²Dokuz Eylul University, Faculty of Science, Department of Statistics, İzmir, Türkiye
neslihan.ortabas@deu.edu.tr
engin.yildiztepe@deu.edu.tr

Abstract

Clustering, an unsupervised learning technique, partitions observations into groups based on similarity. The widely used k-means algorithm requires a predetermined number of clusters, prompting the exploration of methods for the determination of the optimal number of clusters. This study introduces the Adjusted Silhouette Coefficient as an alternative method, aiming to address limitations observed in existing approaches. We evaluate its performance against well-known methods such as Average Silhouette, Caliński-Harabasz, and Davies-Bouldin on both simulated and benchmark datasets. Comparative assessments employ Rand index and Meila's variation of information criteria, on datasets with known cluster numbers. Our results indicate that the proposed Adjusted Silhouette Coefficient exhibits competitive performance and offers a promising alternative to existing methods.

Key Words: *Cluster analysis, Adjusted Silhouette Coefficient, Average Silhouette, Caliński-Harabasz, Davies-Bouldin.*

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INVESTIGATION OF THE FACTORS QUIET QUITTING AND QUIET FIRING WITH THE STRUCTURAL EQUATION MODELLING: A PILOT RESEARCH ON HEALTH PROFESSIONAL'S

Merve AKBAS¹, Ali Mertcan KÖSE²,

¹ Bezmialem Vakif University, Department of Healthcare Management Istanbul, Türkiye and e-mail: makbas@bezmialem.edu.tr

² Istanbul Ticaret University, Department of Computer Programming Istanbul, Türkiye and e-mail: amertcankose@ticaret.edu.tr

Abstract

After the COVID-19 outbreak, there have been changes in the work culture, and new concepts have emerged by moral injury and quiet quitting. Healthcare professionals can witness patients many emotions, such as pain, loneliness, and hopelessness. In the case of effects of the quality of care, that causes “Moral Injury” and “Quiet Quitting”. “Quiet Quitting” means not leaving the job, not only taking on extra responsibilities but also continuing to work. It consists of two dimensions as “Quiet Quitting” and “Quiet Firing”. Research shows that appreciated employees give meaning to work and their commitment to the organization increases [1]. In this regard, “Employee Resilience” refers to the ability of employees to cope with the difficulties they encounter and improve themselves. It is important to provide efficient service in the constantly changing business environment. This study aims to evaluate the mediating role of employee resilience in the effect of moral injury on quiet quitting and in light of the findings, to propose different human resources (HR) management strategies in the health sector. In this research, the mediating role of employee resilience was examined in the effect of moral injury on quiet quitting and quiet firing by using structural equation modelling. The study collected data from 131 (age: 33.29 ± 9.60) participants working in the health profession through relevant scales. In this respect, the research has an empirical character. First, the essential characteristics of the participants who made the data set were determined using descriptive statistics. While moral injury had a positive effect on Quiet quitting ($\beta=0.648$) and Quiet firing ($\beta=0.366$) ($p < 0.0001$), it was found to have a negative effect on Employee resilience ($p < 0.0001$; $\beta= - 0.383$). However, it was determined in the model that employee resilience had a negative effect on quiet quitting ($\beta= - 0.263$) and quiet firing ($\beta= - 0.289$) ($p < 0.0001$). The indirect effects of employee resilience on the effect of moral injury on quiet quitting and quiet firing were found to be statistically significant ($p < 0.0001$; $\beta_1=0.085$, $\beta_2= 0.104$). In this case, it was determined that employee resilience had a mediating effect in the model. In addition, the structural equation model was supported by the fitted criteria (RMSEA=0.08, NFI=0.93, NNFI=0.96, CFI=0.97, GFI=0.96, AGFI=0.94). As a result, while there is an increase in quiet quitting and quiet firing behaviours’ of healthcare professionals due to moral injury, employee resilience decreases this situation. Many studies have concluded that 72% of Generation Y employees quietly leave their jobs [2]. In the means of this research, improvements are expected to ensure the sustainability of organizations and health systems.

Key Words: *Quiet Quitting, Moral Injury, Employee Resilience, Healthcare Professionals, Structural Equation Modelling.*

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RELIABILITY ANALYSIS OF A COMPLEX SAFETY-CRITICAL SYSTEM WITH HETEROGENEOUS COMPONENTS HAVING PROPORTIONAL HAZARD RATES

Teega Venkateswara RAO¹, Ruthwika BOYAPALLY², Sameen NAQVI³

¹Department of Mathematics, Indian Institute of Technology Hyderabad and ma19resch11001@iith.ac.in

²Department of Mathematics, Indian Institute of Technology Hyderabad and ma20btech11004@iith.ac.in

³Department of Mathematics, Indian Institute of Technology Hyderabad and sameen@math.iith.ac.in

Abstract

A complex safety-critical system is composed of components that are typically encountered in engineering or technology. The malfunction or breakdown of these components can have significant implications for human life, the environment, or property. Various methods have been proposed in the literature to comprehensively understand the reliability of complex safety-critical systems. This research introduces a copula-based approach for assessing the reliability of complex safety-critical systems. Our model assumes interdependence among components of the same type while maintaining independence between different types. The intricate relationships among components of the same type are meticulously captured through copulas, with a unique copula assigned to each component type. Additionally, we presume that the lifetime distributions of components exhibit proportional hazard rates. Furthermore, we employ the concept of distorted functions to derive the system reliability function. To showcase the applicability and efficacy of our approach, numerical examples are provided. This study not only advances the understanding of CSCS reliability but also introduces a novel framework for analysis and decision-making in safety-critical systems.

Key Words: *complex safety-critical system; copula; dependent components; distorted function; proportional hazard rates*

Binary Chernobyl Disaster Optimization Algorithm for Feature Selection

Özge TEZEL

Karadeniz Technical University, Faculty of Science, Department of Computer Science, Trabzon/TURKEY
ozge_tzl@hotmail.com

Abstract

Big data can be analyzed, and important information can be extracted by using data mining and machine learning methods. The biggest challenge in information extraction is the presence of many unnecessary variables that reduce the performance of machine learning methods and provide disadvantages and complexity in terms of calculation time. Feature selection methods are part of data preprocessing to overcome this problem. It aims to improve the performance of machine learning methods by selecting distinctive features that best represent the data. Feature selection methods can be classified into two main approaches: filter and wrapper. In wrapper methods, feature selection is a binary NP-hard problem. One approach to solving NP-hard problems is meta-heuristic algorithms. However, the meta-heuristic algorithms cannot be used directly to solve binary problems without modifications. For this reason, this study modifies the Chernobyl Disaster Optimizer (CDO) to binary CDO (BCDO) and uses this algorithm as a wrapper-based feature selection technique. In addition, well-known UCI datasets are tested and compared with other feature selection methods to demonstrate and verify the performance of the BCDO algorithm. Various evaluation measures are used to evaluate the performance of the BCDO algorithm, including accuracy, the number of selected features, fitness values, sensitivity, specificity, and convergence curves.

Key Words: *Chernobyl Disaster Optimization; Feature Selection; Binary Chernobyl Disaster Optimization; Machine Learning*

UTILIZING RANKED SET SAMPLING WITH VARYING PROBABILITIES FOR THE NONPARAMETRIC ESTIMATION OF THE DISTRIBUTION FUNCTION

Tuğba ÖZKAL YILDIZ¹, Yusuf Can SEVİL²,

¹Department of Statistics, Faculty of Science, Dokuz Eylül University, Izmir, Turkey, tugba.ozkal@deu.edu.tr

²The Graduate School of Natural and Applied Sciences, Dokuz Eylül University, Izmir, Turkey,
yusufcansevil97@gmail.com

Abstract

Several studies focus on the estimation of empirical distribution functions (EDFs) in a finite population setting in ranked set sampling (RSS) and its counterparts [2],[4]. These studies have advanced classical EDFs that allocate equal weight to each sampling unit. Our study focuses on developing design-based estimators for distribution function using RSS methods [1],[4],[5]. These sampling designs follow diverse procedures, in terms of their replacement policies that population units are allocated distinct inclusion probabilities for selection, depending on the chosen sampling methods [1],[3]. Hence, this study introduces a novel approach to estimating the distribution function through the application of RSS techniques, offering a fresh perspective on the subject. The efficiency of the suggested estimators is explored through both theoretical considerations and numerical investigations. Additionally, we explore a pointwise estimate of the distribution function and establish confidence intervals for a practical application using real data.

Key Words: *Ranked set sampling; probability sampling designs; design-based estimators; empirical distribution function, efficiency.*

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Can independent Metropolis beat crude Monte Carlo?

Petros Dellaportas¹

University College London, p.dellaportas@ucl.ac.uk

Abstract:

Assume that we would like to estimate the expected value of a function f with respect to a density π . We prove that if π is close enough under KL divergence to another density q , an independent Metropolis sampler estimator that obtains samples from π with proposal density q , enriched with a variance reduction computational strategy based on control variates, achieves smaller asymptotic variance than that of the crude Monte Carlo estimator. The control variates construction requires no extra computational effort but assumes that the expected value of f under q is analytically available. We illustrate this result by calculating the marginal likelihood in a linear regression model with prior-likelihood conflict and a non-conjugate prior. Furthermore, we propose an adaptive independent Metropolis algorithm that adapts the proposal density such that its KL divergence with the target is being reduced. We demonstrate its applicability in a Bayesian logistic and Gaussian process regression problems and we rigorously justify our asymptotic arguments under easily verifiable and essentially minimal conditions.

Assessing the impact of non-pharmaceutical (NPI) interventions and the role of mutations on the SARS-CoV-2 Virus spread in India using a discrete renewal process

Arindom CHAKRABORTY

Department of Statistics, Visva-Bharati University, India; email: arindom.chakraborty@visva-bharati.ac.in

Abstract

In recent years, the world did not suffer so much compared to the devastation caused by Covid 19. The present study is targeted to investigate the impact of various comprehensive and stringent interventions (as advised by the Government of India) implemented to decelerate the spread of the SARS-CoV-2 virus. It is equally important to study the effects of different mutations found in India. We consider a stochastic model based on discrete renewal process that includes various controlling measures to systematically evaluate their effects on the disease transmission dynamics through three inter-linked components. A Bayesian model has been considered for the infection cycle to observe deaths with upper and lower bounds of the total population infected (attack rates), case detection probabilities, and the reproduction number over time. MCMC technique has been adopted for analysing the data. This model is related to the widely used susceptible-infected-recovered (SIR) model, except the renewal is not expressed in differential form. In this study, we treat interventions as covariates in modelling the average reproduction number. Here the time-varying reproduction number (R_t) has been assumed to be a piece-wise constant function which starts from a baseline prior and mutations are used as covariates alongwith the NPIs.

Key Words: Infection model, Death model, Bayesian analysis, reproduction number, Negative binomial distribution,

FOR DEPENDENT OBSERVATIONS: TO GENERALISE THE NEAREST NEIGHBOUR METHOD

Mehmet Sıddık Çadırcı^{1*}

¹ Department of Statistics and Computer, Faculty of Science, Cumhuriyet University, Turkey

*(msiddikcadirci@cumhuriyet.edu.tr) Corresponding author

Abstract

The Nearest Neighbour method has been widely used in machine learning and data mining because of how easy it is to use and how well it categorizes independent observations. However, its applicability to dependent data structures has been limited due to its incapacity to account for interdependencies between observations. This paper presents a generalised structure for the Nearest Neighbour method that is tailored to dependent observations. We provide an optimised strategy that uses a new metric that considers the interdependencies between the various features as well as the observations, improving the classification accuracy. Extensive research, including performance measurements and cross-validation, has demonstrated that our methodology outperforms traditional Nearest Neighbour approaches in the management of dependent data sets. Our approach plugs a significant gap in the literature by offering a dependable solution for data sets where linkages between observations cannot be ignored.

Keywords: Nearest Neighbour Approach; Dependent Observations; Generalized Framework; Data Interdependencies; Classification Accuracy.

