THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

# Abstract Book:

## 11th Annual International Conference on **Mathematics**

26-29 June 2017, Athens, Greece

Edited by

Gregory T. Papanikos

2017

# Abstracts

# 11th Annual International Conference on Mathematics

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# TABLE OF CONTENTS

*(In Alphabetical Order by Author's Family name)*

# Preface

This book includes the abstracts of all the papers presented at the *11th Annual International Conference on Mathematics, 26-29 June 2017*, organized by the Athens Institute for Education and Research (ATINER). In total 29 papers were submitted by 32 presenters, coming from 16 different countries (Armenia, Australia, Austria, Brazil, Colombia, Israel, Italy, Mexico, Romania, Saudi Arabia, South Korea, Spain, Taiwan, Thailand, Turkey and USA). The conference was organized into 9 sessions that included a variety of topic areas such as mathematics theory, statistics, and teaching. A full conference program can be found beginning on the next page. 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 institute. 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 seven research divisions and 37 research units. Each research 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.

**Gregory T. Papanikos**
**President**

## *11th Annual International Conference on Mathematics*
## *26-29 June 2017, Athens, Greece*
## Organizing and Academic Committee

All ATINER's conferences are organized by the Academic Committee (https://www.atiner.gr/academic-committee) of the association.

This conference has been organized with the additional assistance of the following academics, who contributed by chairing the conference sessions and/or by reviewing the submitted abstracts and papers:

1. Gregory T. Papanikos, President, ATINER.
2. Codruta Simona Stoica, Head, Mathematics & Statistics Research Unit, ATINER & Associate Professor, Aurel Vlaicu University of Arad, Romania.
3. Timothy M. Young, Director, Center for Business & Manufacturing Excellence (CBME) & Professor and Graduate Director, Center for Renewable Carbon, The University of Tennessee, USA.
4. Ampalavanar Nanthakumar, Professor, State University of New York at Oswego, USA.
5. Krzysztof Ostaszewski, Professor and Actuarial Program Director, Illinois State University, USA.
6. Robert Powers, Professor, University of Northern Colorado, USA.
7. Marco Tulio Ramirez Torres, Research Professor, Autonomous University of San Luis Potosí, Mexico.
8. Elizabeth Stojanovski, Lecturer, University of Newcastle, Australia.
9. Guzide Senel, Assistant Professor, University of Amasya, Turkey.
10. Jenny Patricia Acevedo Rincon, Academic Member, ATINER & PhD Student, University of Campinas, Brazil.
11. Vassilis Skianis, Research Fellow, ATINER.
12. Olga Gkounta, Researcher, ATINER.
13. Hannah Howard, Research Assistant, ATINER.

# FINAL CONFERENCE PROGRAM
# 11th Annual International Conference on Mathematics,
# 26-29 June 2017, Athens, Greece
# PROGRAM

**Conference Venue: Titania Hotel, 52 Panepistimiou Avenue, Athens, Greece**

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

## Monday 26 June 2017

**08:00-09:00 Registration and Refreshments**

**09:00-09:30 (Room C-10th Floor) Welcome and Opening Address**

Gregory T. Papanikos, President, ATINER.

**09:30-11:00 Session I (Room A-10th Floor): Teaching and Applications I**

**Chair:** Codruta Simona Stoica, Head, Mathematics & Statistics Research Unit, ATINER & Associate Professor, Aurel Vlaicu University of Arad, Romania.

1. Robert Powers, Professor, University of Northern Colorado, USA & Jenni Harding, Professor, University of Northern Colorado, USA. Learning from a Mathematics Teaching Grant: Working With Teachers Kindergarten through High School.
2. Hagar Gal, Head of M.Teach Program, David Yellin Academic College of Education, Israel. Nurturing Mathematically Talented Students as Autonomous Learners - The Case of Generic Questions.
3. Marta Pena, Associate Professor, Universitat Politècnica de Catalunya, Spain. Applying Dynamical Discrete Systems to Teach Mathematics.
4. Yahya Al Zahrani, Assistant Professor, Umm Al Qura University, Saudi Arabia. Strategy to Overcome Mistakes by New Primary Mathematics Teachers in Saudi Arabia in Teaching Geometry.

**11:00-12:30 Session II (Room A-10th Floor): Mathematics I**

**Chair:** Robert Powers, Professor, University of Northern Colorado, USA.

1. Codruta Stoica, Professor / Vice-Rector, Aurel Vlaicu University of Arad, Faculty of Exact Sciences, Romania. Skew-evolution Semiflows in the Study of Stochastic Equations.
2. Bancha Panyanak, Assistant Professor, Chiang Mai University, Thailand. The Demiclosed Principle for multi-Valued Nonexpansive Mappings in Banach Spaces.
3. Manal Gabour, Lecturer, The Academic Arab College for Education, Beit-Berl College, Israel & Amal Sharif-Rasslan, Head of Mathematics Department, The Academic Arab College for Education, Israel. Special Paths in Lattice Rectangles: A Demonstration of an Inner Bound Between Elementary Geometry and Number Theory.
4. Javier Camargo, Researcher, Industrial University of Santander, Colombia. The Jones' Set Function T.

**12:30-14:00 Session III (Room A-10th Floor): Teaching and Applications II**

**Chair:** Krzysztof Ostaszewski, Professor and Actuarial Program Director, Illinois State University, USA.

1. Elias Abboud, Head of Mathematics Section, Academic Arab Institute, Beit Berl College, Israel. On Ratios of Areas Related to the Routh-Steiner Theorem: Exploring Activities.
2. Shaker Rasslan, Lecturer, AL-Qasemi Academic College of Education, Israel, Hussam Arisha, Lecturer, AL-Qasemi Academic College of Education, Israel, Otman Jaber, Lecturer, AL-Qasemi Academic College of Education, Israel, Juhaina Awawdi-Shahbari, Lecturer, AL-Qasemi Academic College of Education, Israel & Amal Sharif-Rasslan, Head of Mathematics Department, The Academic Arab College for Education, Israel. Infinity: A Number or not a Number?
3. Dalal Safiyah, M.Ed. Student, The Academic Arab College for Education, Israel & Amal Sharif-Rasslan, Head of Mathematics Department, The Academic Arab College for

Education, Israel. Pre-Service Teachers' Perceptions of the Percent Concept.
4. Samaher Nama, M.Ed. Student, The Academic Arab College for Education, Israel & Amal Sharif-Rasslan, Head of Mathematics Department, The Academic Arab College for Education, Israel. The Impact of Origami-Based Instruction on Thinking Levels in Euclidean Geometry and on Achievements among High School Students.

**14:00-15:00 Lunch**

**15:00-16:30 Session IV (Room A-10th Floor): Teaching and Applications III**

**Chair:** Timothy M. Young, Director, Center for Business & Manufacturing Excellence (CBME) & Professor and Graduate Director, Center for Renewable Carbon, The University of Tennessee, USA.

1. Krzysztof Ostaszewski, Professor and Actuarial Program Director, Illinois State University, USA. Teaching of Expected Value of a Random Variable Calculation: The Darth Vader Rule.
2. Yihua Wang, Assistant Professor, Tamkang University, Taiwan & Yunru Lai, MSc Student, Tamkang University, Taiwan. Phase II Monitoring of First-Order Autocorrelated General Linear Profiles.
3. Martin Riegler, Senior Researcher, Kompetenzzentrum Holz GmbH, Austria. Closing the Technological Gap within Statistical Models for Producing Wood-Based Composites.

**21:00-23:00 The Pragmatic Symposium of the Conference as Organized in Ancient Athens with Dialogues, Food, Wine, Music and Dancing but fine tuned to Synchronous Ethics**

## Tuesday 27 June 2017

**07:30-10:30 Session V: An Educational Urban Walk in Modern and Ancient Athens**

**Chair:** Gregory Katsas, Vice President of Academic Affairs, ATINER & Associate Professor, The American College of Greece-Deree College, Greece.

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)

**11:00-12:30 Session VI (Room A-10th Floor): Teaching and Applications IV**

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

1. Georgy Burde, Professor, Ben-Gurion University of the Negev, Israel. Symmetry Methods: Research and Teaching.
2. Chih-Ru Hsiao, Professor, Soochow University, Taiwan. Lesson Study on Mathematical Modelling with Contexts of Natural Disasters.
3. Jeffrey Taub, Associate Professor, Maine Maritime Academy, USA. Use of 5th-Year Students to Teach 1st-Year Pre-Calculus.
4. Solange Roa-Fuentes, Researcher, Industrial University of Santander, Colombia. Mental Structures that Shape the Learning of a Linear Algebra Theorem: Cases Study in a University Context.
5. Jenny Patricia Acevedo Rincon, PhD Student, University of Campinas, Brazil. The Professional Learning Situated in an Interdisciplinary Practice of the Future Mathematics Teachers.

**12:30-14:00 Session VII (Room A-10th Floor): Statistics**

**Chair:** Guzide Senel, Assistant Professor, University of Amasya, Turkey.

1. Rafik Aramyan, Chair of the Department of Mathematical Cybernetics, Russian Armenian University, Armenia. An Approach to the Spherical Mean Radon Transform.
2. Ampalavanar Nanthakumar, Professor, State University of New York at Oswego, USA. A Comparison of Misclassification Error Rates.
3. Hyo-Il Park, Professor, Chongju University, South Korea. On the Simultaneous Test for the Mean and Variance.

**14:00-15:00 Lunch**

**15:00-16:30 Session VIII (Room A-10th Floor): Teaching and Applications V**

**Chair:** Marco Tulio Ramirez Torres, Research Professor, Universidad Autónoma de San Luis Potosí, Mexico.

1. Esin Avci, Assistant Professor, Giresun University, Turkey. The Prevalence and Heterogeneity of Energy Drink Consumption in Worldwide: A Meta-analysis. (Tuesday)
2. Elizabeth Stojanovski, Lecturer, University of Newcastle, Australia. Effectiveness of Statistics Teaching Methods.
3. Senem Koc, PhD Student, Ondokuz Mayis University Samsun, Turkey, Paola Berchialla, Assistant Professor, University of Torino, Italy, Giuseppe Migliaretti, Assistant Professor, University of Torino, Italy & Leman Tomak, Assistant Professor, Ondokuz Mayis University Samsun, Turkey. Machine Learning for Biomedical Data.

**16:30-18:00 Session IX (Room A-10th Floor): Mathematics II**

**Chair:** Elizabeth Stojanovski, Lecturer, University of Newcastle, Australia.

1. Guzide Senel, Assistant Professor, University of Amasya, Turkey. Applications of Bitopologies in Analysis and General Topology.
2. Marco Tulio Ramirez Torres, Research Professor, Universidad Autónoma de San Luis Potosí, Mexico, José Salomé Murguía Ibarra, Research Professor, Universidad Autónoma de San Luis Potosí, Mexico, Marcela Mejía Carlos, Research Professor, Universidad Autónoma de San Luis Potosí, Mexico, Luis Javier Ontañon Garcia Pimentel, Research professor, Universidad Autónoma de San Luis Potosí, Mexico & Jesus Agustin Gonzalez Aboytes, PhD Student, Universidad Autónoma de San Luis Potosí, Mexico. Preprocessing Function Based on Synchronization Phenomena for Partial Image Encryption.
3. Peter Brown, Senior Lecturer, University of New South Wales, Australia, Rasool Forooshani Nagholali, Azarbaijan Shahid Madani University, Iran & Farjali Igadi, Azarbaijan Shahid Madani University, Iran. Fourth Power Diophantine Equations in Gaussian Integers.

**21:00- 22:30 Dinner (Details during registration)**

## Wednesday 28 June 2017
## Educational Island Tour or Mycenae and Epidaurus Visit

## Thursday 29 June 2017
## Delphi Visit

**Elias Abboud**
Head of Mathematics Section, Academic Arab Institute, Beit Berl College, Israel

# On Ratios of Areas Related to the Routh-Steiner Theorem: Exploring Activities

Coxeter considered the following theorem of affine geometry: If the sides $BC, CA, AB$ of a triangle $ABC$ are divided at $L, M, N$ in the respective ratios $\lambda : 1,\ \mu : 1,\ \nu : 1$, the cevians $AL, BM, CN$ form a triangle whose area is

$$\frac{(\lambda\mu\nu-1)^2}{(\lambda\mu+\lambda+1)(\mu\nu+\mu+1)(\nu\lambda+\nu+1)}$$

times that of $ABC$.

Coxeter attributed this theorem to Routh and mentioned also that Steiner had rediscovered it. He gave a general proof of this result using barycentric coordinates.

This theorem also implies a general property: The ratio of the area of any sub-polygon to the area of the whole triangle in a triangular net depends only on the division ratios.

The search after nice expressions of area ratios in triangular nets succeeds in symmetric divisions or in special cases. In particular, if each side of the triangle is divided into $n$ equal parts then nice expressions are obtained for area ratios of a hexagon and the triangle. The theorem of Marion Walter is a special case: If the trisection points of the sides of any triangle are connected to the opposite vertices, the resulting hexagon has one-tenth the area of the original triangle. The theorem of Morgan is a generalization: Given a triangular net in which each side of the triangle is divided into $n$ equal parts, where $n$ is odd, then the ratio of the area of the hexagon, formed by connecting two cevians from each vertex to the central points on the opposite side, to the area of the triangle is $\frac{8}{9n^2-1}$.

These cases and others will be the core of some exploring activities based on the Routh-Steiner theorem or its generalizations.

**Jenny Patricia Acevedo Rincon**
PhD Student, University of Campinas, Brazil

# The Professional Learning Situated in an Interdisciplinary Practice of the Future Mathematics Teachers

The Teacher Training courses proposed to the future mathematics teacher and developed by the Education Faculty of the University of Campinas (Brazil) differ from those by institutes. The Teacher Training course developed involved in the same class students of different Education program, forming groups of trainees necessarily non-disciplinary or multidisciplinary. The research of Doctorate is developed in the course's context: The 1st Teacher Training on the Education faculty with 18 students of the Education program like Chemistry, Physics, Mathematics, History and Philosophy, Geography, Literature and Arts. We believe that the Teacher training is interdisciplinary course because trainees can discuss their own situations of teaching practice regardless of the discipline they belong. Thus, participation in the Teacher Training course of Education Faculty allows trainees pervade and exceed the boundaries of their own school and academic disciplines of undergraduate courses. However, it is expected that this training in Education program can help them position by questioning and negotiation of meaning in situations recognized from its participation in school practices. The objective to research is to interpret, analyze and describe the learning and the professional development of the mathematics trainees in the Education program, situated in a interdisciplinary teaching practice within the 1st Teacher Training course at the Education Faculty of the University of Campinas. The trainee participation in the context of teaching practice aims to discuss and reframe their reification in different school contexts, opening possibilities for continuous change in their learning in practice of reflective and analytical way. The research is qualitative and use narrative analyze under the information produced, to interpret, analyze and describe the learning and professional development of the students of the mathematics Bachelor, situated in an interdisciplinary teaching practice within the 1st Teacher Training course.

**Yahya Al-Zahrani**
Assistant Professor, Umm Al Qura University, Saudi Arabia

# Strategy to Overcome Mistakes by New Primary Mathematics Teachers in Saudi Arabia in Teaching Geometry

Grade 4-6 geometry lessons taught by 34 first-year Saudi Arabia primary school mathematics teachers were video-recorded to identify common mistakes. The findings revealed 10 topics relating to four lessons: segments and angles; classifying triangles; segments and distance; and angle pairs. We informed 17 of the new primary mathematics teachers about the mistakes made in these lessons to discover how they would act to rectify them. The results showed that, on average (13 of 17), the teachers became aware of and were able to avoid committing the same mistakes in their lessons. We conclude that highlight common mistakes made by new primary mathematics teachers is a sound strategy to prepare mathematics teachers in future. Moreover, applying this approach may led to similar success in other subjects.

**Rafik Aramyan**
Chair of the Department of Mathematical Cybernetics, Russian Armenian University, Armenia

## An Approach to the Spherical Mean Radon Transform

Medical tomography has had a huge impact on medical diagnostics. The classical Radon transform maps a function to its integrals over straight lines and serves as the basis of x-ray Computer Tomography. Recently researchers have been developing novel methods that combine different physical types of signals. The most successful example of such a combination is the thermoacoustic tomography (TAT). Thermoacoustic theory has been discussed in many literature. Briefly TAT procedure is: a short-duration electromagnetic (EM) pulse is sent through a biological object with the aim of triggering a thermoacoustic response in the tissue. The amount of energy absorbed at a location X strongly depends on the local biological properties of the cells.

Thus, if the energy absorption distribution function f were known, it would provide a great diagnostic tool.

The acoustic wave which is the result of the thermoelastic expansion can be measured by transducers placed outside the object (assuming the sound speed c constant). Thus, one effectively measures the integrals of overall spheres centered at the transducers' locations. To recover f one needs to invert the so-called spherical Radon transform of that integrates a function over all such spheres.

The above motivated the study of the following mathematical problem. For a continuous, real valued function f supported in a compact region G, we are interested in recovering f from the mean value Mf(p,r) of f over circles S(p,r) centered on L; that is, given Mf(p,r) we wish to recover f.

In the report I suggest a new approach what is called a consistency method for the inversion of the spherical Radon transform in 2D with detectors on a line. By means of the method a new iteration formula was found which give an practical algorithm to recover an unknown function supported in a compact region from its spherical means over circles centered on a line outstand the region. Also was proved that reconstruction has a local description.

**Esin Avci**
Assistant Professor, Giresun University, Turkey

# The Prevalence and Heterogeneity of Energy Drink Consumption in Worldwide: A Meta-analysis

Energy drinks (ED) are highly caffeinated beverages, which often include high doses of sugar (or a sugar substitute) and herbal ingredients such as guarana (a naturally occurring form of caffeine)[1]. Consumption of energy drinks have increased over the last several decades. Recent studies suggest that young adults less than 30 years age is the group that buys and consumes the most energy drinks. This study aim to determine the prevalance and heterogeneity of energy drink consumption in wordwide. Using "energy drink" and "stimulant drink" keywords, 9 electronic bibliographic databases, reference lists of relevant studies and searches of the internet was performed to identify articles related to energy drinks. Cross-sectional design that published in English and Turkish language studies were considered for inclusion criteria if they reported raw data or prevalance available for (ED) consumption. A total of 629 studies were located, with 138 meeting the inclusion criteria. To obtain prevalence of ED, "metaprop" function in R was used. Pooled prevalance of ED was calculated using random-effect models and logit transformation. Heterogeneity was determined by subgroup analysis and meta-regression[2]. Most of energy drink studies were conducted in USA (56 studies). The pooled prevalance of ED consumption was 0.45% (95%CI: 0.40%-0.49%). Significant heterogeneity across estimation of prevalance was observed (p=0.0001, $I^2$= 99.9%). The prevalence decreased as the sample size increased. The highest and lowest prevalence observed in UK and Japan, respectively. The African population was more likely to consume ED than other population. Finally, lower middle-income countries were more likely to consume Ed than high-income countries.

**Peter Brown**
Senior Lecturer, University of New South Wales, Australia
**Rasool Forooshani Nagholali**
Azarbaijan Shahid Madani University, Iran
&
**Farjali Igadi**
Azarbaijan Shahid Madani University, Iran

## Fourth Power Diophantine Equations in Gaussian Integers

In this paper, we examine a class of fourth order Diophantine equations over the Gaussian integer using elliptic curve methods.

**Georgy Burde**
Professor, Ben-Gurion University of the Negev, Israel

## Symmetry Methods: Research and Teaching

The two issues to be discussed are: using some symmetry based methods for identifying new types of soliton and experience in teaching the course "Symmetry methods in mathematical physics".

Solitons, as one of the most fundamental solutions, in nonlinear systems have been found in rather different fields of science where they have been subject of extensive theoretical and experimental research within the last decades. Solitons describe nonlinearly localized wave packets that do not change their shape during propagation and exhibit particle-like interactions. In the present study, exact explicit solutions, which describe new multisoliton dynamics, have been identified for some Korteweg-de Vries (KdV) type equations using symmetry-based methods designed specifically for constructing solitary wave solutions of evolution equations (Burde, J. Phys. A: Math. Theor., 2010; Burde, Phys. Rev. E, 2011). First type of solutions, the 'generalized Kaup--Kupershmidt' (GKK) solitary waves, unify the structures of the KdV-like soliton and the Kaup--Kupershmidt soliton. and also provide solutions of some other Equations (Burde, J. Phys. A: Math. Theor., 2010). Second, it is found that the equations, having multi-soliton solutions in terms of the KdV-type solitons, possess also an alternative set of multi-soliton solutions which include localized static structures that behave like (static) solitons when they collide with moving solitons (Burde, Phys. Rev. E, 2011). As distinct from common multisoliton solutions those solutions represent combinations of algebraic and hyperbolic functions and cannot be obtained using the traditional methods of soliton theory. The solutions may be relevant to the classical shallow water wave problem (Burde, Commun Nonlinear Sci Numer Simulat, 2011; Burde and Sergeyeyv, J. Phys. A: Math. Theor., 2013; Burde and Zarmi, Commun Nonlinear Sci Numer Simulat., 2013).

The course "Symmetry methods in mathematical physics" was taught using several teaching formats, mostly an interactive model based on the live online use of the symbolic manipulation "Mathematica" program and a discussion-focused approach guided by topical readings and thought-provoking guiding questions - a traditional lecture-based approach was almost completely avoided.

**Javier Camargo**
Researcher, Industrial University of Santander, Colombia

## The Jones' Set Function T

A continuum is a compact, connected and nonempty metric space. Given a continuum $X$, for each $A$ subset of $X$, the Jones' set function $T$ is defined by $$T(A)=\{x\in X : for each subcontinuum K, such that x\in Int(K), then K\cap A\neq\emptyset\}.$$

In this talk, after giving some basic properties and many examples of this function, we present properties of continua in terms of $T$. We also study continua for which the set function $T$ is continuous.

**Manal Gabour**
Lecturer, The Academic Arab College for Education, Beit-Berl College, Israel
&
**Amal Sharif-Rasslan**
Head of Mathematics Department, The Academic Arab College for Education, Israel

# Special Paths in Lattice Rectangles: A Demonstration of an Inner Bound Between Elementary Geometry and Number Theory

In this paper, we define the concept: a right rectangular path bounded in a $m \times n$ rectangle where $m, n \in \mathbb{N}$; as a " broken line segment" bounded in a lattice rectangle that begins at a vertex, producing a 45° angle with an edge that passes through that vertex, ends at a vertex, such that any two successive segments meet vertically at a point on an edge of the rectangle. We state the problem: what is the relationship between the number of line segments in that path and the rectangle measurements? The process of investigating our problem involves three levels namely numerical, graphical and algebraic. We start at describing the problem, then, several examples are treated graphically. The arranging of the initial numeric results in a table yields to a primary result regarding our problem. The main result is established through investigating the cases where $m, n$ are and aren`t relatively prime. Finally some generalizations, applications and didactical implications are suggested.

**Hagar Gal**
Head of M.Teach Program, David Yellin Academic College of Education, Israel

# Nurturing Mathematically Talented Students as Autonomous Learners - The Case of Generic Questions

Most regular classes host mathematically talented students. The program "From one end to the other - Instruction of mathematically-talented students", aimed at (1) Raising teachers' *awareness* regarding the needs of mathematically talented students. (2) Extending teachers' *mathematical as well as pedagogical content knowledge* (PCK) specifically related to the instruction of mathematically talented students. (3) *Combining theory and practice* in the same program, in order to overcome the gap usually developed between these two areas (Aitken & Mildom, 1991). (4) *Mastering mathematically talented students' tasks.*

One of the main issues discussed in the program was the nurturing of an autonomous learner, who is able to cope by him/herself with mathematical information and assignments, and which, on the long run, will be able to ask him/herself "*generic questions*" such as: "how can I figure out if my answer is correct?", "did I make any implicit assumptions that were wrong?", "did I meet any similar problem, that could help me to solve the current problem?" (See also Polya, 1957).Yet, many teachers use "small-step teaching" (Duval, (1998); Zhang et al. (2004)), which seems to be an obstacle towards the student's autonomy. The program aimed at changing this perspective of instruction adapted by most participants.

I aim to report on my research which analyzed changes which mathematics teachers, who participated in this yearly academic program, went through: from 'small step teaching' towards developing mathematically talented students as autonomous learners, using generic questions. I will introduce a case study of one of the participants, using a qualitative paradigm.

**Chih-Ru Hsiao**
Professor, Soochow University, Taiwan

# Lesson Study on Mathematical Modeling with Contexts of Natural Disasters

This paper includes the main results of a Taiwan government-supported project whose motivations and objectives are to respond to a plan of the Human Resources Development in Asia-Pacific Economic Cooperation (APEC HRDWG) entitled "Emergency Preparedness Education: Learning from Experience, Science of Disasters, and Preparing for the Future" (Code HRD 04 / 2011A) . In accordance with the progress of APEC HRDWG planning, in 2013-2015, with the help of related specialists, for example, fire fighters, we design three mathematical model tasks with the contexts of earthquake, floods and fire respectively.

We gave the above three tasks to a "Lesson Study Group of Mathematical Modeling" which is consist of 8 secondary school mathematics teachers and 2 prospective teachers. We let teachers use the above mathematical modeling tasks as context in their class and tried to improve their pedagogy power through the well-known (Japanese) "lesson study" method. Interviewing two high school teachers who participated in this project, we found that they have significantly improved their mathematical modeling knowledge and pedagogy power. Also, by questionnaires and interview methods, we found that after participating in this project, students and their teachers have clarified many concepts of disaster prevention.

On the other hand, in 2013-2015, we gave Mathematical Contest of Modeling to the high students in Taiwan, Hi-MCM, with the above mathematical model tasks with the contexts of earthquake, floods and fire respectively. Giving questionnaire and interviewing the participants and their supervisors and discussing with the referees, including related specialists, we found that all participants and their teachers have clarified many concepts of disaster prevention.

**Senem Koc**
PhD Student, Ondokuz Mayis University Samsun, Turkey
**Paola Berchialla**
Assistant Professor, University of Torino, Italy
**Giuseppe Migliarett**
Assistant Professor, University of Torino, Italy
&
**Leman Tomak**
Assistant Professor, Ondokuz Mayis University Samsun, Turkey

## Machine Learning for Biomedical Data

Aim: In developing exam programs, item analysis with Rasch model has an important place. Rasch model assumes that each item in the test measures an underlying latent trait. The aim of this study is to analyze the distractors in multiple-choice items used in the exams of medicine faculty students with Rasch model.

Method: In Rasch model, the probability of answering a question correctly is defined as the function of the rate of a person's level of ability to item difficulty. With Rasch model, distractor analysis in measuring students' success gives data about students' comprehension of the variable analyzed in the classroom environment. The data were obtained from a multiple-choice exam on the biostatistics knowledge of 214 medicine students studying their second year at Ondokuz Mayıs University, Faculty of Medicine during the 2016-2017 Academic Year. With the analysis of the items in the exam, summary statistics, Multiple Choice Distractor Curves, Person-Item Curves and Threshold map were obtained. RUMM package program was used for the analysis of the data.

Results: In the multiple choice exam, which consisted of 25 items, fit residual values of the items were between the range of -1.48 and 1.98. Person fit residual values obtained for a total of 214 people were between the range of -1.97 and 2.25. While the items 25, 5, 15 and 17, respectively, were the most difficult items, items 23, 4, 8 and 7 were the easiest and most answered items. Item 25, which was the most difficult item, had 12.15% frequency of being answered and its item difficulty was 2.99, only one distractor of this item was answered with a rate of 76.64%. Item 23, which was the easiest item, had 91.59% frequency of being answered and its item difficulty was -1,520. The highest distractor of this item was answered with a rate of 3.74%.

Conclusion: In multiple-choice items which have one parameter assigned to each distractor, Rasch Model Distractor Analysis is used. As

a conclusion, this method comes to the forefront as an important tool in assessing and developing multiple-choice items both with its summary statistics and the graphics it presents.

**Samaher Nama**
M.Ed. Student, The Academic Arab College for Education, Israel
&
**Amal Sharif-Rasslan**
Head of Mathematics Department, The Academic Arab College for Education, Israel

# The Impact of Origami-Based Instruction on Thinking Levels in Euclidean Geometry and on Achievements among High School Students

This study examined the effect of using origami (paper folding) on geometric thinking levels and geometric achievements; moreover examined the emotion aspect of the students, while learning geometry using origami. Participants were 54 tenth graders of the Arab sector in the north district in Israel. A pre van Hiele questionnaire was conducted to determine the baseline level of geometric thinking of the participants, and a pre-test geometric exam to determine the baseline geometric achievements of the participants. In a post-test design, the experimental group was instructed with the origami-based instruction and the control group was instructed with the traditional instruction for two weeks, both groups learned the parallelogram chapter. A van Hiele questionnaire and an achievement exam were conducted twice, immediately after the experiment and a month after the experiment for both groups. The findings of the repeated measures showed that the origami-based instruction had a statistically significant effect on the levels of geometric thinking and on the geometric achievements. Moreover, the finding showed that origami-based instruction increased the motivation and the enthusiasm of the students.

As a conclusion, origami (folding paper)-based instruction can improve and promote the level of geometric thinking and the geometric achievements of the students. Therefore, it can be recommended to use paper folding as a method of illustration in Euclidean geometric lessons in high school for promoting students' geometric thinking and achievements.

**Ampalavanar Nanthakumar**
Professor, State University of New York at Oswego, USA

# A Comparison of Misclassification Error Rates

In this paper presentation, I will compare the misclassification error ratesin the context of two trivariate populations.

Assumptions:

- The populations are independent
- In each population, for each variable the marginal distribution is a normal distribution

The error rates willbe computed based on the quadratic discriminant classifier (QDC) under the following situations.

1. Using the Gaussiandensity function
2. Using a well defined Copula density function (such as Clayton Copulaor Morgenstern Copula)
3. Using the D-Vine Copula density function

**Krzysztof Ostaszewski**
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# Teaching of Expected Value of a Random Variable Calculation: The Darth Vader Rule

The concept of an expected value is presented in teaching of probability in a way that is dramatically different than most practical calculations in insurance are done. In this work, we show that standard instruction in probability would be greatly enriched by adding the approach of calculating expected value as the integral of the survival function (assuming the random variable considered is non-negative almost surely). This simple rule, which we call *The Darth Vader Rule,* empowers practical calculations in insurance applications, inckuding insurance contract modifications such as deductible, or policy limit, and also including reinsurance contracts.

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# The Demi-closed Principle for multi-Valued Non-expansive Mappings in Banach Spaces

One of the fundamental and celebrated results in the theory of non-expansive mappings is the demi-closed principle that was proved by Opial in 1967. It is known that the demi-closed principle plays important role in studying the asymptotic behavior for non-expansive mappings in Hilbert spaces. The principle was extended to uniformly convex Banach spaces by Browder in 1968.

In contrast to the single-valued case, it is still unknown whether the principle is valid for multi-valued non-expansive mappings in uniformly convex Banach spaces.

In this paper, we prove a multi-valued version of Browder's theorem and then apply it to obtain the homotopic invariance for fixed points of both single-valued and multi-valued non-expansive mappings in uniformly convex Banach spaces.

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## On the Simultaneous Test for the Mean and Variance

In this research, we consider several test procedures for testing the mean and variance simultaneously under normality. First, we propose a likelihood ratio test. Then by partitioning the likelihood ratio statistic for the simultaneous test into two individual statistics for testing partial hypotheses for the mean and variance, separately, we propose another type of simultaneous tests using the combination functions. Then we compare their efficiency by obtaining empirical powers through simulation study.

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# Applying Dynamical Discrete Systems to Teach Mathematics

The main goal is using examples of dynamical discrete systems in order to illustrate basic algebraic notions such as: the solutions of an indeterminate system of equations, the matrix of a linear map, their eigenvalues and eigenvectors.

In particular, we present some examples where some interpretations of the indetermination degree, the computation of the matrix by means of consecutive states and the eigenvalues and eigenvectors as stationary/asymptotic distribution or growing appear. In order to that, we use both discrete flows and discrete systems, and we emphasize the relation between them.

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&
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# Learning from a Mathematics Teaching Grant: Working with Teachers Kindergarten through High School

The Supporting Understanding through Meaningful Mathematical Instructional Tasks Project was a grant-supported collaboration between university faculty and school district personnel that models effective professional development for teachers. The goals of the project were (1) to increase content knowledge of teachers, specifically focusing on data analysis, statistics, and probability as well as number sense, properties, and operations and (2) support teachers to implement high cognitive demand tasks. The three-year project supported teachers through face-to-face workshops at the beginning, in the middle, and at the end of each school year as well as online workshops each month during the school year. Additionally, instructional coaches supported teachers on site for implementation of rich mathematical tasks within the classroom. *Implementing Standards-Based Mathematics Instruction: A Casebook for Professional Development* (Stein, Smith, Henningsen, & Silver (2000) and *5 Practices for Orchestrating Productive Mathematics Discussions* (Stein & Smith, 2011) served as frameworks for the project. The project supported approximately 70 teachers and 3,100 students at 11 high-need schools in the rural and isolated communities in Colorado, United States. Formative evaluation for project included these goals: 1) increasing the number of teachers with understanding of the foundational math concepts of selected Math Colorado Content Standards; 2) increasing teacher understanding of high cognitive demand pedagogical strategies that embed inquiry and active student learning into lessons; 3) increasing teacher implementation of high cognitive demand teaching strategies by using peer and Lead Math Coaches to support teachers as they move from low to high demand tasks and procedures; 4) increasing teachers' confidence in teaching math; and 5) increasing student achievement in math. Reflective evaluations of grant project occurred through content tests (pre and post), evaluation of learning (after each professional development), and reflective essays demonstrating effective changes in mathematical classroom teaching practice.

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## Preprocessing Function Based on Synchronization Phenomena for Partial Image Encryption

Cellular automata (CA) are dynamical and discrete systems where synchronization phenomena appear in some evolution rules. This means if two state vectors evolve according to the same rule, after several steps the difference between these vectors will be zero. Besides CA have been used in different areas including cryptography, where several cryptosystems and pseudo random number generator have been proposed in recent years. Otherwise, classical encryption systems are not suitable for image encryption due to their intrinsic properties as high adjacent correlation, redundancy data, and bulk data capacity. Therefore several encryption systems and operation modes have been developed, some of them are secure for image encryption but have a high computational cost, and to overcome this problem the partial encryption is used.

In this work we propose a preprocessing function based on synchronization phenomena using cellular automaton rule 90, the processed images resist chosen-plaintext attack (CPA), and according to NPCR and UACI parameters they resist differential cryptanalysis attacks, and if this function is combined with partial encryption system, the encrypted images resist Replacement attack. The preprocessing function consists on synchronize the pixel values of an image one at a time with a random vector that should be at least one bit longer than the pixel value. The resulting modified coefficient is fed back as the new random vector concatenating the least significant bit of the previous random vector. The next pixel value is synchronized with this new random vector, the same procedure is iterated repeatedly. Finally, the preprocessed image is flipped right-to-left and down-to-up and it is preprocessed again.

This preprocessing function increases the security because it is sensible to initial conditions, and synchronization is not a simple XOR operation with a random vector, hence when CPA is performed the mask does not keep secret keys or random vectors.

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## Infinity: A Number or not a Number?

This study examined pre-service teachers' (PSTs') understanding of the infinity concept—whether it is a number or not a number—while examining their concept definitions and images, as well as the relations between them. Fifty-nine PSTs participated in this study. A questionnaire was designed to explore the cognitive schemes of the infinity concept that are evoked by the PSTs during numerical tasks. One question aimed to check whether the PSTs knew how to define the infinity concept. Five others were designed to categorize how PSTs work with the infinity concept and how this related to the definition. The results showed that only 10% of our sample knew the formal definition of infinity. Only between 27% and 50% of our sample knew that infinity is not a number. Moreover, 71% and 7% of our sample failed with the misconceptions and, respectively. The reasoning and argumentations provided by the PSTs in deciding whether an expression is a number or not a number were intuitive.

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# Closing the Technological Gap within Statistical Models for Producing Wood-Based Composites

The production of wood-based composites has been continuously optimized and further developed since its establishment in the nineteen fifties, leading to a highly automated and complex industrial process, which is state of the art nowadays. Currently, two major trends are revolutionizing this sector. First, rapid advancements in the field of smart manufacturing can be observed, traded under the term "Industrie 4.0". Although approaches for smart manufacturing have already been applied since the nineteen nineties, current developments in IT technologies offer a wider range of possibilities than it was possible in previous years. Second, alternative raw materials (especially recycled wood) are increasingly used for manufacturing wood-based composites. To control unpredicted effects caused by an increased amount of unconventional raw material, technological information regarding raw material and formation processes needs to be considered. This will especially be important, if statistical models of manufacturing processes are developed.

In general, the precision of recently calculated statistical models is often too low to use the models for process control. One reason might be the high complexity of the industrial manufacturing process, comprising hundreds of possible sources of influence. Although a high proportion of these sources of influence is recorded, some very important information is obviously still missing. It can be assumed that one possible missing link can be found in the formation of the wood-based composite, in especially the composition and orientation of individual particles. Additionally, the proportion of adhesive on contact areas between particles is meant to be essential to form stable products.

To cope with this challenge, a simplified virtual technological model of a wood-based composite is introduced in the present study. Ellipsoids with defined geometry were constructed using MATLAB to simulate individual particles of specific size and shape. Input parameters for the construction of the ellipsoids were derived from experimental data (production and raw material information). For example, size parameters of wood particles were obtained from optical measurements. Afterwards, ellipsoids were oriented and stacked

randomly to obtain a virtual model, which simulates the composition of a wood-based composite.

In a next step, desired aspects such as contact areas or voids can be computed. These outputs will then be incorporated into a statistical model of the production process. From the current point of view, possible algorithms are boosted generalized additive models (GAM) or conventional regression models such as partial least squares regression. Especially GAM offers high flexibility for including several outputs of the virtual technological model or even output functions. Future investigations will also focus on the deformation of ellipsoids due to compression within the pressing process.

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## Mental Structures that Shape the Learning of a Linear Algebra Theorem: Cases Study in a University Context

Qualitative research that explores how Chilean and Colombian university students learn a linear algebra theorem, called TLMA theorem is presented. To this, a cognitive model is defined in terms of the structures and mechanisms proposed by APOS theory (Action, Process, Object, and Schema) to construe the advance mathematician thinking. Furthermore, the levels of Intra, Inter and Trans evolution of the theorem TLMA Schema are described and its development indicators in terms of relationships, transformations and invariants. The results of this research shows on the one hand, that the construction of the matrix representation of a linear transformation as Object, is essential for first year students to understand the TLMA theorem; and on the other hand, the Object must be assimilated by the linear transformation Schema.

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# Pre-Service Teachers' Perceptions of the Percent Concept

About a decade ago, the term "percentage" was examined among pre-service teachers. Previous findings indicated that there are some misconceptions among pre-service teachers while referring to the percentage concept, e.g., incorrect solution strategies using an incorrect algorithm. The current study examined the perceptions of the term "percentages" among pre-service teachers and identified their most common mistakes while dealing with this concept. This study used a mixed method methodology. The study involved 129 students from two colleges of education, which were chosen randomly. To answer the research questions a questionnaire included 20 questions dealing with the percentage concept was built. In addition, 10 students were interviewed to emphasize the quantitative findings. The results show that the dominant correct approach adopted by pre-service teachers is "percentage as the operator", and is the dominant misconception based on "wrong strategy". In addition, there were significant differences between those who had correct perception and those who had misconceptions. In conclusion, we may claim that there is a need to update the mathematics curriculums in colleges for education, mainly, to emphasize the "percentage" concept, and to give the pre-service teachers the opportunity to understand the concept and its uses in real life.

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# Applications of Bitopologies in Analysis and General Topology

The application of sets endowed with two arbitrary topologies of which one may occasionally be finer than the other, deserves consideration in fields of analysis and general topology. This paper consists of three sections. The first two of which dwell upon many aspects of the background [3,4,5,6] and investigate some applications of the bitopological concepts introduced before. Furthermore, in the rest of the paper, in pursing our aims, we concentrate our discussion on the importance of the bitopological space which is fully confirmed by its natural relationship with the theory of ordered topological spaces, that is, of sets simultaneously having a partial order and a topology [2]. Based on this idea, the relations between the separation axioms of ordered topological spaces and the separation axioms of the corresponding bitopological spaces are established. Moreover, some interesting facts, closely connected with the results from analysis and general topology are also proved for two topological spaces. Finally, in addition to the results, some new properties of bitopological spaces associated with analysis and general topology are considered.

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## Skew-evolution Semi-flows in the Study of Stochastic Equations

The approach of evolution equations by means of associated operator families is appropriate in obtaining answers to some open problems by involving techniques of functional analysis and operator theory. Also, as not all real world phenomena can be described by deterministic evolution equations, their approach has to combine the classic study with methods of stochastic analysis.

We aim to study in this paper some asymptotic properties in mean square for stochastic skew-evolution semi-flows associated to stochastic evolution equations. Hence, we emphasize various classes of splitting, as generalization for the classic property of dichotomy. Our approach is based on the extension of some techniques from the deterministic case constructed for co-cycles in Banach spaces.

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# Effectiveness of Statistics Teaching Methods

Due to data now collected at an exponentially increasing rate in all fields of society, there is a much higher demand for statisticians to analyse it. This has partially contributed to the recent emphasis on Science, Technology, Engineering and Mathematics (STEM) as necessary for Australia to maintain a high quality of life. It has been recognised that students need to study in these areas to be able to properly facilitate scientific developments. The identification of Mathematics as one of the pillars of STEM is the first step required to move closer to achieving this goal.

However teaching mathematics and statistics is challenging. Many commencing tertiary students have negative experiences of statistics and mathematics and many have anxiety about statistics. There is further concern that the research on teaching and learning statistics remains disconnected. Recent research in statistical education has focused on the need for reform in statistics pedagogy and hence for teaching statistics.

The main traditional learning theories include Behaviourism and Cognitive theory. With both of these traditional methods, learners remain passive. The more recent focus in statistics education has been on constructivist learning theory, which has been claimed to be a more effective setting to encourage motivation and interest in learning, and, thus, to potentially provide a better opportunity for improved learning outcomes. Evidence of the superiority of this approach as a learning tool is limited. The present study will analyse secondary data to assess whether these different approaches to learning are associated with differing exam performance scores.

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# Use of 5th Year Students to Teach 1st Year Pre-Calculus

This presentation discusses 5th-year undergraduate students teaching 1st-year pre-calculus at Maine Maritime Academy (MMA).

MMA began using 5th -year undergraduates to teach pre-calculus in 2013. This initiative has been implemented continuously and with increasing success since then including most recently in the fall 2016 semester.

The presentation begins with an overview of MMA focusing on the mission of the college, the student body, the mathematics requirements for students, and the mathematics department faculty.

The paper/presentation continues with discussion of the reasons and decision behind 5th-year students teaching pre-calculus, the criteria and process for selecting these students, and the mutual benefits attained by the 5th-year students, the students in the course, and the college.

In conclusion, I provide some typical comments and feedback from the 5th year students on their teaching experience, and the next steps to continue and improve the program at MMA.

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# Phase II Monitoring of First-Order Auto-correlated General Linear Profiles

Statistical process control has been successfully applied in a variety of industries. In some applications, the quality of a process or product is better characterized and summarized by a functional relationship between a response variable and one or more explanatory variables. A collection of this type of data is called a profile. Profile monitoring is used to understand and check the stability of this relationship or curve over time. The independent assumption for the error term is commonly used in the existing profile monitoring studies. However, in many applications, the profile data show correlations over time. Therefore, in this study, we focus on a general linear regression model with a first-order autocorrelation between profiles. We propose an exponentially weighted moving average charting scheme to monitor this type of profile. The simulation study shows that our proposed methods outperform the existing schemes based on the average run length criterion.