THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Abstract Book

13th Annual International Conference on Mathematics & Statistics: Teaching, Theory & Applications
1-4 July 2019, Athens, Greece

Edited by
Gregory T. Papanikos

2019

Abstracts

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(In Alphabetical Order by Author's Family name)

Preface

This book includes the abstracts of all the papers presented at the *13th Annual International Conference on Mathematics & Statistics: Teaching, Theory & Applications (1-4 July 2019)*, organized by the Athens Institute for Education and Research (ATINER).

In total 28 papers were submitted by 30 presenters, coming from 15 different countries (Australia, Canada, France, Germany, India, Ireland, Israel, Italy, Mexico, Poland, Romania, South Africa, Taiwan, UK, and USA). The conference was organized into 8 sessions that included a variety of topic areas such as Polynomials, Statistical and Quantitative Methods, Copula Models, Applied Studies in Statistics and Economics, Teaching and Learning Issues, and other. A full conference program can be found before the relevant abstracts. In accordance with ATINER's Publication Policy, the papers presented during this conference will be considered for inclusion in one of ATINER's many publications.

The purpose of this abstract book is to provide members of ATINER and other academics around the world with a resource through which to discover colleagues and additional research relevant to their own work. This purpose is in congruence with the overall mission of the association. ATINER was established in 1995 as an independent academic organization with the mission to become a forum where academics and researchers from all over the world could meet to exchange ideas on their research and consider the future developments of their fields of study.

It is our hope that through ATINER's conferences and publications, Athens will become a place where academics and researchers from all over the world regularly meet to discuss the developments of their discipline and present their work. Since 1995, ATINER has organized more than 400 international conferences and has published nearly 200 books. Academically, the institute is organized into 6 divisions and 37 units. Each unit organizes at least one annual conference and undertakes various small and large research projects.

For each of these events, the involvement of multiple parties is crucial. I would like to thank all the participants, the members of the organizing and academic committees, and most importantly the administration staff of ATINER for putting this conference and its subsequent publications together. Specific individuals are listed on the following page.

Gregory T. Papanikos
President

13th Annual International Conference on Mathematics & Statistics: Teaching, Theory & Applications
1-4 July 2019, Athens, Greece

Scientific Committee

All ATINER's conferences are organized by the [Academic Council](). This conference has been organized with the assistance of the following academics, who contributed by a) setting up the program b) chairing the conference sessions, and/or c) reviewing the submitted abstracts and papers:

1. Gregory T. Papanikos, President, ATINER & Honorary Professor, University of Stirling, UK.
2. Codruta Simona Stoica, Head, Mathematics & Statistics Unit & Professor and Vice-Rector, Aurel Vlaicu University of Arad, Romania.
3. Timothy Young, Director, Center for Business & Manufacturing Excellence (CBME), ATINER & Professor and Graduate Director, Center for Renewable Carbon, The University of Tennessee, USA.
4. Theodore Trafalis, Professor of Industrial & Systems Engineering and Director, Optimization & Intelligent Systems Laboratory, The University of Oklahoma, USA.
5. Ampalavanar Nanthakumar, Academic Member, ATINER & Professor, State University of New York at Oswego, USA.
6. Diarmuid O'Driscoll, Head of Department of Mathematics and Computer Studies, Mary Immaculate College, Ireland.
7. Peter Vranas, Academic Member, ATINER & Professor, University of Wisconsin–Madison, USA.
8. Alessandro Baldi Antognini, Academic Member, ATINER & Professor, University of Bologna, Italy.
9. Kakoma Luneta, Associate Professor, University of Johannesburg, South Africa.
10. Nimer Baya'a, Senior Lecturer A, Pedagogic Supervisor, Head of ICT Center, Al-Qasemi Academic College of Education, Israel.
11. Otman Jaber, Lecturer, Pedagogic Supervisor, Al-Qasemi Academic College of Education, Israel.
12. Olga Gkounta, Researcher, ATINER.

FINAL CONFERENCE PROGRAM
13th Annual International Conference on Mathematics & Statistics:
Teaching, Theory & Applications
1-4 July 2019, Athens, Greece
Conference Venue: University of Athens (Kapodistriako), 48 Akadimias Street, Athens, Greece

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Monday 1 July 2019

08:10-08:40 Registration
08:40-09:00 (Room A): Welcome and Opening Address **by Gregory T. Papanikos, President, ATINER.**

09:00-10:30 Session I (Room B): Statistics

Chair: Codruta Simona Stoica, Head, Mathematics & Statistics Unit & Professor and Vice-Rector, Aurel Vlaicu University of Arad, Romania.

1. Ampalavanar Nanthakumar, Professor, State University of New York at Oswego, USA. A Comparison of Hierarchical and Vine Copulas.
2. Wei-ming Luh, Professor, National Cheng Kung University, Taiwan & Jiin-huarng Guo, Professor, National Pingtung University, Taiwan. Sample Size Calculation with Cost Constraints for Testing the Superiority/Non-inferiority and the Equivalence of Two Poisson Means.
3. Alan Ker, Professor, University of Guelph, Canada. A Generalized KS-Test.
4. Stelios Georgiou, Associate Professor, RMIT University, Australia. Combining Robust Parameter Designs (RPDs) and Supersaturated Designs (SSDs).
5. Stella Stylianou, Senior Lecturer, RMIT University, Australia. Screening Designs under Model Uncertainty.

10:30-11:45 Session II (Room B): Mathematics: Education & Teaching

Chair: Kakoma Luneta, Associate Professor, University of Johannesburg, South Africa.

1. Nimer Baya'a, Senior Lecturer A, Pedagogic Supervisor, Head of ICT Center, Al-Qasemi Academic College of Education, Israel, Otman Jaber, Lecturer, Pedagogic Supervisor, Al-Qasemi Academic College of Education, Israel, Wajeeh Daher, Head of M.Teach Program in Graduate Studies, Al-Qasemi Academic College of Education, Israel & Ahlam Anabousy, Teaching and Research Assistant, Al-Qasemi Academic College of Education, Israel. Educating Mathematics Pre-service Teachers in Metacognitive Skills.
2. Pei-Wan Liu, PhD Student, National Changhua University of Education, Taiwan & Erh-Tsung Chin, Associate Professor, National Changhua University of Education, Taiwan. How Taiwanese Junior High School Mathematics Teachers Learn Inquiry-Based Teaching via a Teacher Professional Learning Community.
3. Chien Minfeng, Graduate Student, National Changhua University of Education, Taiwan & Erh-Tsung Chin, Associate Professor, National Changhua University of Education, Taiwan. The Study of Vee Map Tactics Integrated into Mathematics Teaching and It's Influence on the Eight Graders' Mathematical Proficiencies.
4. Chia-Hao Tsai, Graduate Student, National Changhua University of Education, Taiwan & Erh-Tsung Chin, Associate Professor, National Changhua University of Education, Taiwan. How Do Pupils Manipulate Teaching Aids to Solve Problems? An Example of Solving Fraction Problems.

11:45-13:30 Session III (Room B): Special Topics in Statistics and Economics

Chair: Ampalavanar Nanthakumar, Professor, State University of New York at Oswego, USA.

1. Wojciech Drozdz, Vice-President for Innovations and Logistics, University of Szczecin, Poland. Poland in the Way to Electromobility.
2. Isaias Chairez Hernandez, Professor, Instituto Politécnico Nacional, CIIDIR Durango, Mexico. White-tailed Deer Sex Identification by Faecal DNA and Pellet Morphometry.
3. Panagiotis Ch. Anastasopoulos, Associate Professor, University at Buffalo, The State University of New York, USA, Ugur Eker, Graduate Research Assistant, University at Buffalo, The State University of New York, USA, Sheikh Shahriar Ahmed, Graduate Research Assistant, University at Buffalo, The State University of New York, USA, Grigorios Fountas, Lecturer, Edinburgh Napier University, UK & Stephen E. Still, Professor, University at Buffalo, The State University of New York, USA. Will Flying Cars Be Safe and Secure: An Exploratory Empirical Analysis of Public Perceptions.
4. Mihir Bhattacharya, Assistant Professor, Ashoka University, India, Saptarshi Mukherjee, Associate Professor, Indian Institute of Technology, India & Ruhi Sonal, PhD Student, Indian Institute of Technology, India. Attention and Framing.
5. Sheikh Shahriar Ahmed, Graduate Research Assistant, University at Buffalo, The State University of New York, USA, Grigorios Fountas, Lecturer, Edinburgh Napier University, UK & Panagiotis Ch. Anastasopoulos, Associate Professor, University at Buffalo, The State University of New York, USA. Accounting for Cross-Equation Error Correlation and Unobserved Heterogeneity in a Bivariate Hazard-Based duration Modeling Framework.

13:30-14:30 Lunch

14:30-16:00 Session IV (Room B): Applied Studies

Chair: Olga Gkounta, Researcher, ATINER.

1. Rainer Przywara, President, Baden-Wuerttemberg Cooperative State University Heidenheim, Germany. Economic Prosperity under Varieties of Capitalism 1970-2010.
2. Thanos Athanasopoulos, Senior Lecturer, De Montfort University - Leicester, UK. Dynamic Pricing and Compatibility in Durable Goods Markets with Network Effects.
3. Estelle Sommeiller, Researcher, Institut de Recherches Economiques et Sociales (IRES), France. Employment & Poverty in Southern Europe: When Measurement Matters.

21:00-23:00 Greek Night and Dinner

Tuesday 2 July 2019

07:45-10:45 Session V: An Educational Urban Walk in Modern and Ancient Athens

Group Discussion on Ancient and Modern Athens.
Visit to the Most Important Historical and Cultural Monuments of the City (be prepared to walk and talk as in the ancient peripatetic school of Aristotle)

11:15-13:00 Session VI (Room B): Mathematics

Chair: Diarmuid O'Driscoll, Head of Department of Mathematics and Computer Studies, Mary Immaculate College, Ireland.

1. Codruta Simona Stoica, Professor, Aurel Vlaicu University of Arad, Romania. Current Trends in the Approach of Evolution Equation.

2. Peter Vranas, Professor, University of Wisconsin–Madison, USA. Natural Deduction for Sentential Pure Imperative Logic.
3. Chang-Yun Lin, Professor, National Chung Hsing University, Taiwan. Data-Driven Multistratum Designs with the Generalized Bayesian D-D Criterion for Highly Uncertain Models.
4. Stefan Veldsman, Professor, Nelson Mandela University, South Africa. Where to Look for the Zeros of a Polynomial.

13:00-14:00 Session VII (Room B): Teaching & Learning

Chair: Otman Jaber, Lecturer, Pedagogic Supervisor, Al-Qasemi Academic College of Education, Israel.

1. Kakoma Luneta, Associate Professor, University of Johannesburg, South Africa & Apostolos (Paul) Giannakopoulos, Lecturer, University of Johannesburg, South Africa. Problem Solving in Mathematics: Use of Teaching and Learning Theories versus the Psychology of Teaching and Learning Mathematics.
2. Stefan Britz, Lecturer, University of Cape Town, South Africa & Leanne Scott, Associate Professor, University of Cape Town, South Africa. Blended Learning Introductory Statistics – Lessons from Five Years of Application at the University of Cape Town in Context of a Socioeconomically Diverse Student Body.

14:00-15:00 Lunch

15:00-16:15 Session VIII (Room B): Statistical and Quantitative Methods

Chair: Nimer Baya'a, Senior Lecturer A, Pedagogic Supervisor, Head of ICT Center, Al-Qasemi Academic College of Education, Israel.

1. Timothy Young, Professor, The University of Tennessee, USA. Improved Predictive Modeling using Bayesian Additive Regression Trees (BART).
2. Diarmuid O'Driscoll, Head of Department of Mathematics and Computer Studies, Mary Immaculate College, Ireland. Comparing Different Methodologies in Polynomial Data Fitting.
3. Maroussa Zagoraiou, Associate Professor, University of Bologna, Italy, Alessandro Baldi Antognini, Professor, University of Bologna, Italy & Marco Novelli, Adjunct Professor, University of Bologna, Italy. Limitations of Likelihood-based Asymptotic Inference in Response-Adaptive Clinical Trials for Treatment Comparisons.
4. Hanitra Rakotoarison, Economist, Office National des Forêts (ONF), France & Martin Delsart, Student, Office National des Forêts (ONF), France. Understanding and Forecasting Wood Price Fluctuation? A Study Case in French Public Forest.
5. Augustus Panton, PhD Candidate, Australian National University, Australia. Leaning Against the Wind via Finance-Neutral Output Gaps: Inflation Targeting and Financial Stability in an Open Economy.

20:30-22:00 Dinner (Titania Hotel)

Wednesday 3 July 2019
Mycenae and Island of Poros Visit
Educational Island Tour

Thursday 4 July 2019
Delphi Visit

Friday 5 July 2019
Ancient Corinth and Cape Sounion

Sheikh Shahriar Ahmed
Graduate Research Assistant, University at Buffalo, The State University of New York, USA
Grigorios Fountas
Lecturer, Edinburgh Napier University, UK
&
Panagiotis Ch. Anastasopoulos
Associate Professor, University at Buffalo, The State University of New York, USA

Accounting for Cross-Equation Error Correlation and Unobserved Heterogeneity in a Bivariate Hazard-Based duration Modeling Framework

Hazard-based duration models have been successfully implemented to study the duration of an event across many disciplines. However, the possibility of evaluating the duration of two interdependent events while accounting for the cross-equation error correlation and unobserved heterogeneity exists. This paper focuses on expanding the hazard-based duration modeling method to a bivariate framework while accounting for the cross-equation error correlation, unobserved heterogeneity and unbalanced panel effect by employing grouped random parameters. The flexibility of using appropriate case-specific distribution of the hazard function for each duration is also implemented. Compared to the parameter estimates from individual univariate duration models, this approach provides more efficient and unbiased parameter estimates for two durations, one of which depends on another. Greater explanatory capacity is achieved through estimation of panel specific random parameters. For demonstrative purpose, travel time and travel distance for trips made by household members from Miami metropolitan area, FL in the year 2017 are modeled using the proposed technique. The results show that using different distributions significantly affect the overall statistical fit, forecasting accuracy and the interaction of error terms within the model.

Thanos Athanasopoulos
Senior Lecturer, De Montfort University - Leicester, UK

Dynamic Pricing and Compatibility in Durable Goods Markets with Network Effects

Abstract
Not
Available

Nimer Baya'a
Senior Lecturer A, Pedagogic Supervisor, Head of ICT Center, Al-Qasemi Academic College of Education, Israel
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&
Ahlam Anabousy
Teaching and Research Assistant, Al-Qasemi Academic College of Education, Israel

Educating Mathematics Pre-service Teachers in Metacognitive Skills

In the present research, we educated mathematics pre-service teachers in using metacognition as learners and teachers of mathematics. This education was performed in one-year and was part of the participants' practical training in the training schools and in the frame of a reflection-based workshop of the practical training. We studied the development of pre-service teachers' perceptions of using metacognition in problem solving as part of mathematics learning. In addition, we verified whether the pre-service teachers' achievement in the different sets of B.Ed. courses in the second year has significant correlations with their metacognitive skills. Twenty four pre-service teachers participated in the preparation. They were in their third academic year majoring in teaching mathematics and computer science in middle schools. The research results indicated that the educating program resulted in significant differences in the preservice teachers' scores in metacognitive skills, except in selecting solving strategies. In addition, the research results indicated that the second year achievement of the pre-service teachers in computer science courses, TPACK courses and pedagogic training courses had significant correlation with the metacognitive evaluation skill. The other correlations between the second year achievements in the different sets of B.Ed. courses, the pre-service teachers' metacognitive skills were insignificant.

Mihir Bhattacharya
Assistant Professor, Ashoka University, India
Saptarshi Mukherjee
Associate Professor, Indian Institute of Technology, India
&
Ruhi Sonal
PhD Student, Indian Institute of Technology, India

Attention and Framing

We consider individual decision-making where every alternative appears with a *frame* (Salant (2008)), for instance a chocolate in a gift-box. The decision maker is subject to inattention that leads to *random choice*. A novelty in our work is that we explicitly model framing effects as the source of inattention and hence the randomness in choice. This is consistent with theory and empirical evidence, which is well-documented in the behavioural psychology literature.

We characterize a class of random choice rules that exhibit the effects of frames in drawing the decision maker's attention. According to the *frame-based stochastic choice rule*, the choice probability of an alternative (say, x) is the probability with which attention is drawn by its frame and that attention is not drawn by the frames which are associated with the alternatives that beat x according to a *complete* and *asymmetric binary relation*. This rule attributes the variation in attention to the frame associated with an alternative.

Stefan Britz
Lecturer, University of Cape Town, South Africa
&
Leanne Scott
Associate Professor, University of Cape Town, South Africa

Blended Learning Introductory Statistics – Lessons from Five Years of Application at the University of Cape Town in Context of a Socioeconomically Diverse Student Body

The Department of Statistical Sciences at the University of Cape Town receives approximately 2000 students annually who enroll for an introductory applied statistics course at first-year level. This course had been historically challenging to teach since it is largely a service course to students across the Science, Commerce, Humanities, and Engineering faculties, with poor levels of engagement.

A blended learning model was introduced in 2014 and was specifically designed to engage students more actively in their own learning as well as to provide a multitude of scaffolded learning opportunities for material that students typically found obscure and inaccessible. The teaching approach is based on active learning with processes set up to engage students both online and offline.

In this paper we reflect upon the successes and challenges encountered throughout the 5 years of presenting the course, which includes 18 iterations and more than 9000 students. Although the focus of the analysis is on the pedagogical merit and efficacy of the teaching model, the interpretation of the analysis takes place against the background of our student body profile, which includes *inter alia* socio-economic status, demographic information, home language, and quality of schooling.

South Africa's wealth distribution is infamously unequal, with some recent sources proclaiming it to be the country suffering from the highest level of inequality. Contrary to intuition, though, we argue that providing all students with a fair learning opportunity is more feasible in a course with a significant online component, due to the ubiquity of smartphones.

The past few years has seen severe unrest and turmoil on South African campuses, speaking to the heart of inequality and decolonization. We discuss the effect that the protest fallout has had on the course and UCT as a whole, as well as how the course continued to function during times when classroom teaching was suspended.

Isaias Chairez Hernandez
Professor, Instituto Politécnico Nacional, CIIDIR Durango, Mexico

White-tailed Deer Sex Identification by Faecal DNA and Pellet Morphometry

Introduction. Sex of white-tailed deer (*Odocoileus virginianus*) individuals can provide information to set harvesting rates and management activities. ***Aims.*** To obtain the sex classification function by using faecal pellet morphometry. ***Methods.*** We collected faeces for 12 months in Durango, Mexico, measured their morphometric variables, extracted DNA and amplified an SRY gene marker to identify sex. We then obtained a neural network and fuzzy logic sex classification function. Outputs were validated with the SRY gene. ***Key results.*** Data from adults in the winter were used to obtain the classification functions. We could accurately classify sex in 94.4% with neural networks and 86.9% with fuzzy logic. ***Conclusion.*** Both neural network and fuzzy logic accurately classified the sex of the white-tailed deer from their faecal pellets from the adults collected in the winter. ***Implications.*** Classification function with faecal morphometric variables provide information to set accurate harvesting rates and management activities without disturbing individuals.

Wojciech Drozdz
Vice-President for Innovations and Logistics, University of Szczecin, Poland

Poland in the Way to Electromobility

Recently, Electromobility is one of the most powerful ideas implemented on a large scale in Europe. Poland, following the trend of sustainable development, on 14 February 2017 adopted the Resolution No. 8 on the Strategy for Responsible Development until 2020 (with an outlook until 2030) and the Act on Electromobility of February 5, 2018. The Strategy adopted by the Government in February includes, among others E-bus project (stimulating the design and production of Polish electric vehicles, building strong entities at all stages of the value chain in the urban transport fleet production sector) and the design of an electric car. Electromobility is a concept closely related to the future of sustainable transport.

In Poland, as in other European countries, the era of electricity in the automotive industry is expected. Electromobility is therefore a necessity and affects various socio-economic aspects

According to the Electromobility Development Plan in Poland, this process should take place in three phases, which will differentiate, among others, level of market maturity and necessary state involvement:

1. 2016-2018 - of a preparatory nature. Conditions for the development of electromobility on the regulatory side as well as targeted public financing will be created.
2. 2019-2020 - in selected agglomerations an infrastructure for powering electric vehicles will be built. The incentives for the purchase of electric vehicles will be intensified. The commercialization of research results in the field of electromobility started in the first phase and the implementation of new business models for the universalisation of electric vehicles is expected.
3. 2020-2025 - it is assumed that the electromobility market will reach maturity, which will allow the gradual withdrawal of support instruments.

An important document is also the National Policy Framework for the Development of Alternative Fuels Infrastructure. It was assumed in them that by the end of 2020 - in six selected agglomerations, 6,000 will be located. points with normal charging power and 400 points with high charging power that will be used by at least 50,000 electric vehicles.

The main assumptions include reduction of the impact of transport on the environment, minimization of dependence on crude oil, implementation of the 2014/94 / EU Directive, development of the infrastructure and

alternative fuels market as well as general improvement of Poland's energy and fuel security.

The implementation of innovations referred to in the Act on Electromobility is a key activity from the point of view of the development of electric transport. For the mass introduction of electric cars to the automotive market, optimal adaptation of the infrastructure in the form of a charging station is required. The stages of implementation of electromobility processes are complex and require cooperation of many entities at both national and local levels. In addition to such important issues as the development and principles of the functioning of charging infrastructure, or clean transport areas, the Act introduced changes to other regulations, including in construction law, energy law, tax law, where basic incentives for electric car users have been hidden.

Ugur Eker
Graduate Research Assistant, University at Buffalo, The State University of New York, USA
Sheikh Shahriar Ahmed
Graduate Research Assistant, University at Buffalo, The State University of New York, USA
Grigorios Fountas
Lecturer, Edinburgh Napier University, UK
Stephen E. Still
Professor, University at Buffalo, The State University of New York, USA
&
Panagiotis Ch. Anastasopoulos
Associate Professor, University at Buffalo, The State University of New York, USA

Will Flying Cars Be Safe and Secure:
An Exploratory Empirical Analysis of Public Perceptions

This paper investigates public perceptions towards the safety and security implications from the future introduction of flying cars in the traffic fleet. The paper's focus is on individuals' opinions on possible safety benefits and concerns, as well as policy measures that can potentially enhance the security of flying cars. Due to the emergent nature and lack of public exposure of this technology, individuals' perceptions and opinions regarding flying cars might be subject to several layers of unobserved heterogeneity. A few examples include shared unobserved variations across interrelated perceptions, grouped effects, and interactive effects among sources of unobserved heterogeneity. To explore individuals' perceptions, while accounting for such heterogeneity patterns, grouped random parameters bivariate probit and correlated grouped random parameters binary probit models with heterogeneity in means are estimated. For the analysis, recent data collected from online surveys of 692 individuals are used. The estimation results show that the perceptions towards the safety aspects of flying cars, and the attitudes towards potential security interventions, are affected by a number of individual-specific socio-demographic, behavioral, and driving attributes. Despite the empirical and exploratory nature of the analysis, the findings can provide manufacturers, policy-makers, and regulating agencies with valuable information regarding the integration and acceptance challenges that may arise with the introduction of flying cars.

Stelios Georgiou
Associate Professor, RMIT University, Australia

Combining Robust Parameter Designs (RPDs) and Supersaturated Designs (SSDs)

Robust parameter designs (RPDs) and supersaturated designs (SSDs) have attracted a great deal of attention. In this talk, these two fields are combined. A new construction of an effective SSD is presented along with an analysis method, in order to deal with the significant problem of the robust parameter design methodology (RPDM). Combining iterative SIS variable selection and a penalized method, namely SCAD, we perform the analysis of the SSDs developed in the present work. The proposed methodology applied in different models to show its effectiveness in many different scenarios, assuming both first and second-order models in a sense of a response surface design. Two illustrative examples as well as numerous numerical experiments are conducted for plenty cases. The results imply that the proposed method is highly effective for identifying the active effects of main factors, two-factor interactions, three-factor interactions as well as the pure quadratic ones, under the assumption of effect sparsity.

Alan Ker
Professor, University of Guelph, Canada

A Generalized KS-Test

The KS-test is used to test if two samples come from distinct distributions or data generating processes. The KS-test statistic measures the maximum difference between two empirical distribution functions generated from two samples. In this sense the KS-test is a sup-type test. In this manuscript we propose a generalization to the KS-test where the cut-off between the two samples is unknown. We do this by first calculating the KS-test statistic on all possible cut-off points and then comparing the maximum of the KS-test statistics to its order statistic under the null of identical distributions or data generating processes. In some sense, this is closely related to the generalization of the Chow test by Bai-Perron where the cut-off point for structural change is unknown. However, the Chow and subsequently Bai-Perron tests strictly relate to structural change in the conditional mean and have no power against structural changes in higher moments. Fortunately, the KS-test measures differences in the empirical distribution functions and thus has power against structural change in higher moments. We use this generalization of the KS-test in a number of simulated and real applications to illustrate its usefulness.

Chang-Yun Lin
Professor, National Chung Hsing University, Taiwan

Data-Driven Multistratum Designs with the Generalized Bayesian D-D Criterion for Highly Uncertain Models

Multistratum designs have gained much attention recently. Most criteria, such as the D criterion, select multistratum designs based on a given model that is assumed to be true by the experimenters. However, when the true model is highly uncertain, the model used for selecting the optimal design can be seriously misspecified. If this is the case, then the selected multistratum design will be not efficient for fitting the true model. To deal with the problem of high uncertain models, we propose the generalized Bayesian D-D (GBDD) criterion, which selects multistratum designs based on the experimental data. Under the framework of multistratum structures, we develop theorems and formula that are used for conducting Bayesian analysis and extracting information about the true model from the data to reduce model uncertainty. The GBDD criterion is easy and flexible in use. We provide several examples to demonstrate how to construct the GBDD-optimal split-plot, strip-plot, and staggered-level designs. By comparing with the D-optimal designs and one-stage generalized Bayesian D-optimal designs, we show that the GBDD-optimal designs have higher efficiency on fitting the true models. The extensions of the GBDD criterion for more complicated cases, such as more than two stages of experiments and more than one class of potential terms, are also developed.

Pei-Wan Liu
PhD Student, National Changhua University of Education, Taiwan
&
Erh-Tsung Chin
Associate Professor, National Changhua University of Education, Taiwan

How Taiwanese Junior High School Mathematics Teachers Learn Inquiry-Based Teaching via a Teacher Professional Learning Community

Inquiry-based learning [IBL] is one of the main streams of the contemporary education, as science, technology and inquiry are considered as the three crucial skills in the 21st century (NRC, 2010). Although inquiry-based teaching [IBT] has been the trend of science and mathematics education and research in Taiwan (Yang & Tuan, 2015), the time control of teaching, the load of lesson preparation, and the students' performance on exams are the major difficulties and pressures for teachers to conduct IBT (Tseng, Tuan & Chin, 2011). This is a case study of how two junior high school mathematics teachers learn IBT with the support of a teacher professional learning community [PLC]. The teacher PLC, consisting of in-service, pre-service teachers, and mathematics educators, was formed based on the theory of co-learning, and had run once every two weeks for two years. The regular PLC meetings include studying literature for helping the community members develop theoretical background of IBL and IBT, and observing and discussing the members' teaching practice for supporting them to implement theory into practice. By means of collecting case teachers' IBL activity designs, students' worksheets, teachers' reflection diaries, classroom teaching records, and student interviews, the researchers apply grounded theory to analysing and constructing the two case teachers' strategies and models for learning IBT, and their corresponding teaching knowledge for IBT.

The research results show that, by means of the support of the teacher PLC under the co-learning relationship, the two case teachers developed slightly different models for learning IBT. They also showed some corresponding teaching knowledge for IBT, such as setting proper contexts of inquiry problems and the following guidance, understanding students' prior knowledge and hypothetical learning trajectories, and creating and arranging a better environment for IBL. It might be suggested that, before putting IBT into practice, literature review might help the IBT beginner grasp the possible problems and solutions. While implementing IBT in the classroom, the support from a teacher PLC plays a crucial role for the teachers to continuously revise their teaching strategies for making IBL successfully happened in students' mathematics learning.

Wei-ming Luh
Professor, National Cheng Kung University, Taiwan
&
Jiin-huarng Guo
Professor, National Pingtung University, Taiwan

Sample Size Calculation with Cost Constraints for Testing the Superiority/Non-inferiority and the Equivalence of Two Poisson Means

The Poisson distribution is probably the most popular model for describing the number of rare events, for example, the breakdown of a machine in the engineering field or the onset of a disease in the medical setting. However, for testing the superiority/non-inferiority and equivalence of two Poisson means, the studies for sample size planning and power analysis are very limited. Most of the studies focus on the case of testing equality rather than testing equivalence. Thus, there are two purposes for the present study. When considering the cost constraint and based on Whitworth (1901) and Maguire, Pearson and Wynn's (1952) methods, the present study aims to discuss the sample size calculation on the basis of the incidence rate for testing superiority/non-inferiority and equivalence of two Poisson means, respectively. Under cost constraints, the second purpose of the present study is to develop an optimal sample size allocation ratio such that the total sampling cost is minimal or the statistical power is maximal for a given significance level. To evaluate the performance of the proposed methods, we derived the test statistics, calculated the sample sizes needed and the corresponding total cost, and then the resulting Type I error rates and the statistical power were evaluated in the simulation study. The simulated results show that the proposed methods are valid and economic.

Kakoma Luneta
Associate Professor, University of Johannesburg, South Africa
&
Apostolos (Paul) Giannakopoulos
Lecturer, University of South Africa, South Africa

Problem Solving in Mathematics: Use of Teaching and Learning Theories versus the Psychology of Teaching and Learning Mathematics

Why problems solving (in general and in Mathematics in particular) is a ..problem to many people? Does it lie in the teaching and learning situation? The teaching and learning (T & L) of Mathematics has puzzled many researchers, psychologists, educationists and Mathematics educators for decades. If it is accepted that learners have to be taught how to solve problems in Mathematics, then the teaching and learning theory used has to be the appropriate one that fits with Mathematics as well as the context that Mathematics is taught. The assumption though is that the teacher knows the learners and what the leaners know and continues with the imparting of new knowledge that is assumed to be connected to the previous knowledge. These two assumptions in the end become the reasons that so many learners fail or go as far as to hate Mathematics. Such perceptions start from an early stage of development where children begin to see Mathematics as 'cold and abstract' or 'hot and abstract (the aesthetic and utilitarian aspect of Mathematics). Applying existing T & L theories (e.g. Behaviourism, Cognitivism, Constructivism), although they all make a contribution to the education, somehow they fall short, especially when it comes to Mathematics. The reason could be because such theories are not designed for the learning of Mathematics but learning in general. However, Richard Skemp back in the late seventies introduced the idea of the psychology of teaching and learning Mathematics which gave new life to Mathematics as it combined the general learning theories but also how people learn Mathematics. Using Skemp's ideas and including pragmatism, a new way of teaching problem solving in Mathematics is suggested, making use of existing learning theories in general and the psychology of teaching and learning Mathematics in particular. The paper concludes with a new model for the teaching and learning of Mathematics and problem solving from pre-school to higher education which could assist especially novice Mathematics teachers to improve the teaching and learning situation.

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The Study of Vee Map Tactics Integrated into Mathematics Teaching and its Influence on the Eight Graders' Mathematical Proficiencies

The study is an action research conducted by a researcher and a teacher, aiming at investigating the progress of how the teacher integrates Vee map tactics (Afamasaga-Fuata'i, 2004) into mathematics teaching and the performance of high, medium and low achievers' mathematical proficiencies under the Vee map tactics integrated teaching.

The research subjects are twenty five eighth grade students of the same class, including twelve boys and thirteen girls, while eight students are purposively selected as the main observing subjects. There are two main stages of the study. The first is to develop an appropriate Vee map tactics for the students' learning. During this stage, two cycles of action research of plan, action, reflection and modification are conducted by means of collecting and analysing the students' Vee maps, teacher's teaching diary, researcher's classroom observation records, and students' interviews. In the second stage, modified Vee map tactics is applied in the teaching, and students' performance of mathematical proficiencies is examined.

The research results show that the key point of modifying the Vee map tactics should be whether the students could grasp the essence of the Vee map and apply it easily, in order to help them record the process of constructing new knowledge effectively and then reach the learning goals meaningfully. Besides, by means of the Vee maps drawn by the students, the processes and methods of students' thinking while they are solving a problem are revealed clearly. No matter they are high, medium or low achievers, all of them could reveal conceptual understanding, procedural fluency and adaptive reasoning. Especially the low achievers show productive disposition through actively consulting and discussing with the teacher and peers. To sum up, the Vee map tactics developed in the study might be helpful for the traditional expository, or even didactic, mathematics teaching and the students' development of mathematical proficiencies.

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A Comparison of Hierarchical and Vine Copulas

In this paper, we compare the performance of a hierarchical copula with a Vine Copula when the actual data has three dimensions.

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Comparing Different Methodologies in Polynomial Data Fitting

The standard linear regression model can be written as $Y=X\beta+\varepsilon$ with uncorrelated zero mean and homoscedastic errors. Here X is a full rank n x p matrix containing the explanatory variables and the response vector y is n x 1 consisting of the observed data. The Ordinary Least Squared (OLS) estimators are given by $\widehat{\beta_L} = (X'X)^{-1}X'y$ and the Gauss-Markov Theorem states that $\widehat{\beta_L}$ is the best linear unbiased estimator. However, the OLS solutions require that $(X'X)^{-1}$ be accurately computed. A given set of data may suggest that a polynomial best represents the general trend of the data. If we try to fit a polynomial of too high a degree to a data set, containing noise, using OLS, then $(X'X)^{-1}$ will be numerically difficult to calculate and can lead to very unstable solutions. This paper will compare the performance of the recent mixture estimators of Jensen, D.R. and Ramirez, D.E. (2018) with the performance of using orthogonal polynomials in the design matrix to 'control' the complexity of the model and to prevent the polynomial from fitting the noise in the data. The surrogate estimators of Jensen, D.R. and Ramirez, D.E. (2008) perturb the singular values of $X \rightarrow X_k$ by the rule $\sigma_i \rightarrow \sqrt{(\sigma_i^2 + k)}$, whereas the new mixing procedure of Jensen and Ramirez perturbs the eigenvalues of $X'X$ towards a target value, so that the small eigenvalues are increased and the large eigenvalues are decreased. The orthogonal polynomials considered are Chebyshev and those constructed by the Gram Schmidt process using the inner product $< p, q = \sum p(x_i)q(x_i)$. The paper will use backward reduction, starting with a high order polynomial and using a t-test to reduce the model in a stepwise manner, which will best capture the underlying function.

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Leaning Against the Wind via Finance-Neutral Output Gaps: Inflation Targeting and Financial Stability in an Open Economy

It has long been argued that a monetary policy regime that is narrowly focused on near-term price stability does not necessarily guarantee long-term financial and macroeconomic stability. In the wake of the global financial crisis (GFC)and the ensuing Great Recession, the debate on the role of central banksin sustaining financial stability has intensified, with a strong reawakening of the view that monetary policy must pre-emptively *lean against the wind* (LAW) of asset price bubbles—tighten the policy stance more than would be conventionally required, to prevent incipient asset price bubbles from becoming severe or bursting. In examining the use of finance-neutral output gaps as an approach to following the concept of LAW, this paperdepartsfrom the existing literature in a non-trivial way. Instead of restricting financial stability risks to imbalances only in the domestic financial system, a further step is takenby including external indicators of financial imbalances alongside domestic indicators. By doing so, the fact that domestic financial stability risks are not only internally generated but could be contagiously transmitted from abroad via liberalized financial marketsis recognized. To achieve this, the paperemploysa Bayesian dynamic factor model (DFM) in which distinctions are madebetween domestic and global (external) business and financial cycles, with the output gap then decomposed into its domestic and external finance-neutral components. Incorporating the open-economy finance-neutral output gaps into a Taylor-type monetary policy framework, counterfactual policy simulations are performed aimed at exploring what the policy signals during the years leading to the GFC would have been had central banks followed the LAW concept. The frameworkis calibratedto Australian and G-7 data to ensure comparison with existing evidence in the literature.

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Economic Prosperity under Varieties of Capitalism 1970-2010

In a study based on macro-economic data for 12 mature countries (i.e. fully industrialized states beyond their maximum relative employment in manufacturing) covering the years 1973-2008, their industrial development was analyzed with regard to outcome in terms of sectoral parameters and the resulting GDP per capita, employment and trade.

Manufacturing productivity was identified as a key indicator and specific driver for economic success. Following the achieved manufacturing productivity, three groups of states were identified. Their paths of development were put in relation with the politico-economic regimes of the analyzed states as described by models of capitalism. The match of these models with the identified streams of industrial development was tested. It was found that the varieties of capitalism (VoC) approach by Hall and Soskice (2001) provides a sound explanatory basis for macro-economic developments triggered by the manufacturing sector:

- Manufacturing requires incremental innovation, a path that is paved by coordinated market economies (CME) like Germany or Sweden.
- Due to their institutional structures, liberal market economies (LME) aim at disruptive innovation and put less effort into incremental innovation as required to achieve a high manufacturing productivity.

This notwithstanding, the VoC dichotomy was found to be incomprehensive since a number of coordinated market economies were found to be less successful in reaching a cutting-edge productivity. For this deviating third group, the strong role of the state in their national economies was identified as a very likely source of explanation, drawing from the model of Schmidt (2003). According to her, the state-led group is characterized by high direct influence of the state in terms of economic guidance and interference. This strong influence has kept the respective states from living up to their full potential in manufacturing and thus hampered economic success.

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Understanding and Forecasting Wood Price Fluctuation? A Study Case in French Public Forest

In the neoclassical approach of economics as Marshall (1890), equilibrium is defined by the intersection between the supply and demand functions. This is a simplifying approach and not adapted to the forest-wood sector. Partial dynamic equilibrium models such as the French Forest Sector Model under the acronym of FFSM (Caurla, 2014) better represent this sector, taking into account the long-term links between supply, demand, resource growth, foreign product competition and economic growth. Temporal variations in prices are addressed through price elasticities. These macroeconomic models, however, remain an approximate and limited description of forest-wood sector economy with a few variables.

In this paper, we propose to analyze the evolution of wood prices in France during the last decade (2009-2017) through variables inspired by the neo-Keynesian approach with the introduction of market imperfection, in particular the heterogeneity of the products, the international trade, currencies but also logging cost. The originality of the approach lies in the fact that we do not fix any assumptions *a priori* of the form of the relationships between all the variables. We proceeded in two stages: a selection of the explanatory variables of wood price among more than 80 variables of forest economics with a Random Forest model, then a creation of two types of temporal models: an autoregressive and a vector autoregressive model.

The preliminary results totally contradict the classic variables of the economy such as the impact of economic growth and supply on the wood market but only show a significant weight of the demand of the different sectors using wood. The case of oak price in French public forest, however, reacts differently according to the heterogeneity of products: a positive correlation has been found with the price of high quality products and negative correlation with the other products. We end by testing the ability of these empirical models to make short-term market forecasts to inform investment and management decision-making for all stakeholders.

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Employment & Poverty in Southern Europe: When Measurement Matters

The standard measure of in-work poverty is the risk of poverty rate at work[1] published by Eurostat. According to this indicator, the working poor in Southern Europe have not recovered from the crisis of 2008. Spain, Italy and Portugal have rates ranging between 9% and 10% in 2007 compared to 11% - 13% in 2017. Greece is the only Southern European country where the rate of poverty at work has decreased over the period: from 14% in 2007 to 11% ten years later. The standard measure of poverty in the workplace, if not completed by other poverty measures, provides a very incomplete and unsatisfactory view of the overall picture. Using 2005-2015 EU-SILC microdata, this article aims to complete the measure of in-work poverty in several ways. First by considering poverty lines anchored in time, so that the poverty line considered is that of 2007.

Second by completing the sole measure of the poverty headcount by other dimensions of poverty as suggested by Amartya Sen: the degree of intensity of poverty (the distance between the disposable income of the working poor to the poverty line) and how inequal the working poor population may be. All measures being considered over time, before and after the Great Recession.

Third, the statistical population in Eurostat's standard indicator raises questions. Using the most frequent activity status, Eurostat considers a person as employed whenever s·he works (part-time or full-time) more than six months a year. If, in its standard indicator of poverty at work, Eurostat had delimited the scope of the population to persons working full-time throughout the year, then neither the intermittency of employment nor part-time work, and only the low level of wages would be the economic factor of in-work poverty. Such is not the case. Conversely, the Eurostat indicator does not make it possible to apprehend in-work poverty precisely where it is located, on the edge of un·employment and inactivity. The measures proposed here will do so.

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[1] In the total working-age population (18-64 years), the at-risk-of-poverty rate at work is the proportion of people in employment over half of the year whose disposable income per unit of consumption does not exceed the poverty line, which is set at 60% of national median income. Consumption units have been designed to consider the economies of scale achieved when several people share the same household. An adult living alone represents 1 consumption unit; a couple 1.5; a child over 14 represents 0.3 and a child under 14, 0.5.

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Current Trends in the Approach of Evolution Equation

The paper has the aim of showcasing the progress in recent years in the study of evolution equations. The approach is done by means of cocycles.

As the state space of the dynamical systems that describe processes from engineering, physics, biology is of infinite dimension, the study is more appropriate by means of associated operator families. The notion of skew-evolution cocycle arises naturally when considering the linearization along an invariant manifold of a dynamical system generated by a nonlinear differential equation. It generalizes the classic concepts of evolution operators and skew-product semiflows, and enables a unitary study in a non-uniform setting.

The aim of this research is to develop a framework that enables us to obtain characterizations in a unitary approach for the asymptotic behaviors of skew-evolution semiflows in Banach spaces. The classic techniques used to characterize asymptotic properties as stability, instability and dichotomy are generalized for the study of splitting and trichotomy.

Our main objective is to give characterizations for the above-mentioned notions and to establish connections between them. All results are underlined by examples and counterexamples.

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Screening Designs under Model Uncertainty

In experimental situations it is often anticipated that only few of the investigated variables will be important. Usually it is not known which of the variables will be the important ones, so it is not known which columns of the experimental design will be of further interest. Many designs have been proposed to be used for screening experiments and to identify the relevant variables. Edge designs is a new class of designs that allow a model-independent estimate of the set of relevant variables, thus providing more robustness than traditional designs. Here we present a method for generating edge designs having n-1 edges, n = 0 (mod 4) from skew conference matrices of order n.

We provide an algorithm to construct the needed circulant matrices and use them to build new inequivalent skew Conference matrices. From these we generated new edge designs. An illustrative simulated example using the analysis of edge design is provided.

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How Do Pupils Manipulate Teaching Aids to Solve Problems? An Example of Solving Fraction Problems

In Taiwan, we hope to cultivate our future citizens who are able to solve problems. How to effectively improve students' ability to solve problems by means of formal teaching has become a crucial issue in education reform globally. In the 12-year Basic Education Curricula of recent education reform in Taiwan, it emphasises students' ability of operation for enhancing their mathematical proficiencies. Therefore, in this study, we plan to investigate pupils' ability to solve mathematical problems by means of manipulating teaching. Firstly, we refer to the principles of problem solving proposed by Polya (1954) in his famous book "*How to Solve It*", in order to generalise the proper role of the teaching aid and how it can support students in solving fraction problems during the process of comprehending the problem, proposing solving strategies, conducting the solving plan, and reflecting feedback. Secondly, we select six fourth graders as our research subjects, while two of them are low achievers, another two middle achievers, the last two high achievers. By means of an on-line testing system, these six subjects' abilities of solving fraction problems are analysed. Then they are given appropriate teaching aids to help them solve fraction problems. The research results show that whether the pupils can effectively apply the teaching aids to solve fraction problems depends on their former experience of manipulating teaching aids, their ability to represent mathematical meaning by the teaching aids and communicate with others. The results might be able to provide some experimental evidence for teachers to apply teaching aids in their teaching for fostering the students' competence of problem solving.

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Where to Look for the Zeros of a Polynomial

One of the early joys of a first undergraduate course in ring theory (or abstract algebra), is the result that any monic polynomial over a ring with unity will always have a zero in the coefficient ring or in an extension thereof. This well-known result of Kronecker is usually shown by embedding the coefficient ring into the quotient ring of the polynomial ring over the ideal generated by the polynomial. As such, the elements are cosets which can also be written as polynomials of formal sums, all with degree less than the degree of the starting polynomial and the inderterminate is a root of the original polynomial. Products of such formal sums give powers of the indeterminate which must be reduced to the required degree by using a rule prescribed by the starting polynomial.

More than often, the beauty and significance of this process and result is lost on the students at this early stage of their training in algebra. This is mainly due to their discomfort of working with rings where the elements are cosets or formal sums or, as is the case for the complex numbers, using a symbol to stand in the place of the unknown square root of negative 1.

There is a more natural way to view this ring extension which requires a minimum number of tools; the only requirement is a knowledge of basic matrix theory. Most introductory modern algebra texts will refer to this only in the exercises (if at all) by considering one or two special cases.

In this talk this approach of extending a number system to a bigger system of matrices will be motivated and outlined. Of course, this approach using matrices, is not new in the sense that bits and pieces of the ideas involved have appeared in different contexts elsewhere. However, the simplicity and the minimal requirements of the method does warrant wider exposure. A further advantage of this approach is that many properties of the extension ring can be expressed in terms of well-known linear algebra concepts.

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Natural Deduction for Sentential Pure Imperative Logic

I present a sound and complete natural deduction system for sentential pure imperative logic, in five steps. (1) Syntax: I introduce an *imperative formal language* by using the imperative operator '!'; e.g., if '*A*' is a declarative sentence, '!*A*' ("let *A* be true'') is an imperative sentence. (2) Semantics: I introduce *interpretations* of the imperative formal language, and (building on previous work) I define what it is for a declarative sentence to *sustain* a (declarative or imperative) sentence on an interpretation. (3) Semantic validity: I define an argument to be *semantically valid* exactly if, on every interpretation, every declarative sentence that sustains its premises also sustains its conclusion. (4) Syntactic validity: I define an argument to be *syntactically valid* exactly if its conclusion can be derived from its premises by applying certain "natural" replacement and inference rules that I introduce. (5) Soundness and completeness: I prove that semantic and syntactic validity coincide.

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Improved Predictive Modeling using Bayesian Additive Regression Trees (BART)

Abstract

Not

Available

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Limitations of Likelihood-based Asymptotic Inference in Response-Adaptive Clinical Trials for Treatment Comparisons

Adaptive experiments are sequential procedures in which the decision about how to proceed is made according to a pre-established rule that makes use of the information accrued along the way. Widely used in different experimental fields, they are nowadays considered as a gold standard in the clinical context, especially in phase-III trials for treatment comparisons, where the ethical goal of maximizing the subjects care often conflicts with the statistical aim of drawing correct inferential conclusions.

In order to overcome in some sense the above-mentioned drawback, many authors suggested suitable Response-Adaptive (RA) randomization procedures, namely sequential allocation rules in which the treatment allocation probabilities change on the basis of earlier responses and past assignments in order to i) favour the treatment that appears to be superior at each step or ii) progressively approach a chosen target allocation of the treatments representing a possible trade-off among ethics and inference. Classical examples are the Play-the-Winner rule proposed by Zelen (1969), the efficient randomized-adaptive design suggested by Hu, Zhang and He (2009) and the doubly-adaptive biased coin design (Hu and Zhang, 2004).

Even if RA procedures induce a complex dependence structure between the outcomes, since the observations are no longer independent and inference should be unconditional with respect to the chosen design, several authors provided the conditions under which the classical likelihood-based asymptotic inference is still valid. These rely essentially on the functional form of the limiting allocation proportion of the treatments – i.e. the target – induced by a given RA procedure. Even if these conditions are apparently satisfied for several RA procedures of the literature, in many circumstances these are not sufficient to guarantee the applicability of classical likelihood-based inferential procedures.

The aim of the present paper is to explore the inadequacy and the practical limitations of the classical likelihood-based approach in terms of asymptotic confidence intervals and hypothesis testing, especially when the chosen target is characterized by a strong ethical component. In particular, we will stress the crucial role played by the target, that could i)

compromise the quality of the CLT approximation of the standard MLEs and ii) lead to a vanishing Fisher information, thus severely undermining any likelihood-based inferential method.