2012

Mathematics, Statistics & Mathematical Education Abstracts

Sixth Annual International Conference on Mathematics, Statistics & Mathematical Education 11-14 June 2012, Athens, Greece

Edited by Gregory T. Papanikos

THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Mathematics, Statistics & Mathematical Education Abstracts

6th Annual International Conference on Mathematics, Statistics & Mathematical Education

11-14 June 2012, Athens, Greece

Edited by Gregory T. Papanikos

First Published in Athens, Greece by the Athens Institute for Education and Research.

ISBN: 978-960-9549-93-6

8 Valaoritou Street
Kolonaki, 10671 Athens, Greece
www.atiner.gr

TABLE OF CONTENTS

(In Alphabetical Order by Author's Family name)

Preface

This abstract book includes all the abstracts of the papers presented at the *6th Annual International Conference on Mathematics, Statistics & Mathematical Education, 11-14 June 2012,* organized by the Athens Institute for Education and Research. In total there were 43 papers and 49 presenters, coming from 27 different countries (Albania, Algeria, Australia, Austria, Botswana, Bulgaria, Canada, Germany, Chile, China, Colombia, Czech Republic, India, Israel, Italy, Korea, Malaysia, Romania, Saudi Arabia, Singapore, South Africa, Spain, Thailand, Turkey, Ukraine, UK and USA). The conference was organized into 13 sessions that included areas of Teacher Training, Mathematics, Theoretical Statistical Issues, Applied Statistics, Teaching Methodology and other related fields. As it is the publication policy of the Institute, the papers presented in this conference will be considered for publication in one of the books of ATINER.

The Institute 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 in Athens and exchange ideas on their research and consider the future developments of their fields of study. Our mission is to make ATHENS a place where academics and researchers from all over the world meet to discuss the developments of their discipline and present their work. To serve this purpose, conferences are organized along the lines of well established and well defined scientific disciplines. In addition, interdisciplinary conferences are also organized because they serve the mission statement of the Institute. Since 1995, ATINER has organized more than 150 international conferences and has published over 100 books. Academically, the Institute is organized into four research divisions and nineteen research units. Each research unit organizes at least one annual conference and undertakes various small and large research projects.

I would like to thank all the participants, the members of the organizing and academic committee and most importantly the administration staff of ATINER for putting this conference together.

Gregory T. Papanikos
President

FINAL CONFERENCE PROGRAM
6th Annual International Conference on Mathematics, Statistics and Mathematics Education, 11-14 June 2012, Athens, Greece

PROGRAM

Conference Venue: Metropolitan Hotel of Athens, 385 Syngrou Ave., 175 64, Athens, Greece

Organization and Scientific Committee

1. Dr. Gregory T. Papanikos, President, ATINER.
2. Dr. Vladimir Akis, Head, Mathematics & Statistics Research Unit, ATINER & Professor, Department of Computer Science and Department of Mathematics, California State University, Los Angeles, USA.
3. Dr. Nicholas Pappas, Vice-President of Academics, ATINER & Professor, Sam Houston University, USA.
4. Dr. Panagiotis Petratos, Vice-President of ICT, ATINER & Associate Professor of Computer Information Systems, California State University, Stanislaus, USA.
5. Dr. George Poulos, Vice-President of Research, ATINER & Emeritus Professor, University of South Africa, South Africa.
6. Dr. Angelos Tsaklanganos, Academic Member, ATINER & Professor, University of Nicosia, Cyprus.
7. Dr. Constantine Georgakis, Academic Member, ATINER & Associate Professor, DePaul University, USA.
8. Dr. Alexander Makedon, Head, Education Research Unit, ATINER & Professor, College of Education, Chicago State University, USA.
9. Dr. Margarita Kefalaki, Director of Communication, ATINER.
10. Ms. Lila Skountridaki, Researcher, ATINER & Ph.D. Student, University of Strathclyde, U.K.
11. Mr. Vasilis Charalampopoulos, Researcher, ATINER & Ph.D. Student, University of Strathclyde, U.K.

Administration: Fani Balaska, Stavroula Kiritsi, Eirini Lentzou, Konstantinos Manolidis, Katerina Maraki & Celia Sakka

C O N F E R E N C E P R O G R A M

(The time for each session includes at least 10 minutes coffee break)

Monday 11 June 2012

08:00-08:30 Registration
08:30-09:00 Welcome and Opening Remarks

- Dr. Gregory T. Papanikos, President, ATINER.
- Dr. Constantine Georgakis, Academic Member, ATINER & Associate Professor, DePaul University, USA.
- Dr. Vladimir Akis, Head, Mathematics & Statistics Research Unit, ATINER & Professor, Department of Computer Science and Department of Mathematics, California State University, Los Angeles, USA.

09:00-10:30 Session I (Room A): Teacher Training
Chair: Pappas, N., Vice-President of Academics, ATINER & Professor, Sam Houston University, USA.

1. *Batten, L., Professor, Deakin University, Australia, Oyganowski, M., Professor, Deakin University, Australia & James, S., Professor, Deakin University, Australia. Anxiety abatement in a Class of Future Mathematics Teachers – A Case Study.
2. Bedwell, M., Teacher, Ukrainian Education Center, Ukraine. Exploiting the Sudoku Syndrome.
3. Emanovsky, P., Associate Professor, Palacky University Olomouc, Czech Republic & Stepankova, B., Lecturer, Palacky University Olomouc, Czech Republic. On Some Experience with an Innovation of Initial Mathematics Teacher Training and its Evaluation.
4. Henning, H., Professor, University of Otto von Guericke Magdeburg, Germany. Reality and Mathematical Modelling – New Problems for Mathematical Classes and Teaching Mathematics in the Secondary School.

10:30-12:00 Session II (Room A): Curriculum
Chair: *Batten, L., Professor, Deakin University, Australia

1. Navarra-Madsen, J., Associate Professor, Texas Woman's University, USA. Mathematics Tutoring and Course Completion.
2. Maponyane, D., Educator, Bathokwa Secondary School, South Africa. Alarming State of Mathematics Grade 12 Results in South Africa. (Monday, 11th of June, 2012)
3. Ratheal, J., Associate Professor,

10:30-12:00 Session III (Room B): Mathematics I
Chair: Akis, V., Head, Mathematics & Statistics Research Unit, ATINER & Professor, Department of Computer Science and Department of Mathematics, California State University, Los Angeles, USA.

1. Ma, R., Lecturer, Northwestern Polytechnical University, China. On the Congruence Properties of the Lucas Numbers.
2. Camargo, J., Researcher & Teacher, Universidad Industrial de Santander, Colombia, Covarrubias, P.P., Researcher & Teacher, University National Autónoma de México, México & Rincón, M., Student, University

The University of Texas of the Permian Basin, USA. How Individual Personalities Affect Achievement and Behavior. 4. Ren, G., Professor, The College of St. Scholastica, USA. Two Stones Kill One Bird-Connections among Branches of Math. (Education) (Monday, 11th of June, 2012)	Industrial of Santander, Colombia. On G-Contractibility of Dendroids.

12:00-13:30 Session IV (Room A): Theoretical Statistical Issues **Chair:** Sadhra, A., Chair, Mathematics Department, Kwantlen Polytechnic University, Canada.	**12:00-13:30 Session V (Room B): Mathematics II** **Chair:** Henning, H., Professor, University of Otto von Guericke Magdeburg, Germany
1. Nanthakumar, A., Professor, State University of New York at Oswego, USA & Kanbur, S., Associate Professor, State University of New York at Oswego, USA. On the Detection of Heteroscedasticity by Using CUSUM Range Distribution. 2. Li, J., Assistant Professor, University of California, USA. New Nonparametric Multivariate CUSUM Control Charts for Location and Scale Changes. 3. *Kuphon, B., Lecturer, Mahasarakham University, Thailand. A Distribution of Monthly Rainfall for Lampao Site in the Chi River Basin, Thailand. 4. Trafalis, T., Professor, The University of Oklahoma, USA. SVM Classification of Uncertain and Imbalanced Data Using Robust Multi-Kernel Methods. (Statistics)	1. Kim, B.S., Professor, Seoul National University of Science and Technology, Korea. Disentangling in Feynman's Operational Calculi for Noncommuting Operators. 2. Roy, P., Professor, Indian Statistical Institute, India. Bound States in Continuum in Two Dimensions. 3. Erlacher, E. Assistant Professor, Vienna University of Economics and Business, Austria. A Concept of Invertibility for Generalized Functions. 4. Simon, R., Lecturer, L.S.E., U.K. A parametrized version of the Borsuk–Ulam theorem. (Mathematics) 5. Maican, M., Researcher, Institute of Mathematics of the Romanian Academy, Romania. On The Geometry of the Moduli Space of Semi-Stable Plane Sheaves With Hilbert Polynomial 6m+3. 6. Vera Villagran, O.P., Professor, University of Bio-Bio, Chile. Gain of Regularity for a Benney-Lin Equation Type. (Mathematics)

13:30-14:30 Lunch (details during registration)

14:30-16:00 Session VI (Room A): Applied Statistics I
Chair: Georgakis, C., Academic Member, ATINER & Associate Professor, DePaul University, USA.

1. Mazumdar, H.P., Professor, Indian Statistical Institute, India & Mamaloukas, C., Professor, Athens University of Economics and Business, Greece. On Millionschikov's Zero-Fourth Cumulant Hypothesis Applied to Turbulence.
2. Tsakiri, K., Assistant Professor, Nova Southeastern University, USA & Zurbenko, I., Professor, Nova Southeastern University, USA. Determining the Main Climatic Factors in Water Use Time Series. (Statistics)
3. Evtimova, E., Associate Professor, University of Sofia St. Kliment Ohridski, Bulgaria. Discrete and Continual Energy-Momentum Tensor Distributions in Cylindrical Potential Well. (Statistics)

16:00-17:30 Session VII (Room A): General Issues on Statistics
Chair: Trafalis, T., Professor, The University of Oklahoma, USA.

1. Arnab, R., Professor, University of Botswana, Botswana. Variance Estimation from Complex Survey Designs.
2. Kim, J., Professor, Fariborz Maseeh Dept of Mathematics and Statistics, USA. A Simple Alternative Test to One-Sample Log-Rank Test.
3. Zagoraiou, M., Researcher, University of Bologna, Italy. Multi-Objective Optimal Designs in Comparative Clinical Trials with Prognostic Factors.

20:30–22:30 Greek Night (Details during registration)

Tuesday 12 June 2012

08:00-10:00 Session VIII (Room A): Teaching Methodology I
Chair: *Kuphon, B., Lecturer, Mahasarakham University, Thailand.

1. Koublanova, E., Associate Professor, Community College of Philadelphia, USA. Teaching On Line an Introductory Probability Course in a Two-Year College. (Tuesday, 12th of June, 2012)
2. Eid, W., Lecturer, Otto-von-Guericke-University Magdeburg, Germany. Geometric Analogies in Mathematics Lessons.
3. Roa-Fuentes, S., Universidad Industrial de Santander, Grupo de Investigación EDUMAT-UIS, Colombia &Centro de Investigación y de Estudios avanzados del IPN, México & Oktac, A., Centro de Investigación y de Estudios avanzados del IPN, México. Mathematically Talented Students Thinking About Infinity: A Cognitive Perspective Using APOS Theory.
4. Toh, T.L., Associate Professor, National Institute of Education, Singapore. How Singapore Teachers' School Mathematics Content Knowledge

Developed: Results from an International Comparative Study.

10:00-11:30 Session IX (Room A): Applied Statistics II **Chair:** Koublanova, E., Associate Professor, Community College of Philadelphia, USA.	**10:00-11:30 Session X (Room B): Mathematics III** **Chair:** Eid, W., Lecturer, Otto-von-Guericke-University Magdeburg, Germany.
1. *Ray, S., Faculty Member, Indian Statistical Institute, India. Improve Efficiency of Marketing Process by Using Six Sigma. 2. Torrecilla, J.S., Associate Professor, Complutense University of Madrid, Spain. Combination of Self-Organizing Map and Chaotic Parameters for Classifying Anomalous Digital Signals. 3. Saat, N., Lecturer, University Kebangsaan, Malaysia. The Relationship of REM Sleep Stages and Socio-Demographic Factors.	1. *Cho, D.H., Professor, Kyonggi University, Korea. Relationships between a Conditional Integral Transform and Convolution of Bounded Fuctions on an Analogue of Wiener Space. 2. Al-Aidarous, E., Associate Professor, King Abdul-Aziz University, Saudi Arabia. Application of the Haar Wavelets for Solution of Systems of Integral Equations.

11:30-13:00 Session XI (Room A): Teaching Methodology II **Chair:** *Ray, S., Faculty Member, Indian Statistical Institute, India	**11:30-13:00 Session XII (Room B): Mathematics IV** **Chair:** *Cho, D.H., Professor, Kyonggi University, Korea.
1. Yavich, R., Lecturer, Ariel University Center of Samaria, Israel & Kanel-Belov, A., Professor, Bar-Ilan University, Israel. Staging of Mathematical Education. 2. Robinson, G., Lecturer, University of Texas at San Antonio, USA & Hall, N., Lecturer, University of Texas at San Antonio, USA. Developing Quantitative Literacy through Writing. 3. Mahri, Z.L., Associate Professor, Unversité Mentouri Constantine, Algeria. Some Observations about Improving the Numerical Analysis Teaching.	1. *Stoica, C., Assistant Professor, Aurel Vlaicu University of Arad, Romania. Muldowney Type Asymptotic Behaviors in the Study of Evolution Equations. (Tuesday, 12th of June, 2012) 2. Ozdemir, Y., Assistant Professor, Anadolu University, Turkey. Wallpaper Patterns with Self-Similar and Graph-Directed Fractal Lattice Units. 3. Kagaris, D., Professor, Southern Illinois University, USA. The Differentiating Hitting Set Problem and Applications. (Mathematics)

13:00-14:00 Lunch (Details during registration)

14:00-15:30 Session XIII (Room A): Models and other Essays
Chair: *Stoica, C., Assistant Professor, Aurel Vlaicu University of Arad, Romania.

1. Chough, K., Professor, University of Alberta, Canada, Liang, Y., Professor, University of Texas-Sana Antonio, USA & Li, Y., Professor, University of Alberta, Canada. Response Adaptive Repeated Measurement Designs in the Presence of Treatment Effects.
2. Das, P., Professor, Indian Statistical Institute, India. Quality Improvement of Green Moulding Sand: An approach Using Statistical Experiments and Composite Desirability Function.

17:00-20:00 Urban Walk (Details during registration)

20:00-21:00 Dinner (Details during registration)

Wednesday 13 June 2012
Cruise: (Details during registration)

Thursday 14 June 2012
Delphi Visit: (Details during registration)

Eman Salem Al-Aidarous
Associate Professor, King Abdul-Aziz University, Saudi Arabia

Application of the Haar Wavelets for Solution of Systems of Integral Equations

In this work, the Haar wavelet approach for numerical solution of the system of Fredholm integral equations (SFIEs) and the system of Volterra integral equations (SVIEs) are presented, Illustrative examples are included to demonstrate the validity and applicability of the technique. The calculations indicate that the accuracy of the obtained solutions is quite high even when the number of calculation points is small.

Dong Hyun Cho
Professor, Kyonggi University, Korea

Relationships between a Conditional Integral Transform and Convolution of Bounded Functions on An Analogue of Wiener Space

Let $C[0, t]$ denote the function space of all real-valued continuous paths on $[0, t]$. Define $X_{n}: C[0, t]\to \mathbb R^{n+1}$ and $X_{n+1}: C[0, t]\to \mathbb R^{n+2}$ by

\begin{eqnarray*}

X_n(x) = (x(t_0), \cdots, x(t_n)) \text{ and } X_{n+1}(x) = (x(t_0), \cdots,x (t_n), x(t_{n+1})),

\end{eqnarray*}

where $0=t_0 < t_1 < \cdots < t_n<t_{n+1} =t$.

In the present talk, using two simple formulas for the conditional expectations with the conditioning functions X_n and X_{n+1}, we evaluate the $L_p(1\le p\le\infty)$-conditional analytic Fourier-Feynman transforms and the conditional convolution products of the functions which have the form

\begin{eqnarray*}

\int_{L_2[0,t]}\exp\{i(v,x)\} d\sigma (v)\int_{\mathbb R^r}\exp\biggl\{\sum_{j=1}^ru_j(v_j,x)\biggr\} d\rho (u_1,\cdots, u_r)

\end{eqnarray*} for a.e. $x\in C[0,t]$, where $\{v_1, \cdots, v_r\}$ is an orthonormal subset of $L_2[0,t]$ and σ and ρ are the complex Borel measures of bounded variation on $L_2[0,t]$ and $\mathbb R^r$, respectively. We finally investigate that the conditional

analytic Fourier-Feynman transforms of the conditional convolution products for the functions, can be expressed in terms of the products of the conditional analytic Fourier-Feynman transform of each function.

Evelina Erlacher
Assistant Professor, Vienna University of Economics and Business, Austria

A Concept of Invertibility for Generalized Functions

The theory of distributions was developed in order to handle singular (i.e. delta-like) objects in linear partial differential equations, obeying rigorous mathematical standards. However, the limitations of a purely linear theory soon became apparent. In the 1980s, J.F. Colombeau introduced a method to construct associative, commutative differential algebras whose product coincides with the pointwise product of smooth functions and which contain the space of distributions. Since then the theory of these generalized functions has been extended and applied successfully to numerous problems. However, a growing need for an appropriate notion of invertibility, together with corresponding inverse function theorems for generalized functions is to be felt.

In this talk, we give a short introduction to the special Colombeau algebra. Then we present and discuss different notions of invertibility for generalized functions. Several necessary conditions for (left, right) invertibility are derived, giving rise to the concepts of compactly asymptotic infectivity and subjectivity. We analyse to which extent these properties are also sufficient to guarantee the existence of a (left, right) inverse of a generalized function. Finally, we establish several inverse function theorems in this setting and study the relation to their classical counterparts.

Dimitri Kagaris
Professor, Southern Illinois University, USA

The Differentiating Hitting Set Problem and Applications

The Differentiating Hitting Set (DHS) problem is an extension of the Hitting Set (HS) problem. The task in HSis,givena collection T of items and a collectionSof subsets of those items, to find the minimum cardinality subset t of T so that for any subset s in S the intersection t∩s is non-empty. The DHS requires that for any subset s in S the intersection t∩s is unique among all subsets s in S.DHS (as alsoHS) is NP-Hard. We proposea heuristic for DHS and show applications in dimensionality reductionin image retrieval and in fault diagnosis in digital circuits.

Byoung Soo Kim
Professor, Seoul National University of Science and Technology, Korea

Disentangling in Feynman's Operational Calculi for Noncommuting Operators

It is important in several areas of mathematics and its applications to be able to form functions of operators.

If one has a single self-adjoint or several commuting self-adjoint operators, the spectral theorem provides an extremely rich functional calculus. However, as soon as we have two or more noncommuting operators, the functional calculus becomes much more complicated. Feynman invented some 'rules' for forming functions of noncommuting operators.

We introduce an approach to Feynman's operational calculus for systems of bounded, not necessarily commuting, linear operators acting on a Banach space. In particular, formulas which simplify 'disentangling' under various conditions are given. The operation of disentangling is the key to Feynman's operational calculi.

Rong Ma
Lecturer, Northwestern Polytechnical University, China

On the Congruence Properties of the Lucas Numbers

As is well known, the Fibonacci sequence F_{n} (n=0,1,2,\dots) is the sequence $$0,1,1,2,3,5,8,13,21,\dots$$ which can be expressed as the second-order linear recurrence sequence \begin{eqnarray}
F_{n+2}=F_{n+1}+F_{n}
\end{eqnarray}
with the initial value $F_{0}=0,\,F_{1}=1$. The formula of general term of this sequence is
\begin{eqnarray}
F_{n}=\frac{1}{\sqrt{5}}\left(\alpha^{n}-\beta^{n}\right),
\end{eqnarray}
where $\alpha=\frac{1+\sqrt{5}}{2},\beta=\frac{1-\sqrt{5}}{2}$. It is very surprising that such a sequence consisting of natural numbers actually has been expressed as the form of irrational numbers.

Another important sequence is the Lucas sequence $L_{n} (n=0,1,2\dots)$ which is defined by the same recurrence sequence $L_{n+2}=L_{n+1}+L_{n}$ with the different initial value $L_{0}=2,\,L_{1}=1$. Thus, we also have the formula of general term of Lucas sequence
\begin{eqnarray}
L_{n}=\alpha^{n}+\beta^n,
\end{eqnarray}
where α and β are the same above. L_n is congruent to 1 mod n if n is a prime, but some composite values of n also have this property.

In this paper, we make full use of the identities involving the Fibonacci numbers F_n and the Lucas numbers L_n by the elementary method and give several congruence formulas about the Lucas numbers modulo p , where p is a prime.

Mario Maican
Researcher, Institute of Mathematics of the Romanian Academy, Romania

On The Geometry of the Moduli Space of Semi-Stable Plane Sheaves With Hilbert Polynomial 6m+3

Moduli spaces in algebraic geometry are objects (e.g. varieties) that parametrise a class of objects (e.g. sheaves, vector bundles, sub-varieties of a fixed variety) with fixed invariants. In order to construct moduli spaces Mumford introduced the concept of semi-stability. We are concerned with semi-stable coherent sheaves supported on curves of degree 6 in the complex projective plane. The notion of coherent sheaf generalises the notion of vector bundle as follows: a vector bundle of rank r over a variety attaches to every point of the variety a vector space of dimension r. Intuitively, a coherent sheaf attaches vector spaces whose rank can jump on closed subvarieties. The concept of semi-stability for sheaves, as refined by Gieseker, allowed Simpson to contruct moduli spaces of sheaves on a smooth projective variety with fixed Hilbert polynomial. We classify all Gieseker semi-stable sheaves on the complex projective plane that have Hilbert polynomial P(m)=6m+3. These sheaves are supported on plane curves of degree 6 and have Euler characteristic 3. According to Le Potier their moduli space is an irreducible projective variety of dimension 37. We show that this moduli space is birational to the blow-up at a special point of the quotient space of semi-stable 3 by 3 matrices with entries homogeneous quadratic polynomials in three variables modulo the canonical action by conjugation of GL(3) times GL(3). This is a continuation of previous work in which we studied sheaves supported on quintic curves and, together with Drezet, sheaves supported on quartic curves.

Yunus Ozdemir
Assistant Professor, Anadolu University, Turkey

Wallpaper Patterns with Self-Similar and Graph-Directed Fractal Lattice Units

One of the beautiful results of plane geometry is about the classification of wallpaper patterns. A wallpaper pattern is a subset of the plane invariant under two independent translations and has a corresponding discrete subgroup of the plane isometry group leaving the pattern invariant, called a wallpaper group. It is well known that there are 17 different wallpaper groups up to isomorphism.

Fractals are another source of beauty and it is intriguing whether wallpapers can be constructed with fractal lattice units. Another question is related to the so-called graph-directed fractals which generalize the classical self-similar fractals.

We construct two sets of 17 plane patterns corresponding to the 17 wallpaper groups such that for each pattern the lattice units are realized as self-similar fractals and graph-directed fractals, respectively.

Pinaki Roy
Professor, Indian Statistical Institute, India

Bound States in Continuum in Two Dimensions

Bound states in continuum (BIC) are discrete energy states which are embedded in the continuum. Such states are important from the point of view of both theory as well as applications. There have been many attempts to construct BIC , quasi bound states for both scalar as well as spin ½ electrons in two dimensions using various magnetic field configurations. Here we shall show that for scalar electrons described by the Schroedinger equation it is possible to create BIC using electric fields. As for the methodology we shall use the supersymmetric or the Darboux formalism. Possible ways to apply the formalism to spin ½ electrons will also be discussed.

Roberts **Simon**
Lecturer, L.S.E., U.K.

A Parametrized Version of the Borsuk–Ulam Theorem

We show that for a 'continuous' family of Borsuk–Ulam situations, parametrized by points of a compact manifold W, its solution set also depends 'continuously' on the parameter space W.

By such a family we understand a compact set $Z \subset W \times S^m \times R^m$, the solution sets consist of points $(w, x, v) \in Z$ such that also $(w,-x, v) \in Z$. Here, 'continuity' means that the solution set supports a homology class that maps onto the fundamental class of W.

We also show how to construct such a family starting from a 'continuous' family $Y \subset \partial W \times R^m$ when W is a compact top-dimensional subset in R^{m+1}. This solves a problem related to a conjecture that is relevant for the construction of equilibrium strategies in repeated two-player games with incomplete information. A new method (of independent interest) used in this context is a canonical symmetric squaring construction in Cech homology with Z/2-coefficients.

Codruta Stoica
Assistant Professor, Aurel Vlaicu University of Arad, Romania

Muldowney Type Asymptotic Behaviors in the Study of Evolution Equations

As the state space of some dynamical systems that describe phenomena from physics, engineering or economics is of infinite dimension, the approach is more appropriate to be done by means of associated operator families. The techniques used for stability and instability can be generalized in the case of dichotomy, one of the most important asymptotic properties for the solutions of evolution equations, introduced by O. Perron in 1930, as a starting point for many papers on the stability theory, and which has gained importance since the works of J.L. Daleckii and M.G. Krein and J.L. Massera and J.J. Schaffer.

A particular case of dichotomy was introduced by J.S. Muldowney in 1984, for linear differential systems. The aim of this paper is to define and characterize the concept of Muldowney dichotomy for skew-evolution semiflows, introduced by us in the literature of stability theory by means of evolution semiflows and evolution cocycle, as generalization for the classic notions of skew-product semiflows and evolution operators.

In this paper, connections of the new concept with the classic notion of exponential dichotomy in the uniform case are also given. We emphasize as well the importance of the dichotomy in the study of the solutions of evolution equations. Several illustrative examples motivate the approach.

Octavio Paulo Vera Villagran
Professor, University of Bio-Bio, Chile

Gain of Regularity for a Benney-Lin Equation Type

We study the existence of local and global solutions, the gain of regularity for the initial value problem associated to the Benney-Lin equation type perturbed by a dispersive and dissipative terms which appear in several fluids dynamics problems.

Raghunath Arnab
Professor, University of Botswana, Botswana

Variance Estimation from Complex Survey Designs

The Central Statistical Office (CSO), Botswana and Statistics South Africa conduct large scale nationwide surveys on a regular basis. The survey design involves selection of first stage units (fsu's) with inclusion probability proportional to size (IPPS) sampling design introduced by Goodman and Kish (1950) and the second stage units (ssu's) by systematic sampling scheme. CSO, Botswana employed the same sampling design for "Household Income and Expenditure Survey 2002/03 (HIES, 2002/03)" and "Botswana Aids Impact Survey II, 2004 (BAIS II, 2004)". Chaudhuri and Arnab (1982) proved that for the sampling design recommended by UNDP, the variance of the population total or mean cannot be estimated unbiasedly. Unbiased variance estimation is required for estimating precision of the survey estimates, confidence interval, optimum sample size and testing of hypothesis amongst others. The optimum sample size is the key factor of determination of cost of a survey and precisions of estimates.

In our present investigation we have proposed a few methods of variance estimation for the surveys proposed by CSO. The performances of the proposed estimators are tested with the live data collected by CSO for HIES survey with six indicators.

Michael Bedwell
Teacher, Ukrainian Education Center, Ukraine

Exploiting the Sudoku Syndrome

This paper will examine how teachers of statistics can exploit the universal popularity of the Sudoku mind-game by the use of small, simple and discrete observations. Two examples of problems that can be solved by enumeration in two-dimensional matrices will be discussed: first the Kruskal-Wallis test for three groups of not necessarily the same size, and secondly the calculation and comparison of standard deviations and standard errors when the sampling methods are either with- or without- replacement. In this second example the discussion will be extended to suggest how students can gain insight into Boot-Strapping, a technique that is not apparently intuitive, yet of growing importance in many fields of statistical investigation.

The author will use these examples as further evidence for his hypothesis that the fundamentals of statistical thinking can be learnt with recourse neither to advanced mathematics nor to electronic computation.

Javier Camargo
Researcher & Teacher, University Industrial of Santander, Colombia,

Patricia Pellicer Covarrubias
Researcher and Teacher, University National Autónoma de México, México
&
Michael Rincón
Student, University Industrial of Santander, Colombia

On G-Contractibility of Dendroids

A continuum is a compact, connected and nonempty metric space. A continuum X is g-contractible provided that there exists an onto map f:X->X such that f is homotopic to a constant map. Professor David Bellamy defined the notion of g-contractibility in order to give a characterization of all continua which are both a continuous image and a continuous reimage of the Cantor fan.

Given a continuum X, we say that X is uniformly path wise connected if there exists a subjective map f:Cone(C)->X, where C is the Cantor middle-thirds set. Bellamy asked if every uniformly path wise connected continuum is necessarily g-contractible. In 1999, I. Krzeminska and J. Prajs answered that question in the negative, their example is not hereditarily incoherent. In fact their example is far from being acyclic; it separates the plane into infinitely many components. We defined an uncountable family of pair wise non-homeomorphic den droids; each den droid X answered the Bellamy´s question in the negative.

Also, we show properties in relation with the g-contractibility of continua.

Keumhee Carriere Chough
Professor, University of Alberta, Canada,

Yuanyuan Liang
Professor, University of Texas-Sana Antonio, USA
&
Yin Li
Professor, University of Alberta, Canada

Response Adaptive Repeated Measurement Designs in the Presence of Treatment Effects

A multiple-objective allocation strategy was recently proposed for constructing response-adaptive repeated measurement designs for continuous responses. In this talk, we briefly review and extend the allocation strategy to constructing response-adaptive repeated measurement designs for binary responses. Through computer simulations, we find that the allocation strategy developed for continuous responses also works well for binary responses and it can successfully allocate more patients to better treatment sequences without sacrificing much of estimation precision. However, design efficiency in terms of mean squared error drops sharply as more emphasis is placed on increasing treatment benefit than estimation precision. We also find that the allocation for the binary response case is rather largely spread out over the treatment sequences considered, leading to designs with many treatment sequences, unlike the continuous response case, where the adaptive designs often coincided with the fixed optimal designs. I will also briefly introduce optimal N of 1 trial designs.

Prasun Das
Professor, Indian Statistical Institute, India

Quality Improvement of Green Moulding Sand: An approach Using Statistical Experiments and Composite Desirability Function

A statistically designed experimental approach is adopted for improving the quality of bentonite bonded green moulding sand mixture. Control of facing sand property is the prime challenge in steel foundry and to get the desirable property several additives are added to the facing sand. A statistically designed experiment is planned by varying the levels of reclaimed-sand, bentonite, dextrin, water percentage, mulling time and bench time to estimate the green sand properties, viz., green compressive strength (GCS), green shear strength (GSS) and Permeability. Initially a half fraction of 26 factorial experiment with central runs is used for the experiment and a first order response surface is fitted. Each model indicates the presence of curvature in the experimental region along with presence of non-linear and interaction effects. Observing the inadequacy (lack of fit) of this model, another set of experiment is carried out based on a spherical central composite design (CCD) with the remaining half of the 26 factorial experiment, and a second order response surface is developed for which lack of fit is found insignificant. All the three response surfaces have been generated whose stationary points are characterized with the help of eigen values of the design matrix. After checking the adequacy of this model, the best compromise operating levels of process variables are found to achieve the most desirable green sand properties, based on a composite desirability function approach. The desirability functions for GCS and Permeability are chosen 'nominal' type whereas for GSS, it is chosen as 'higher the better type' also for some trials. On implementation of the recommendations at the steel foundry, the average levels of GCS, GSS and Permeability are observed as 746.83 gm/cm2, 260.65 gm/cm2 and 338.82 PN (permeability number) respectively which are quite nearer to the target set by the foundry experts during process optimization.

Elena Evtimova
Associate Professor, University of Sofia St. Kliment Ohridski, Bulgaria

Discrete and Continual Energy-Momentum Tensor Distributions in Cylindrical Potential Well

The aim of the work is to represent quantum particles as composed of some sub-quantum units whose existence is discrete and singular in space as well as in time. For each quantum particle the sub-quantum units form a standing wave discrete flashing on and off singularity sequences in space-time. Using the tensor apparatus of relativity theory their discrete singularity distributions are introduced. The standing waves of flashing on and off singularities are modeled by sequences of pure matter energy-momentum tensors which are proportional to specifically ordered sets of 4D δ-functions. The space-time locations of the poles of the 4D δ-functions determine where the singularities are. Quantum particles are considered as objects appearing as an averaged effect of these discrete in space-time sequences of sub-quantum units. Averaging the pure matter singularity energy-momentum tensors over space-time leads to the well-known quantum field theory energy-momentum tensors of different particles. Hence, the continuous space-time probability distributions of these sequences of sub-quantum units are defined via the quantum wave functions. As application of these concepts the case of a quantum particle in an infinite cylindrical potential well is considered. The energy-momentum tensor of this particle is represented through a sum of 6 pure matter tensor flows and their scalar density distribution and 4-dimesional velocities are found. The behavior of the continual density distribution of these standing wave singularities inside the cylindrical potential well is investigated. Expressions of the singularity repetition periods in general and particular case are given.

Jong Sung Kim
Professor, Portland State University, USA

A Simple Alternative Test to One-Sample Log-Rank Test

When there are patients with a rare, life-threatening disease, it may be of interest to know if the study sample is experiencing the same survival as the demographically matched general population, according to actuarial tables. Finkelstein et al. (2003) have developed software to perform one-sample log-rank test developed by Woolson (1981). The software provides a p-value for testing the equality of the survivals along with a comparative graph of the survival functions. From a practical point of view, patients would prefer to know how closer their remaining lifetimes are to the general population's counterpart. With this in mind, we developed a censored data version of a paired sample t-test. A simulation study shows that this simpler test has the same power as one-sample log-rank test. A real data example is provided.

Bungon Kumphon
Lecturer, Mahasarakham University, Thailand

A Distribution of Monthly Rainfall for Lampao Site in the Chi River Basin, Thailand

In this study, the four-parameter kappa distribution with L-Moments estimation has been used to fit the distribution of monthly rainfall data at Lampao site in the Chi River Basin, Thailand. The probabilities that the precipitation was equal to 0.75 each week were estimated, and the estimated extreme rainfall values obtained can be used for water and agriculture management in the neighboring area.

Jun Li
Assistant Professor, University of California, USA

New Nonparametric Multivariate CUSUM Control Charts for Location and Scale Changes

With the manufacturing process becoming more and more complicated, there are many situations in which monitoring multiple quality characteristics is necessary. In most cases, these quality characteristics are correlated, so multivariate control charts are needed to monitor these quality characteristics simultaneously. Among different multivariate control charts, multivariate cumulative sum (CUSUM) control charts are the popular choice for detecting small and moderate changes in the manufacturing process. However, most of CUSUM procedures in the literature were developed under the multivariate normality assumptions, which is usually difficult to justify in practice. Therefore, nonparametric multivariate CUSUM procedures are more desirable. In this talk, we will present two new nonparametric multivariate CUSUM procedures based on the spatial sign and data depth for detecting location and scale changes. These two procedures can be considered as the nonparametric counterparts of the two parametric multivariate CUSUM procedures developed in Crosier (1998). We will discuss the properties of the two procedures and demonstrate their performance by comparing with the existing CUSUM procedures in a variety of simulation settings. This is joint work with Xin Zhang and Daniel R. Jeske, from Department of Statistics, University of California, Riverside.

Himandri Pai Mazumdar
Professor, Indian Statistical Institute, India
&
C. Mamaloukas
Professor, Athens University of Economics and Business, Greece

On Millionschikov's Zero-Fourth Cumulant Hypothesis Applied to Turbulence

Ampalavanar Nanthakumar
Professor, State University of New York at Oswego, USA
&
Shashi Kanbour
Associate Professor, State University of New York at Oswego, USA

On the Detection of Heteroscedasticity by Using CUSUM Range Distribution

In this paper, we present a new method for checking the heteroscedasticity among the error terms. The method is based on the CUSUM Range distribution. We will analyze the error residuals of a simple linear regression in order to check for a possible heteroscedasticity among the error variability. Here, the response variable is the Cepheid Luminosity and the predictor is the natural logarithm of the Cepheid Periodicity. The Cepheids are pulsating stars from the nearby galaxy LMC (Large Magellanic Clouds).

$$L_i = \alpha + \beta.\log_e(P_i) + \varepsilon_i \quad , \quad i = 1,2,\ldots\ldots\ldots,n \qquad (1.1)$$

where L represents the luminosity; P the periodicity and ε, the noise in the data. We use the least square method to estimate the unknowns.

Let

$$C(j) = \sum_{i=1}^{j}\left(L_i - a - b.\log_{\varepsilon}(P_i)\right) = \sum_{i=1}^{j}\hat{\varepsilon}_i \qquad (1.2)$$

where a and b are the least square estimates of α and β respectively.

Here, we will use the range statistic

$$R = \max_j C(j) - \min_j C(j) \qquad (1.3)$$

Note: Based on the probability pattern, we have developed a formula for the probability weight

$$w_n(i) = \frac{(n-i).2^i}{\left(2^{n+1} - 2(n+1)\right)} \qquad (1.4)$$

where n = number of observations and i = number of error terms in the CUSUM Range.

Next, we present the distribution for the Range (R).

Lemma 1: Let R represent the CUSUM Range. Then, the overall distribution

$$P(R \le x) = \sum 2.w_n(i).\left\{\Phi\left(\frac{x}{\sqrt{i}.\sigma_\varepsilon}\right) - 0.5\right\} \tag{1.5}$$

$$= 2.\sum_{i=1}^{n} \frac{(n-i).2^i}{\left(2^{n+1} - 2(n+1)\right)}.\left\{\Phi\left(\frac{x}{\sqrt{i}.\sigma_\varepsilon}\right) - 0.5\right\}$$

$$= \sum_{i=1}^{n} \frac{(n-i).2^i}{\left(2^n - (n+1)\right)}.\left\{\Phi\left(\frac{x}{\sqrt{i}.\sigma_\varepsilon}\right) - 0.5\right\} \tag{1.6}$$

Remark: The CUSUM Range is a mixture of folded normal variables. Its density is given by

$$f_R(r) = \frac{1}{\left(2^n - (n+1)\right)}.\sum_{i=1}^{n} \frac{(n-i).2^i.e^{-\frac{r^2}{2.i.\sigma_\varepsilon{}^2}}}{\sqrt{2\pi.i}.\sigma_\varepsilon} \tag{1.7}$$

Also, the conditional density function is given by

$$f_R(r / r \ge y) = \frac{1}{\left(2^n - (n+1)\right)}.\sum_{i=1}^{n} \frac{(n-i).2^{i-1}.e^{-\frac{r^2}{2.i.\sigma_\varepsilon{}^2}}}{\sqrt{2\pi.i}.\sigma_\varepsilon.\left(1 - \Phi\left(\frac{y}{\sqrt{i}.\sigma_\varepsilon}\right)\right)} \tag{1.8}$$

Result 1: The conditional expected value for the CUSUM Range is given by

$$E(R / R \ge y) = \frac{\sigma_\varepsilon}{\sqrt{2.\pi}}.\sum_{i=1}^{n} \frac{(n-i).2^{i-1}.\sqrt{i}.e^{\frac{-y^2}{2.i..\sigma_\varepsilon{}^2}}}{\left(2^n - (n+1)\right).\left(1 - \Phi\left(\frac{y}{\sqrt{i}.\sigma_\varepsilon}\right)\right)} \tag{1.9}$$

Result 2: The conditional second moment for the CUSUM Range is given by

$$E(R^2 / R \ge y) = \frac{\sigma_\varepsilon.y}{\left(2^n - (n+1)\right).\sqrt{2\pi}} \sum_{i=1}^{n} \frac{(n-i).\sqrt{i}.2^{i-1}.e^{-\frac{y^2}{2.i.\sigma_\varepsilon{}^2}}}{\left(1 - \Phi\left(\frac{y}{\sqrt{i}.\sigma_\varepsilon}\right)\right)} +$$

$$\sigma_\varepsilon{}^2.\sum_{i=1}^{n} \frac{i.(n-i).2^i}{\left(2^n - (n+1)\right)}$$

(1.10)

As we noted earlier when there is homogeneity among the error variability, the Range follows a mixture of folded normal distribution. Hence its conditional expected value and the conditional second moment satisfy equations (1.9) and (1.10). Unlike the papers that were published in the past on the topic of error heteroscedasticity, this paper presents a very simple method to detect error heteroscedasticity. Here, we use the properties of the CUSUM Range distribution to detect error heteroscedasticity.

Nur Z. Saat
Lecturer, University Kebangsaan, Malaysia

The Relationship of REM Sleep Stages and Socio-Demographic Factors

Studies on apnea patients are often carried out based on data obtained from the sleep study. Sleep stages that occurred during sleep is light sleep, deep sleep and Rapid Eye Movement (REM). The proportion of REM during sleep is difference according to gender, age group and Body Mass Index(BMI). Most apnea events occurred during REM sleep stages. Data on apnea subjects is quite scarce since high cost is required for conducting the study. Bayesian method is particularly suitable for analyzing limited data as it allows for updating of information by combining the current information with the prior belief. In this paper we demonstrate the use of regression models of Poisson, Binomial and Negative binomial distribution with Bayesian methods. The data consist of sleep stages, gender, age and body mass index for 22 patients of apnea. The objective of the study is to determine the relationship between occurrence of REM sleep stages with gender, age and body mass index(BMI). Secondly to determine the best model according to the Deviance Information Criteria(DIC). From the comparison of results using three different distributions for the underlying rate of occurrence of REM, the best model was negative binomial models. The occurrence of REM was lower in women by 38% . Moreover, the occurrence of REM increase as the age and BMI increased. In conclusion, the occurrence of REM, was higher among men , higher age group and obese patients.

José S. Torrecilla
Associate Professor, Complutense University of Madrid, Spain

Combination of Self-Organizing Map and Chaotic Parameters for Classifying Anomalous Digital Signals

Adulteration of foods is more and more prevalent, mainly in highly priced products with a strong demand such as extra virgin olive oil (EVOO) in Mediterranean countries. The adulteration of EVOO with cheaper and insalubrious ingredients could have serious health implications for consumers. One dramatic example of this was the Spanish toxic oil syndrome resulting from the consumption of aniline denaturalized rapeseed oil, that up to now involves more than twenty thousand people, having caused serious illness and in some cases death. This is why detection of adulteration of EVOO is an important research issue that attracts the interest of many research groups.

A combination of algorithms will be tested to distinguish noisy signals from adulterated and pure samples. In this way, the equipment used is more suitable to combat against the adulteration of foods. To the best of our knowledge, this application has not been shown before. In particular, nonlinear algorithms based on the Lyapunov exponent (LE) and lag-k autocorrelation coefficients (CC) have been tested to detect different natures of output signals types from UV-vis spectrophotometer. These signals come from UV-vis scans of adulterated samples of extra virgin olive oil (EVOO) with refined olive oil or refined olive pomace oil or UV-vis signals of pure samples of EVOO with white random and sinusoidal white random noises. The data collected from this equipment were used to calculate LE and CC values. By the application of self-organizing maps the signals can be adequately classified into five groups. Inside every group each scan is classified depending on the percentage of noise added and the concentration of adulterant agents, with a misclassification rate of less than 1%. Given the successful results achieved here, this opens a door to the reliable "on line" determination of possible adulterations present in the food chain.

Theodore Trafalis
Professor, The University of Oklahoma, USA

SVM Classification of Uncertain and Imbalanced Data Using Robust Multi-Kernel Methods

In this study we have developed a Robust Support Vector Machines (SVM) scheme of classifying uncertain and imbalanced data. In SVM classification data uncertainty is not addressed efficiently. Also, imbalanced data exist while performing analysis of rare events, in which the minority class becomes critical. Furthermore, while traditional SVM methods use a single kernel for learning, multiple kernel schemes are being developed to incorporate a better understanding of all the data features. We combine the multiple kernel learning methods with the robust optimization concepts to formulate the classification as a semi-definite programming problem and develop its robust counterparts under bounded data uncertainties. We enhance our analysis by including multiple kernels for handling the data and investigate the robust formulations for such problems. Initial experimental results are presented.

Katerina Tsakiri
Assistant Professor, Nova Southeastern University, USA
&
Igor Zurbenko
Professor, Nova Southeastern University, USA

Determining the Main Climatic Factors in Water Use Time Series

We present techniques for studying the influence of the climatic and other variables for the explanation of the water use time series. A statistical methodology is described for separating the different time scale components in time series of the water use, namely, long term component, seasonal component, and short term component. We show that the temperature, precipitation, soil temperature, and relative humidity are the main climatic factors for the explanation of the long term, seasonal and short term component of the water use time series. Part of the residuals of the linear regression for the long term component of the water use can be explained by the unemployment rate. This methodology can be applied for studying the water use time series in other locations, as well.

Maroussa Zagoraiou
Researcher, University of Bologna, Italy

Multi-Objective Optimal Designs In Comparative Clinical Trials With Prognostic Factors

The present paper deals with the problem of allocating patients to two competing treatments in the presence of covariates in order to achieve a good trade-off among ethical concerns, inferential precision and randomness in the treatment allocations.

Assuming the linear homoscedastic model, we suggest a multiobjective design strategy based on a compound optimization approach that combines inferential precision and ethical gain by means of flexible weights, which can be fixed a priori by the experimenter or they may be functions of the unknown model parameters.

The ensuing compound optimal allocations of the treatments depend on the covariates and their distribution on the population of interest, as well as on the unknown parameters of the model. Therefore, suitable applications of covariate-adjusted response-adaptive procedures can be adopted in order to target the derived compound target.

Lynn Batten
Professor, Deakin University, Australia,

Michelle Oyganowski
Professor, Deakin University, Australia
&
Simon James
Professor, Deakin University, Australia

Anxiety abatement in a Class of Future Mathematics Teachers – A Case Study

In (Chen and Chang, 2006), the authors argue (page 2) that while development of the 'whole child' is a widely accepted principle among early childhood educators, an analogous approach to teacher development for early childhood teachers is an effective method of improving teacher confidence and competence. The Whole Teacher approach is designed specifically for early childhood teachers and (see their Table 1) 'emphasizes promoting all aspects of a teacher's development, including attitudes, knowledge and skills, and classroom practices.' The approach has the characteristics of being multidimensional (targeting attitudes, skills and practices, offering multiple ways to learn and develop and accommodating diverse needs and motivations), domain specific (in this case, technology proficiency), integrated (facilitating inter-relationships between attitudes, skills and practices) and developmental (continuous growth).

Chen and McCray (2012) describe an application of the Whole Teacher approach in a mathematics education project in Chicago whose aim was to enhance mathematical competence in early childhood teachers. The professional development programme has three components which are learning labs in which the participants interact with the teaching staff over a period of several days, on-site coaching where staff and teachers meet on a one-to-one basis several times per year, and classroom implementation for which research lessons are constructed by the project staff around major themes and developed and presented in the classroom by the teachers to their own students. The authors report that 'Learning labs present a unique opportunity for teachers to develop stronger professional identities as they meet new peers, share their experiences and learn about other teachers' struggles and success with early math. By providing structured opportunities for teachers to work together in a spirit of fun and exploration, adult learning exercises help create a sense of unity among teachers. Group learning becomes another positive association with mathematics.'

In this paper, we apply the concept of the Whole Teacher to a group of first year university students in a primary education teaching programme at an Australian university. We study a group of 2104 students (1604 females and 500 males) in a mathematics subject between the years 2008 and 2011. These students pursued a degree in primary education enabling them to teach mathematics as well as other subjects to students aged 5 to 12 in the Australian primary school education system. The mathematics subject they were undertaking was designed specifically for future teachers of mathematics at primary levels and was constructed by a team of professional university mathematics educators and mathematicians. It covered various topics within the general area of numeracy and lasted for twelve weeks.

Approximately two thirds of the students enrolled in the university subject entered university directly from high-school; the other third were classified as 'adult' students who were undertaking a programme of retraining. In all cases, their mathematics background was weak and students approached the study of the subject with trepidation.

In addition to teaching content, a primary task of the teaching staff was to mitigate the anxiety of the students for the subject. Several mechanisms, aligned with the Whole Teacher model, were deliberately introduced by the staff to counter fear and to facilitate the easy learning of content. These were:

A. Weekly use of lecture, tutorial and lab, providing multiple pathways to learning

B. Making lecture notes and video lectures available on-line

C. The use of on-line assessment

D. A focus on a deep understanding of concepts.

Of the 600 comments provided as feedback from the students in each year 2008, 2009, 2010 and 2011, over 40 mentioned a negative predisposition towards mathematics, including 'lack of confidence', 'not being good at it', being 'afraid of mathematics' or 'never having enjoyed it'. However, six features were identified by the students as assisting with fear mitigation. These were:

a. Teachers were approachable and supportive

b. Teachers made the subject enjoyable

c. The use of multiple formats (lecture, lab, tutorial) for presentation of the mathematical content

d. All resources were available on-line

e. On-line assessment

f. Group learning experiences which removed pressure from the individual to achieve.

Of interest is the fact that all four of the mechanisms established by the staff were recognized by the students as contributing to the success in reducing fear of mathematics. However, the most frequently

mentioned comments were related to an additional two items listed as (a) and (b) above. Examples of such comments were: students appreciated the fact that the teaching staff were able to make the subject enjoyable because of their enthusiasm, teaching staff appeared to be confident with the subject matter and able to explain concepts clearly, and teaching staff were always available for assistance and gave helpful feedback.

Student feedback also permitted staff to examine comments relating to this reduction of anxiety; there was clear evidence that the students themselves recognized the changes in their attitudes towards mathematics.

This change is confirmed by such feedback comments as 'made me want to learn more and get excited by a subject I find difficult', 'This was the first year of maths I have ever enjoyed or understood', 'I am not very good at maths but this subject has been my favourite', and 'As someone who is not overly fond of math I was not expecting to enjoy this unit at all, in fact I was dreading it. I have come out of this experience somewhat confident in my skills.'

The contributions of this work are:

Demonstration that the Whole Teacher methodology (designed originally for use as a professional development tool for practicing teachers) can be effectively implemented in a university setting with future primary education teachers;

Demonstration that mathematics anxiety can be mitigated in a large group of first year university students.

Wolfram Eid
Lecturer, Otto-von-Guericke-University Magdeburg, Germany

Geometric Analogies in Mathematics Lessons

Thinking in analogous structures leads through all areas of life, on the one hand in the daily life in various situations, on the other hand in scientifical thinking, too. It has been told NEWTON created the idea of gravitation by comparative considerations between the strengths which hold the universe together and the event of an apple falling down from a tree.

Analogies are often used vaguely, there are ambiguous and incomplete or incomplete cleared analogies but analogy can also reach a high level of mathematical precision. Corresponding analogies are used in mathematics in different didactic situations.

That is why approaching problem solutions humanly by thinking in analogous structures is a typical form of thinking and therefore school espacially mathematical lesson should help to form and to develop correspondding heuristic abilities of the pupils.

In the contribution a summary of possibilities of the mathematics lesson regarding this shall particularly be conveyed from the view of the geometry lesson in different age-groups. Being supposed to exemplarily be illustrated introducing character and object of making analogies at an example. The connection of modeling of mathematical and heuristic training then shall be illustrated with concrete lesson contents.

Petr Emanovsky
Associate Professor, Palacky University Olomouc, Czech Republic
&
Bronislava Stepankova
Lecturer, Palacky University Olomouc, Czech Republic

On Some Experience with an Innovation of Initial Mathematics Teacher Training and its Evaluation

Quality of mathematical education is very actual didactic topic at present. Improving the quality of education is unthinkable without a quality mathematics teacher training at universities and other educational institutions. The contribution deals with some innovation possibilities of contents and organization of the study programme for future mathematics teachers realized within ESF project „Professional training of teachers of sciences for careers in a competitive environment“ at Faculty of Science of Palacký University in Olomouc, Czech Republic. The project focuses on improving the training of teachers of all science branches in connection with the growing needs of the current competitive labor market. One of the main aims of the project leading to this improvement is the creation of innovative curricula and special textbooks for these programs. Another objective of the project is to create a system of university schools, mainly for an implementation of a newly conceived student pedagogical practice. To strengthen the feedback from pilot education of new and innovative subjects as well as the new pedagogical practice the complete evaluation was done. The aim of the evaluation was to determine the difference between expectations and real benefits of the subjects and the practice. The evaluation results are very useful as a feedback for a subsequent modification of the study programs. There are described some particular innovative modifications of study program for mathematics teachers in the contribution.

Herbert Henning
Professor, University of Otto von Guericke Magdeburg, Germany

Reality And Mathematical Modelling – New Problems For Mathematical Classes An Teaching Mathematics in the Secondary School

Mathematical modelling and mathematics are a "Key Technology". Mathematics is one if the core competences in developing reliable and efficient simulations for technical, economical and biological systems; thereby, mathematics found a new role as a key technology. In order to simulate any process, it is necessary to find an appropriate model for it and to create an efficient algorithm to evaluate the model. In practice, still one of the main restrictions is time: If one wants to optimize the process, the simulation must be very fast and, therefore, model and algorithm must be looked as a whole and, together, made as efficient as possible.

Four problems are very important:

1. A problem finding competence, i. e. the capacity to discover real world problems, which may be solved successfully by simulation (this seems not to be well developed in teachers);
2. To develop a hierarchy of models, which, together with;
3. To construct, for each model, the most efficient evaluation algorithm, allows us to reduce the simulation time;
4. To check the reliability of the simulation, its limitations and possible extensions; there is never an end in modelling a real world problem.

While modeling a real-world problem, we move between reality and mathematics. The modelling process begins with the real-world problem. By simplifying, structuring and idealizing this problem, you get a real model. The mathematizing of the real model leads to a mathematical model. By working within mathematics, a mathematical solution can be found.

We show a modeling task by the NBA-Basketball player Dirk Nowitzki:

"The NBA-Basketball player Dirk Nowitzki became in collaboration with his coach Holger Geschwindner one of the world's best basketball players. Geschwindner applied mathematical methods based on physical laws as modeling tolls in order compute the optimal shooting-technique for basketball-players."

Elena Koublanova
Associate Professor, Community College of Philadelphia, USA

Teaching On Line an Introductory Probability Course in a Two-Year College

In this paper, we discuss the following questions regarding on-line teaching an Introductory Probability course in a two-year community college.

Is this course suitable for distance education at a Community College? We discuss positive factors such as flexible time frame, a "stress-free atmosphere" for students, open book tests and exams, as well as negative and questionable factors such as students abilities to learn by their own, readiness for distance education and concerns about integrity.

How do course management systems help to achieve the teaching and learning goals? The course is based on the two systems, MyLabsPlus and Webstudy. We discuss positive features of both systems and what could be done to overcome some their shortcomings.

Is distance education environment suitable for struggling students? We discuss some popular on-line course tools, and the Course Forum as a useful instrument for class discussions and communication.

What possibilities for challenging average and capable students can be realized in distance education? With a possibility for students to obtain information on the Internet, more theoretical, concept - oriented questions could be addressed, researched and discussed on the Course Forum.

What is specific in teaching this course to future teachers in an elementary education program? The probability course is sometimes the last math course for future teachers in an elementary education program. Anything our students acquire in this course -- logical thinking, abilities to effectively use technology, to read, analyze, and interpret word problems -- they will bring to their school students.

Examples of student's feedback regarding the course, course tools and technology are included in the presentation.

Zine Labidine Mahri
Associate Professor, Unversité Mentouri Constantine, Algeria

Some Observations about Improving the Numerical Analysis Teaching

Numerical analysis is the area of mathematics that uses algorithms for solving numerically the problems of continuous mathematics. Numerical methods are powerful tools for the solution of complex problems in all fields of engineering and science, and courses involving programming and numerical methods are common in all engineering programs.

In such courses, teachers usually put much emphasis on explaining theoretical concepts and problem-solving techniques, with little attention to practical problems.

After examining the content of some numerical analysis courses taught in the faculties of engineering and sciences in our university and in some other Algerian university the following observations can be made:

- Most numerical analysis courses are taught theoretically, and students are usually required to do a great deal of exercises involving hand calculation solutions of numerical methods rather than practicing the implementation of numerical algorithms by writing computer programs.
- Most of these courses neglect completely the practical aspect of numerical methods such as numerical stability and error analysis which is the most important topic in teaching numerical method for engineers and scientists. In fact, some teachers use some theoretical assumptions in a generalized manner, such as the convergence rule, despite the fact that, in the practice, this rule doesn't always hold true.

One can wonder about the aim of teaching numerical methods to engineering students. Is it to enable the student get credits for the course or to give the student skills that allow him to solve real engineering problems?

In my opinion, some measures should be taken by teachers in order to improve the teaching of numerical methods, among them:

- Introducing applications of numerical methods that deal with solving real-world problems, such as engineering and scientific problems: Because the most important thing is to motivate students and engage them in learning and helping them gaining some lifelong learning skill that will be of great importance in their future career.
- The teachers must put as much emphasis on computer programming practice as on numerical-solving techniques since we cannot separate the two skills if we want give the students good

training in such courses. Moreover, the analysis of the stability and the convergence of any numerical method, for a given problem, cannot be predicted theoretically without running its program and doing the necessary tests.

- The student should be aware of instability and divergence problems in using numerical methods. To do so a special topic on numerical error analysis must be included in the course. However, most textbooks ignore this topic and so do teachers.

Some examples are presented in this article in order to demonstrate that any numerical method does not give always reliable solution and it can fail in some cases. Consequently, if the student is unable to detect the method instability by using appropriate analysis and tools, he may end up with catastrophic results.

However, in my opinion this topic should not be introduced at the beginning of the course as usually the case in textbooks, but it's preferable to leave this subject at the end of the course.

The reason of this choice is to give the student a chance to acquire experience in numerical methods before tackling the complicated task of predicting the accuracy of calculation.

I assume that these observations may contribute to improve teaching and learning outcomes of numerical methods.

Dungile Maponyane
Educator, Bathokwa Secondary School, South Africa

Alarming State of Mathematics Grade 12 Results in South Africa

The alarming state of mathematics results in South African schools has brought a great concern amongst all stakeholders in education. Mathematics grade 12 results has been declining for the past years, this resulted in the decline in number of learners who take mathematics as a subject in the FET phase.

A maximum number of learners register for mathematical Literacy instead. This is disadvantageous for learners who are willing to follow MST related careers, because mathematical Literacy is not accepted as one of the compulsory subjects by most of the Higher Institutions in our country.

Besides that the other thing that is jeopardised is the quality of mathematics results in this country. With the recent curriculum the pass mark is 30% which does not open any doors for our learners to be admitted to study engineering and other maths related professions. It is time that learners, parents, teachers SGB's and governmental officials must ensure that the quality of matric mathematics results is maintained.

Junalyn Navarra-Madsen
Associate Professor, Texas Woman's University, USA

Mathematics Tutoring and Course Completion

In the past two decades, there have been remarkable advances at the intersection of applied mathematics and molecular biology. Some of these advances come from the use of DNA topology and knot theory in deciphering protein-DNA interactions. This paper gives a brief survey of the trends and development in this dynamic field. In particular, this paper answers basic questions such as: (1) How are some topological approaches and knot theoretical techniques such as tangle analysis utilized to pinpoint certain enzymatic actions?; and (2) What are the advantages and disadvantages in using this kind of mathematical modeling?

Juli D'Ann Ratheal
Associate Professor, The University of Texas of the Permian Basin, USA

How Individual Personalities Affect Achievement and Behavior

The session will concentrate on how individual personalities affect achievement and behavior. Information will be provided that 1) helps identify individual personality types; 2) what motivates each personality type; 3) what types of instructional strategies work best for each personality type; 4) what types of behavior modification work best for each personality type; and 5) what types of praise will best motivate each personality type. The session will provide insight into how teacher's and individual student's personalities affect 1) teacher behavior, 2) student behavior, 3) student achievement, and 4) teacher/student feelings. Presenter has conducted professional development workshops with STEM teachers since 2006 which has resulted in a significant improvement in teacher satisfaction, student self-efficacy, student achievement, and student behavior. Teacher retention and student achievement can be positively affected by an understanding of how individual personalities think, feel, learn, and behave. Participants will discover their own personality type and how their personality determines how they perceive external and internal stimuli. An overview of the four major personality types will be presented including strategies for the classroom along with qualitative data from actual workshop evaluations.

Sanjit Ray
Faculty Member, Indian Statistical Institute, India

Improve Efficiency of Marketing Process by Using Six Sigma

This paper details how Six-Sigma methodology was utilized to improve marketing process of an original equipment manufacturing plant. Six-Sigma, like total quality management, is a strategy for improving customer satisfaction by reducing variation and thus producing products and services better, faster and cheaper. Usually, an organization uses the DMAIC (Define, Measure, analyze, Improve and Control) methodology to improve current process performance. Initially, Six-Sigma methodologies were implemented to improve manufacturing processes and now its use is rapidly expanded to other functional areas. Marketing and Sales processes are the driving force for any business process. The sales of products as per the business plan are very critical for survival for any business house. The structured methodology of DMAIC was applied to improve the sales productivity by improving the marketing process. This project has substantially benefitted the organization by redefining the marketing process as lead generation, prospect conversion and then sales conversion. For all these sub processes, probable causes were identified, validated by factor analysis & prioritized by carrying out regression analysis. Root causes were established and necessary process changes were implemented to achieve the desired sales productivity. This paper will be of interest to academic researchers and practical managers. It describes the justification and selection of the project, how the tools and techniques of DMAIC methodology were employed in the different phases and how the improvement actions were implemented. This project methodology can be used generally to improve the sales productivity for any other business processes as well, which will help in increase turnover, achieving business targets and finally survive in the competition.

Guanshen Ren
Professor, The College of St. Scholastica, USA

How to Cut an Arbitrary Convex Polygon into Two Halves by One Line? (Math Education)

In this article, we demonstrate how to use methods of elementary geometry to cut an arbitrary convex quadrilateral, pentagon, or hexagon into two halves by one line. This method may be applied to convex polygons of seven or more sides.

Solange Roa-Fuentes
Universidad Industrial de Santander, Grupo de Investigación EDUMAT-UIS, Colombia
Centro de Investigación y de Estudios avanzados del IPN, México
&
Asuman Oktac
Centro de Investigación y de Estudios avanzados del IPN, México

Mathematically Talented Students Thinking About Infinity: A Cognitive Perspective Using APOS Theory

We present a study about how mathematically children and adolescents from Mexico and Colombia construct ideas concerning infinity in a context of paradoxes; in particular we use the paradox of Hilbert's Hotel and the problem of tennis balls. Following the research cycle related to APOS (Action – Process – Object – Schema) Theory and basing ourselves on previous research studies by Dubinsky and RUMEC (Research in Undergraduate Mathematics Education Community) we propose a model called a genetic decomposition, describing the way with which students may construct the notion of mathematical infinity, taking into account the identification of transformations on the set of natural numbers in order to construct infinite iterative processes. Once these processes are coordinated into a single process, this can give rise to the construction of a transcendent process. Analysis of empirical data shows that the difficulties of students that we interviewed are associated with their construction of the set of natural numbers and the ideas that they develop about infinity in contexts out of mathematics. The idea of "next" in the construction of natural numbers prevents the individuals from seeing the iterative processes as complete. For example in the case of the Hilbert's Hotel paradox, they argue that "it is always possible to add more rooms" or they deny the conditions of the problem saying that "it is not possible for a hotel with infinity of rooms to be full". On the other hand there are students who can give satisfactory answers to the paradoxes thanks to the distinction that they make between the facets of infinity as cardinal and ordinal. This is achieved because of the construction of the set of natural numbers as a totality on which certain transformations can be applied (object conception) and because of the capacity to think about the set in terms of its elements (process conception). Use of the research cycle related to APOS Theory allowed us to restructure our initial theoretical analysis and to propose a model for the construction of mathematical infinity. Our goal is to propose

activities to be used in class and suggestions for evaluation, in order to develop the idea of mathematical infinity in mathematically talented students, beyond the primary conceptions linked to temporality or to events that repeat without end.

Gaylynne Robinson
Lecturer, University of Texas at San Antonio, USA
&
Nancy Hall
Lecturer, University of Texas at San Antonio, USA

Developing Quantitative Literacy through Writing

Teaching Quantitative Research through Writing is a two-course sequence for university freshmen that teaches students how to write abstracts, research questions, hypotheses, literature reviews, annotated bibliographies, methodology, findings, and significance for a variety of audiences. Students participate in class activities and experiments to gather data from which they write articles and formal research papers. Students learn to use APA and MLA documentation and to incorporate tables and graphs into their writings. In the second semester, students build upon these skills to then learn the art of reasoned discourse, argument, that is supported by research and data. Besides learning to research, write, graph, and document, students learn to think in an organized and critical way. Writing is the manifestation of such thinking.

Tin Lam Toh
Associate Professor, National Institute of Education, Singapore

How Singapore Teachers' School Mathematics Content Knowledge Developed: Results from an International Comparative Study

This paper reports the result of an International Comparative Study on Mathematics Teacher Training on tracing the growth of 31 pre-service mathematics teachers' development of school mathematics content through their three years (2007 to 2009) of full-time pre-service education in the National Institute of Education. These pre-service teachers pursued an undergraduate course in mathematics, studied Educational Studies and Curriculum Studies modules in mathematics and specialized in teaching secondary school mathematics. As such, they could be assumed to be relatively competent in university mathematics compared with many of their contemporaries.

However, Shulman (1986, 1987) distinguishes between (university) mathematics content knowledge and school mathematics content knowledge. Ball (1991) cautioned that a teacher's school mathematics content knowledge should not be measured by the number of modules of undergraduate mathematics alone. In addition, research has shown that pre-service teachers enter teacher education programs with rather narrow conceptions of mathematics as a set of rules and conventions (Ball, 1990; Cooney, 1999; Taylor, 2002; Wilson & Ball, 1996). In short, one should not assume that being good in university mathematics means that one is also good in school mathematics content knowledge.

A paper-and-pencil test on school mathematics was administered to the group of pre-service teachers early in their first year and also before their graduation from the pre-service teacher training course. The test questions, designed by the University of Plymouth, were selected from the various strands of school mathematics that were listed in the Singapore mathematics curriculum: (a) Algebra and Arithmetic, (b) Geometry, Trigonometry and Measurement, (c) Functions and Graphs, (d) Probability and Statistics, (e) Higher Algebra, (f) Higher Geometry and Trigonometry, and (g) Calculus (Ministry of Education, 2007a, 2007b).

Data on the pre-service teachers' performance in the pre-course and post-course test were collected. From this set of data, we identified the questions with the highest and the lowest facility indices (FI). This session presents the pre-service teachers' performance in the two tests, and discusses the implications derived from this study.

Roman Yavich
Lecturer, Ariel University Center of Samaria, Israel
&
Alexsey Kanel-Belov
Professor, Bar-Ilan University, Israel

Staging of Mathematical Education

The overwhelming majority of students are not good at Mathematics. The rest are called "mathematically gifted". But school and university Mathematics courses are understandable for an average student. The same concerns the other subjects. We suggest that teaching, learning and mastering a subject are stepwise processes and every step has its tasks and methodology of realization. Break of these step-by-step processes can lead to negative consequences. At the beginning of the teaching process the main task is to form the right attitude towards the subject, to overcome the perception of a subject as a formulary and a set of meaningless instructions. This is the main purpose of the first step, and knowledge, skills formation and factual material acquirement go second.