Book of Abstracts

Almería, June 6-10, 2005

CIMMA 2005
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E-mail: cimma05@ual.es;
URL: www.ual.es/congresos/CIMMA2005

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Contents

Introduction

Welcome

Dear Participant,

Welcome to the International Mediterranean Congress of Mathematics Almería 2005 (CIMMA 2005), which has gathered about 300 mathematicians from more than 30 countries. During these days you will have the opportunity to attend the lectures of three excellent plenary speakers, to work within one of nine Special Sessions, and to interact with your colleagues during two Poster Sessions. We hope that you will be also able to find time for the Social Program we have arranged, as well as for an informal exchange with people from Almería, and to enjoy beaches, gastronomy and other local attractions.

The venue of CIMMA 2005 is a relatively young University of Almería. This university, although not very large according to Spanish standards, has been offering undergraduate and graduate studies in Mathematics for more than 10 years. Some of the students will be helping you as volunteers, whose contribution we wish to acknowledge. The Secretariat and the meeting rooms for the special sessions will be located in "Aulario I", right in front of the Mediterranean.

This event is celebrated within the framework of the XVth Mediterranean Games Almería 2005. That is because the life in our city, usually rather busy, these days might be even hectic. We hope you will forgive any inconvenience it may cause, and enjoy the excitement of a major event.

Members of the Organizing Committee have spent countless hours arranging all the aspects of this Congress. CIMMA 2005 was made possible also by the support of the authorities of this university, and by a contribution of many collaborating institutions, whose list you will find in the next page. Finally, the Mediterranean Journal of Mathematics and Birkhäuser Verlag have agreed to publish an issue of their journal, containing articles by invited speakers of CIMMA 2005. Thanks to all of them.

This booklet contains the abstracts of the invited and plenary lectures and contributed talks, listed within each session in alphabetical order according to the speaker, followed by abstracts of posters. At the end you will find the list of participants with their affiliation and electronic address.

Thank you for coming and enjoy the meeting!

The Organizing Committee
Almería, June 6, 2005

Collaborating Institutions

- Universidad de Almería:
  - Vicerrectorado de Investigación y Desarrollo Tecnológico;
  - Vicerrectorado de Extensión Universitaria;
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- Consejería de Educación de la Junta de Andalucía.
- XV Juegos del Mediterráneo Almería 2005.
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Organizing Committees for Sessions

1. **Algebras and their Representations**

   Luis Oyonarte (local coordinator), Antonio Morales Campoy (Almería), Justo Peralta López (Almería), Maribel Ramírez Álvarez (Almería), Freddy Van Oystaeyen (Antwerp).

2. **Geometry and Topology**

   José L. Rodríguez Blancas (local coordinator), Carles Casacuberta (Barcelona), Frank Neumann (Leicester).

3. **Approximation, Special Functions and Numerical Analysis**

   Andrei Martínez Finkelshtein (local coordinator), Bernhard Beckermann (Lille), Juan José Moreno Balcázar (Almería), Pedro López Artés (Almería).

4. **Functional Analysis and its Applications**

   El Amin Kaidi (local coordinator), Enrique de Amo Artero (Almería), José Carmona Tapia (Almería), Antonio Jiménez Vargas (Almería), Juan Carlos Navarro Pascual (Almería).

5. **General Topology and its Applications**

   Miguel A. Sánchez Granero (local coordinator), Francisco G. Arenas (Almería), Jesús Rodríguez López (Valencia), Salvador Romaguera (Valencia).

6. **Probabilistic Spaces, Copulae and t-norms. Applications**

   Bernardo Lafuerza Guillén (coorinator), Manuel Úbeda Flores (Almería).

7. **Random Models and Design of Experiments**

   Amelia V. García Luengo (local coordinator), José Miguel Angulo Ibáñez (Granada), Juan Cuadra Carreño (Almería), Ramón Gutiérrez Jaímez (Granada), Conrado M. Manuel García (Madrid).

8. **Financial Mathematics and Mathematical Economics**

   Salvador Cruz Rambaud (local coordinator), José García Pérez (Almería).

9. **Mathematics Education**

   Francisco Gil Cuadra (local coordinator), María Francisca Moreno Carretero (Almería).

Plenary Talks

Chebycheff and Belyi polynomials, Dessins d'enfants, Beauville surfaces and Group Theory

CATANESE, FABRIZIO
UNIVERSITY OF BAYREUTH (GERMANY)

In the year 1978 Beauville was able to construct a surface with vanishing geometric genus, quotient of the product of two Fermat curves.

I observed later, in the course of investigating the surfaces which are quotients of products of curves, that the Beauville surface enjoys a property of STRONG RIGIDITY, i.e., every surface with the same fundamental group and the same Euler number, is biholomorphic to the Beauville surface.

I defined then the Beauville surfaces as the surfaces isogenous to a product of 2 curves which are rigid (this implies biholomorphicity or antibiholomorphicity to the given surface).

These surfaces are very interesting because of an action of the Galois Group of $\mathbb{Q}$ on its moduli space, which changes the Topology of the corresponding surfaces. We have therefore a generalization of the Program of Grothendieck, "Dessins d'enfants", in order to obtain interesting representations of the above Galois Group.

In my talk, before I will describe certain new results obtained in cooperation with Ingrid Bauer and Fritz Grunewald, I will dedicate myself to the description of very elementary examples and questions. Starting from the group of field automorphisms of $\mathbb{R}$ and $\mathbb{C}$, I will consider, as a baby example of Grothendieck's program, the polynomials with only two critical values. Since one can assume w.l.o.g. that these critical values are only 0 and 1 , or -1, + 1, we have an action of the group of automorphisms of $\mathbb{C}$ on this class of polynomials. Such polynomials are the well known polynomials of Chebycheff and Belyi, for which I will give a characterization and explicit formulae.

Then I will dedicate myself briefly to the Dream of Grothendieck, describe the "Dessins d'enfants" and the relation between triangular curves and Beauville surfaces (through Belyi's Theorem).

Finally, I will give some results and conjectures, which relate the classification of Beauville surfaces with questions in the theory of finite groups.

Mathematical models for technology, medicine and sport

QUARTERONI, ALFIO
POLITECNICO DI MILANO AND EPFL (SWITZERLAND)

In this talk I will review some classical mathematical models to describe complex phenomena in continuum mechanics. Applications will concern aerodynamics, hydrodynamics, cardiovascular flow problems, and problems arising from sport competition.

The interest in the use of mathematical modelling and numerical simulation in the study of the cardiovascular system (and its inherent pathologies) has greatly increased in the past few years. We

will describe the mechanical interaction of blood flow with arterial walls and simulate numerically the complex fluid-structure interaction problem in large arteries.

In sport, mathematical models are often used to try to enhance performances of athletes as well as to improve the design of vehicles that are used in the various disciplines. In particular we will mention recent results achieved in the design of America's cup yachts as well as Olympic rowing hulls and swim suites.

More in general, we will highlight the role of scientific computing in everyday analysis of problems of real life interest.

WHICH GROUPS ARE LINEAR?

ZELMANOV, EFIM
UNIVERSITY OF CALIFORNIA (UNITED STATES)

It is an open problem whether the free pro-p groups (and some other "large" groups) are linear. I will discuss connections of this problem to the theory of PI-algebras and, what is more surprising, to Lie algebras graded by root systems.

Talks by Sessions

1. Algebras and their Representations

On $SL(2,p)$-construction of unimodular lattices

AHMADZADEH-RAJI, MEHRDAD
RAZI UNIVERSITY (IRAN)

We will introduce a construction of lattices by using the Higher Power Resisue codes. The lattices obtained by this construction are all invariant under an action of the group $SL(2,p)$ on the vector space $\mathbb{R}^{(3(p+1))}$. The centralizer C of this action is a $\mathbb{Q}$-algebra acting on $\mathbb{R}^{(3(p+1))}$. Invertible elements in C act on the set $SL(2,p)$-invariant lattices. Certain even unimodular lattices are shown to be constructed by this method. This includes some Niemeier lattices. Using certain elements of this $\mathbb{Q}$-algebra we define a lifting for both higher power residue codes and quadratic residue codes. Certain self dual codes are obtained by this procedure.

Finite-dimensional absolute valued algebras containing a central idempotent

ABDELLATIF, ROCHDI
UNIVERSITY OF CASABLANCA (MOROCCO)

We give a classification for those absolute valued real algebras containing a non zero central idempotent and we solve the isomorphism problem. The triviality of the group of automorphisms can happen in dimension 8 and is equivalent to the non existence of 4-dimensional subalgebras.

Gorenstein local cohomology modules

ASADOLLAHI DEHAGHI, JAVAD
SHAHRE-KORD UNIVERSITY (IRAN)

Let R be a commutative noetherian rings and $\mathfrak{a}$ be an ideal of R. Grothendieck-Hartshorne local cohomology theory has become indispensable for many mathematicians working in the theory of commutative Noetherian rings. There are several approaches to this cohomology: it can be computed as the right derived functors of the $\mathfrak{a}$-torsion functor $\Gamma_{\mathfrak{a}}(-) = \bigcup_{n\in N} 0 :_{(-)} \mathfrak{a}^n$ as well as using 'Ext_R' functors, that is the ith local cohomology of N with respect to $\mathfrak{a}$, denoted $H^i_{\mathfrak{a}}(N)$, is isomorphic to $\varprojlim Ext^i_R(R/\mathfrak{a}^n, N)$. In this talk, using relative 'Ext' functors with respect to the class of Gorenstein injective modules, we give a generalization of local cohomology theory. It is closely related to the generalized local cohomology modules, introduced by J. Herzog. We present some vanishing and non-vanishing results of Gorenstein local cohomology modules over Gorenstein rings.

HOLLOW MODULES

AZIZI, ABDULRASOOL
SHIRAZ UNIVERSITY (IRAN)

Let R be a commutative ring with identity. An R-module M is said to be a hollow module if the set of maximal submodules of M is empty or for every maximal submodule N of M, and for every submodule K of M, the equality $N+K=M$ implies that $K=M$. In this paper we will characterize hollow modules. In particular we will characterize modules whose submodules are hollow.

ON COMMUTATIVE FGI-RINGS

BARRY, MAMADOU
CHEIKH ANTA DIOP UNIVERSITY (SENEGAL)

Let R be a ring. An $R-$module M is said to have property (I) if every injective endomorphism of M is an automorphism of M. Let F_R be the class of finitely generated R-modules and I_R the class of R-modules satisfying property (I). In this note we characterize commutative rings for which $F_R = I_R$.

TILTING MODULES ARE OF FINITE TYPE

BAZZONI, SILVANA
UNIVERSITÀ DI PADOVA (ITALY)

A right R-module T is tilting if and only if $T^{\perp} = Gen\,T$, where $Gen\,T$ is the class of modules generated by T and $T^{\perp} = \{M \in Mod\ R \mid Ext^1_R(T,M) = 0\}$. A tilting module T is of *finite type* (*countable type*) provided there is a set $\mathcal{S}$ of *finitely presented* (*countably presented*) right R-modules of p.d.≤ 1 such that $T^{\perp} = \mathcal{S}^{\perp}$. In the talk I will illustrate our main result :

Theorem 1. Every tilting module over an arbitrary ring R is of finite type.

The proof uses results proved in [3], in particular the result stating that tilting modules are of countable type and is based on a characterization of a factorization property of maps between some type of countable direct sums of modules. This characterization is a generalization of Bass and Azumaya's stationary conditions for the projectivity of countable presented flat modules (cfr. [2], [1]). The key tool will be the closure under direct sums of the class $T^{\perp}$. This is a joint work with Dolors Herbera.

[1] G. AZUMAYA, *Finite splitness and projectivity*, J. Alg., 106 (1987), pp. 114–134.

[2] H. BASS, *Finitistic dimension and a homological generalization of semi-primary rings*, Trans. Amer. Math. Soc., 95 (1960), pp. 466–488.

[3] S. BAZZONI, P. EKLOF, J. TRLIFAJ, *Tilting cotorsion pairs,* to appear in Bull. London Math. Soc.

LAMBDA DETERMINANTS, GROUP CHARACTERS, AND PERFECT MATCHINGS (MAIN TALK)

BENKART, GEORGIA
UNIVERSITY OF WISCONSIN (UNITED STATES)

This talk will survey some of the connections among these three topics, and their relations to such subjects as alternating sign matrices and representation theory.

ON TORSIONFREE CLASSES WHICH ARE NOT PRECOVER CLASSES

BICAN, LADISLAV
CHARLES UNIVERSITY (CZECH REPUBLIC)

In the class of all exact torsion theories the torsionfree classes are cover (precover) classes if and only if the classes of torsionfree relatively injective modules or relatively exact modules are cover (precover) classes and this happens exactly if and only if the torsion theory is of finite type. Using the transfinite induction a new construction of a torsionfree relatively injective cover of an arbitrary module with respect to Goldie's torsion theory of finite type can be given.

K_1 OF CORNER SKEW LAURENT POLYNOMIAL RINGS AND APPLICATIONS

BRUSTENGA, MIQUEL
UNIVERSITAT AUTÒNOMA DE BARCELONA (SPAIN)

We give a description of the Whitehead group of a corner skew Laurent polynomial ring $A[t_+, t_-; \alpha]$ associated to an isomorphism $\alpha\colon A \to pAp$ from a unital associative ring A onto a corner ring pAp. Using this, we compute the Whitehead group of the Leavitt algebras of type $(1, n)$.

ON NORMED COALGEBRAS

CHOULLI, HANAN
UNIVERSITY ABDLMALEK ESSAAIDI (MOROCCO)

In this talk, we are interested by normed coalgebras. For us, a coalgebra (C, Δ, ϵ) is said to be normed if C is a normed vector space overe complexe or real field, the coproduct and the counit are continuous with respect to the projective tensor norm in $C \otimes C$. Some relevant counterexamples are indicated. It is also given an important classes of normed coalgebras. We are interested to relate the structure of a coalgebra to the norm.

ALGEBRA APPLICATIONS TO CODING THEORY

COUSELO HERNÁNDEZ, ELENA
UNIVERSIDAD DE OVIEDO (SPAIN)

We give a complete description of the best parameters of linear codes that correspond to the left ideals in loop algebras F_qG for $q \in \{2, 3, 4, 5\}$ and $|G| \leq 7$, and also in group algebras for all group with $|G| \leq 12$. We distinguish the linearly optimal codes, the codes lying on the Varshamov–Gilbert bound as well al those that achieve the Plotkin bound. The results show the importance of investigation of codes generated by non-semisimple and non-commutative group algebras.

ON COFROBENIUS HOPF ALGEBRAS

CUADRA, JUAN
UNIVERSIDAD DE ALMERÍA (SPAIN)

One of the most important notions in Hopf algebra theory is the notion of integral. A *left integral* for a Hopf algebra H (over a field k) is a k-linear map $\int_l \in H^*$ such that $h^* \int_l = h^*(1) \int_l$ for all $h^* \in H^*$. Hopf algebras having a non-zero left integral are called *coFrobenius* and they have been extensively studied in the literature.

Radford showed that a coFrobenius Hopf algebra H whose coradical H_0 is a subalgebra has finite coradical filtration. Andruskiewitsch and Dăscălescu proved later on that a Hopf algebra with finite coradical filtration is necessarily coFrobenius and they conjectured that any coFrobenius Hopf algebra has finite coradical filtration.

In this talk we will present several partial results about this conjecture. We will provide an alternative formulation of this conjecture in terms of an upper bound for the Loewy length of the injective hulls of the simple comodules. Two new sufficient conditions for a coFrobenius Hopf algebra to have finite coradical filtration will be then derived. One of these conditions will be used to show that the conjecture holds for the Hopf algebra of regular functions of an algebraic group with integral over a perfect field. We will also present several characterizations of non-cosemisimple coFrobenius Hopf algebras.

COMATRIX CORINGS AND INVERTIBLE BIMODULES

EL KAOUTIT, LAIACHI
UNIVERSIDAD DE GRANADA (SPAIN)

We extend, by using different methods, Masuoka's result concerning the isomorphism between the group of invertible bimodules in a non-commutative ring extension and the group of automorphisms of the associated Sweedler's canonical coring, to the class of finite comatrix corings introduced by the authors.

This is a joint work with J. Gómez-Torrecillas.

NEW SIMPLE LIE SUPERALGEBRAS (MAIN TALK)

ELDUQUE, ALBERTO
UNIVERSIDAD DE ZARAGOZA (SPAIN)

Symplectic (respectively orthogonal) triple systems provide constructions of Lie algebras (resp. superalgebras). However, in characteristic 3, it is shown that this role can be interchanged and that Lie superalgebras (resp. algebras) can be built out of symplectic triple systems (resp. orthogonal triple systems) with a different construction. As a consequence, new simple finite dimensional Lie superalgebras, as well as new models of some nonclassical simple Lie algebras, over fields of characteristic 3, will be obtained.

GORENSTEIN CATEGORIES AND TATE COHOMOLOGY ON PROJECTIVE SCHEMES (MAIN TALK)

ENOCHS, EDGAR E.
UNIVERSITY OF KENTUCKY ((LEXINGTON, KY, UNITED STATES)

If R is a Gorenstein local ring, a module over R has finite projective dimension if and only if it has finite injective dimension. Also the finitistic projective and injective dimensions of R are finite. So we say that a Grothendieck category $\mathcal{A}$ is Gorenstein if it has the analogous properties and if it has a generator of finite injective dimension. We show that a Grothendieck category $\mathcal{A}$ with enough projectives is Gorenstein if and only if it has finite global Gorenstein projective and injective dimensions. Finally we prove that the category of quasi-coherent sheaves on a projective scheme is Gorenstein if and only if the scheme has at most Gorenstein singularities. In this case we show that we can then define Tate cohomological functors on such categories.

ON CO-NOETHERIAN RINGS

ESSANNOUNI, HASSANE
MOHAMMED V -AGDAL (MOROCCO)

Let R be a semilocal ring and J its Jacobson radical. We show that the injective hull of every simple left R-module is artinian iff the endomorphism ring of the injective hull of R/J is left noetherian. We also consider a commutative ring R over which every artinian module is of the form $L \oplus (\overset{n}{\underset{i=1}{\oplus}} E_i)$ with L of finite length and each E_i is an injective hull of a simple module.

THE GROUP OF COVERING AUTOMORPHISMS OF A QUASI-COHERENT SHEAF

ESTRADA DOMÍNGUEZ, SERGIO
UNIVERSIDAD DE GRANADA (SPAIN)

CoGalois groups appear in a natural way in the study of covers. They generalize the well-known group of covering automorphisms associated to a universal covering space. Recently it has been proved that each quasi-coherent sheaf over the projective line $\mathbf{P^1}(R)$ (R is a commutative ring) admits a flat cover, so we have the associated coGalois group of the cover. In general the problem of computing the coGalois group is difficult. In this talk we study a wide class of quasi-coherent sheaves whose associated coGalois group admits a very accurate description in terms of topological properties. This class includes finitely generated and cogenerated sheaves, so in particular vector bundless.

REGULAR REDUCTIVE SEMIGROUP E-SUBCOMPACTIFICATION

FATTAHI, ABDOLMAJID
RAZI UNIVERSITY (IRAN)

In this article we consider reductive semigroups and give a characterization of regular reductive semigroups. Then we state the enveloping semigroup of a flow generated by the action of a semi-topological semigroup on any of its semigroup compactifications, and show that this notion is closely related to the reductivity of the semigroup compactification.

THE BRAUER GROUP OF AZUMAYA CORINGS AND THE SECOND COHOMOLOGY GROUP

FEMIC, BOJANA
UNIVERSIDAD DE ALMERÍA (SPAIN)

Let R be a commutative ring. If R is a field, then the Brauer group of R can be described completely using Galois cohomology. Over a commutative ring, Galois cohomology describes the Brauer group only partially; in this case, we have to consider more general cohomology theories, like Amitsur cohomology or étale cohomology. Classical results are the following.
Let S be a commutative faithfully flat extension of R. Then we have a canonical embedding

$$\mathrm{Br}(S/R) \to H^1(S/R, \underline{\underline{\mathrm{Pic}}}),$$

where $\mathrm{Br}(S/R)$ is the part of the Brauer group of R split by S, and $H^1(S/R, \underline{\underline{\mathrm{Pic}}})$ is the first Amitsur cohomology groups with values in the category of invertible modules, as introduced by Villamayor

and Zelinsky. This embedding is an isomorphism if S is finitely generated and projective as an R-module. As a consequence, we have an embedding of the full Brauer group into the second cohomology group $H^2(R, \mathbb{G}_m)$. This embedding is not surjective, since the Brauer group is torsion and the second cohomology group is not torsion in general. A famous result of Gabber states that the Brauer group is precisely the torsion part of the second cohomology group.

In this talk, we propose an alternative definition of the Brauer group, and we show that this new Brauer group is isomorphic to the full second cohomology group. The elements of this Brauer group are represented by corings over a faithfully flat extension S of R, which become isomorphic to the comatrix coring after faithfully flat base extension. Such a coring is called an Azumaya S/R-coring. We introduce an equivalence relation on the set of isomorphism classes of Azumaya corings, and the quotient forms a monoid under the operation introduced by the tensor product. This monoid is denoted by $\mathrm{Bc}(R)$. We then show that

$$\mathrm{Bc}(S/R) \cong H^1(S/R, \underline{\underline{\mathrm{Pic}}}),$$

and this implies easily that $\mathrm{Bc}(R) \cong H^2(R, \mathbb{G}_m)$. This is joint work with S. Caenepeel.

H_v-Field of fractions and H_v-Quotient rings

GHADIRIHERATI, MANSOUR
UNIVERSITY OF YAZD (IRAN)

The largest class of algebraic hyperstructures satisfying the ring and field axioms are the H_v-ring and H_v-field. In this paper we define H_v-quotiont rings of an H_v-ring and H_v-field of fractions of a hyper integral domain. Some interesting results concerning those H_v-ring and H_v-field are proved.

Crossed products for weak structures

GONZÁLEZ RODRÍGUEZ, RAMÓN
UNIVERSIDAD DE VIGO (SPAIN)

The aim of this talk, is to introduce a general notion of crossed product in a weak context, which generalizes the ones defined by Blattner, Cohen and Montgomery, Doi and Takeuchi in the context of Hopf algebras and the one given by Brzeziński for entwined structures. Also, the crossed products that arises in weak contexts, for example, crossed products for weak Hopf algebras living in a symmetric monoidal category with split idempotents and crossed products for weak C-cleft extensions associated to weak entwined structures in braided monoidal categories with equalizers and coequalizers, are particular instances of this general notion.

Flat cotorsion modules and pure-injectivity (main talk)

GUIL ASENSIO, PEDRO ANTONIO
UNIVERSIDAD DE MURCIA (SPAIN)

The category Flat-R of flat modules over an associative ring with identity R is a locally finitelly presented additive category that admits a theory of purity in which pure-injective objects coincide with flat cotorsion right R-modules. This is the starting point of a series of joint works with I. Herzog in which we try to get a better understanding of the structure of these categories; as well as the behaviour of these modules.

In this talk we will survey these results and give some new properties of these categories. In our approach, we develop a method for studying indecomposable flat cotorsion modules in terms of simple subfunctors of continuous functors from Flat-R to Ab. This allows us to show that the class of indecomposable flat cotorsion modules forms a set that "purely cogenerates" the category of flat modules over the ring R. We will also discuss the possible construction of a Spectrum for the category Flat-R.

[1] L. ANGELERI-HUGEL AND M. SAORÍN, *Modules with perfect decomposition*, preprint.

[2] L. BICAN, R. EL BASHIR AND E. ENOCHS, *All modules have flat covers*, Bull. London Math. Soc. 33 (2001), pp. 385–390.

[3] W. W. CRAWLEY-BOEVEY, *Lovally finitely presented additive categories*, Comm. Algebra., 22 (1994), pp. 1641–1674.

[4] P. A. GUIL ASENSIO AND I. HERZOG, *Left cotorsion rings*, Bull. London Math. Soc., 34 (2004), pp. 303–309.

[5] P.A. GUIL ASENSIO AND I. HERZOG, *Sigma-cotorsion modules*, Advances i n Math., 191 (2005), pp. 11–28.

[6] P. A. GUIL ASENSIO AND I. HERZOG, *Cotorsion modules and divisibility matrix subgroups*, preprint.

[7] P. A. GUIL ASENSIO AND I. HERZOG, *Simple functors in the category of flat modules*, in progress.

[8] H. KRAUSE, *Exactly definable categories*, J. Algebra, 201 (1998), pp. 456–492

GORENSTEIN INJECTIVE MODULES OVER COMMUTATIVE NOETHERIAN RINGS (MAIN TALK)

JENDA, OVERTOUN
AUBURN UNIVERSITY (UNITED STATES)

An R-module M is said to be *Gorenstein injective* if there exists an exact sequence

$$\cdots \to E_1 \to E_0 \to E^0 \to E^1 \to \dots$$

of injective R-modules with $M = \mathrm{Ker}(E^0 \to E^1)$ such that $\mathrm{Hom}_R(E, -)$ leaves the sequence exact whenever E is an injective R-module. Clearly, every injective R-module is Gorenstein injective, and it is easy to see that a Gorenstein injective R-module has finite injective dimension if and only if it is injective. Furthermore, if R is a Gorenstein ring of dimension n, then every mth cosyzygy is Gorenstein injective whenever $m \geq n$. So we have an abundant supply of Gorenstein injective modules. In this talk, we will outline various properties of Gorenstein injective modules. In particular, we will study interesting properties of Bass invariants and R-sequences and their applications to Gorenstein injective modules over commutative noetherian rings. We will then explore some basic structure theorems for these modules as compared to injective modules in view of the desired Metatheorem: Every result in classical homological algebra has a counterpart in Gorenstein homological algebra.

JORDAN DERIVATION AND JORDAN AUTOMORPHISMS OF TRIANGULAR MATRIX ALGEBRA

L'MOUFADAL, BEN YAKOUB
UNIVERSITÉ ABDELMALEK ESSAÂDI (MOROCCO)

We investigate Jordan derivations of a class of algebras called triangular algebras. We prove that any Jordan derivation on such an algebra U is a derivation and with some conditions, any Jordan automorphism of U is either an automorphism or an anti-automorphism.

ON THE ROLE OF RINGS AND MODULES IN ALGEBRAIC CODING THEORY (MAIN TALK)

LÓPEZ-PERMOUTH, SERGIO
OHIO UNIVERSITY (UNITED STATES)

We consider foundational and theoretical aspects of coding theory over rings and modules. Topics discussed include the role of rings and modules as alphabets in coding theory and the necessity to explore metrics other than the traditional Hamming weight on such alphabets. We survey attempts to extend the classical results of coding theory over finite fields to this new setting. We also address rings as an ambient (rather than as an alphabet) for block and convolutional codes. This talk is partially based on a recent expository paper by Greferath and López-Permouth.

DEFORMATION BY QUANTIFICATION AND RIGIDITY OF ENVELOPING ALGEBRAS

MAKHLOUF, ABDENACER
UNIVERSITÉ DE HAUTE ALSACE (FRANCE)

The aim of the talk is to show how a deformation of the linear Poisson structure associated to a Lie algebra induces a deformation of its enveloping algebra. We call a Lie algebra strongly rigid if its enveloping algebra has no nontrivial deformation. The properties of such Lie algebras are studied. I show that a strongly rigid Lie algebra has to be rigid as Lie algebra and, in addition, his second scalar cohomology group has to vanish.

ON PRIME $\mathbb{Z}$-GRADED LIE ALGEBRAS OF GROWTH ONE (MAIN TALK)

MARTÍNEZ LÓPEZ, CONSUELO
UNIVERSIDAD DE OVIEDO (SPAIN)

A $\mathbb{Z}$-graded Lie algebra having a decomposition $L = [L_i, L_j] \subseteq L_{i+j}$. O. Mathieu classified all graded simple Lie algebras under the assumption of polynomial growth of dimensions dim L_i . He proved that every such algebra is a (twisted) loop algebra of Cartan type or the Virasoro algebra Vir. The problem of classification of $\mathbb{Z}$-graded Lie superalgebras with dim L_i uniformly bounded from above is still open. The case when the even part of L contains Vir has particular interest, since it corresponds to superconformal algebras. We will consider a modification of the result proved by Mathieu, obtaining a classification of $\mathbb{Z}$-graded prime Lie algebras, having in mind the future application to the study of the even part of a superconformal algebra.

CONTACT ALGEBRAS

MOHAMED SGHIR, EL YAAQUOUBI
ABDELMALEK ESSAADI (MOROCCO)

The aim of this work is to solve a problem stated by Kirillov in his paper: Local lie algebras. Poison algebras and symplectic algebras are well known.

It is necessary to introduce Contact algebras to complete the scheme. Then we precise this notion. And we unify all those algebras and others by defining the Jacobi algebras. When all of this is in place, we establish that there is a one-to-one correspondance between contact algebras and transitive Jacobi algebras. This answers Kirillov's problem.

ON STABLE LOCALIZATIONS OF COALGEBRAS

NAVARRO GARULO, GABRIEL
UNIVERSIDAD DE GRANADA (SPAIN)

The localizing subcategories of a comodule category have been studied in several papers with satisfactory results. In this context, idempotents elements of the dual algebra plays a crucial rôle to permit us to give an explicit description of the localization functor and to characterize some important classes of localizing subcategories; results are particularly satisfactory in the study of stable localizations which we characterized by semicentral idempotents elements.

This is a joint research with P. Jara, L. Merino and J. F. Ruíz.

RING OF QUOTIENTS OF PATH ALGEBRAS

ORTEGA ESPARZA, EDUARD
UNIVERSITAT AUTÒNOMA DE BARCELONA (SPAIN)

The main effort in this talk will be to compute the maximal right/left/symmetric ring of quotients (in Utumi sense) of a path algebra of a finite/locally finite oriented graph.

CHARACTERIZATIONS OF FGI-DUO-RINGS

SANGHARE, MAMADOU
UNIVERSITE CHEIKH ANTA DIOP DE DAKAR (SENEGAL)

A unital left $R-$module R_M is said to have property (I) if every injective endomorphism of M is an automorphism of R_M. The ring R is called left (right) FGI-ring if every left (right) R-module with property (I)is finitely generated, R is called FGI-duo-ring if it is both a left and right FGI-duo-ring. A ring R is called duo-ring if every left (right) ideal of R is a two sided ideal.

In this note we show that a duo-ring is FGI-duo-ring if and only if it is an artinian principal ideal duo-ring.

FINITE $\mathbb{Z}$-GRADINGS OF SIMPLE ASSOCIATIVE ALGEBRAS

SILES, MERCEDES
UNIVERSIDAD DE MÁLAGA (SPAIN)

We show that every finite $\mathbb{Z}$-grading of a simple associative algebra A comes from a Peirce decomposition induced by a complete system of orthogonal idempotents lying in the maximal left quotient algebra of A (which coincides with the graded maximal left quotient algebra of A). Moreover, a nontrivial 3-grading can be found. This grading provides 3-gradings in simple $\mathbb{Z}$-graded Lie algebras. Some consequences are obtained for left nonsingular algebras with a finite $\mathbb{Z}$-grading.

NIL SUBRINGS OF ENDOMORPHISM RINGS (MAIN TALK)

SMALL, LANCE
UNIVERSITY OF CALIFORNIA AT SAN DIEGO (UNITED STATES)

Various nil implies nilpotence theorems will be discussed. In particular, we shall show that nil subrings of endomorphism rings of finitely generated modules over affine PI rings are nilpotent. This result will be applied to show that weakly Engel Lie subalgebras of affine PI algebras are Lie nilpotent.

This is joint work with R. Guralnick and E. Zelmanov.

ARTINIAN RINGS AND MODULES (MAIN TALK)

SMITH, PATRICK
THE UNIVERSITY OF GLASGOW (UNITED KINGDOM)

Let R be a ring. An R-module M satisfies the (H)-condition if the annihilator of M in R is the annihilator of a finite subset of M. It is well known that if R is a right Artinian ring then every right R-module satisfies the (H)-condition. However, for any commutative ring R, every finitely generated R-module satisfies the (H)-condition. In general, it turns out that if every countably generated right R-module satisfies the (H)-condition then R is a right Artinian ring. This result and various other results concerning Artinian rings and modules will be presented.

TILTING EQUIVALENCES

TONOLO, ALBERTO
UNIVERSITÀ DI PADOVA (ITALY)

Let R and S be arbitrary associative rings. The purpose of this talk is to describe the equivalences induced by $\mathrm{Hom}_R(V,-)$, $\mathrm{Hom}_S(V,-)$ and their derived functors with ${}_RV_S$ partial tilting bimodule, without any finiteness condition.

TBA (MAIN TALK)

VAN OYSTAEYEN, FREDDY
UNIVERSITY OF ANTWERP (BELGIUM)

COHOMOLOGY FOR COMODULES: SEPARABLE AND MASCHKE FUNCTORS

VERCRUYSSE, JOOST
VRIJE UNIVERSITEIT BRUSSEL (BELGIUM)

The notion of a Maschke functor was first introduced and studied by S. Caenepeel and G. Militaru. One of the remarkable facts is that every separable functor is a Maschke functor and the converse is true in some particular and interesting cases, such as the forgetful functor $\mathcal{M}_H \to \mathcal{M}_k$, where H is a Hopf algebra over k. In the proper formulation; this last statement goes back to a classical result of M. Sweedler.

Generalising a cohomological treatment of comodules over corings by F. Guwman to the framework of comonads, we further investigate the relation between separable and Maschke functors. In particular we obtain the result that the separability of a large class of (forgetful) functors is equivalent with the fact that a closely related functor is Maschke.

This is a joint work with L. El Kaoutit from Granada.

2. Geometry and Topology

Geometry of abelian covers and special ballquotients (main talk)

BAUER, INGRID
UNIVERSITY OF BAYREUTH (GERMANY)

In this talk we will describe the construction of a minimal smooth algebraic surface over the complex numbers of general type with $K^2 = 45$ and $p_g = 4$.

This result is motivated on one hand by the following question of F. Enriques

Try to construct surfaces having a birational canonical map (so-called simple canonical *surfaces) with geometric genus $p_g = 4$ and K^2 as high as possible.*

In fact, Enriques even conjectured that the highest possible value for $K2$ should be 24, based on the conjecture that the expected number of moduli should be strictly positive. There already exist counterexamples by work of Catanese and Liedke, but our example is the best possible, since $c_1^2 = 3c_2$, which is the bound given by the Bogomolov–Miyaoka–Yau inequality.

It is well known nowadays, that surfaces lying on the border of the Bogomolov–Miyaoka–Yau inequality are etale quotients of the twodimensional complex ball.

We construct our surface as $(\mathbb{Z}/5\mathbb{Z})^2$ covering of the plane ramified exactly in the lines of a complete quadrangle. Any such cover, once it is smooth, gives a surface with $K^2 = 4$ and $\chi = 5$. We are done, once we prove that there is a regular surface between the constructed ones. In order to do this we give an algebraic topological description of Abelian covers, which allows to calculate the character sheaves of an Abelian covering with group G once we know the first homology group H_1 of the base minus the branch divisor and the surjective homomorphism

$$H_1 \to G$$

explicitly. We finally remark that this surface is an etale quotient of the Hirzebruch surface (given as the Kummer covering of the complex plane ramified in a complete quadrangle). These have already been studied by M. Kato, but he only found irregular examples.

This is a joint work with F. Grunewald and F. Catanese.

Mirror symmetry and toric super Calabi–Yau Manifolds

BELHAJ, ADIL
OTTAWA UNIVERSITY (CANADA)

In this talk, we discuss mirror symmetry of super Calabi–Yau manifolds constructed as fermionic extensions of compact toric varieties. We mainly study the case where the linear sigma A-model contains as many fermionic fields as there are $U(1)$ factors in the gauge group. After integrating out all the fermions, we find that there is a relation between the super Calabi–Yau conditions of the A-model and quasi-homogeneity of the B-model, and that the degree of the associated superpotential in the B-model is given in terms of the determinant of the fermion charge matrix of the A-model. Illustrating applications will be given.

COMPRESSIBLE ENDS OF LEAVES IN FOLIATED 3−MANIFOLDS

CHARITOS, CHARALAMPOS
AGRICULTURAL UNIVERSITY OF ATHENS (GREECE)

In this work we generalize the classical Poincaré–Bendixson theorem for 2−dimensional leaves in 3−manifolds.

Consider a closed orientable 3−dimensional manifold M equipped with an orientable foliation $\mathcal{F}$ of dimension two. An end e of a non-compact leaf L is defined by a decreasing sequence $... \supset K_n \supset K_{n+1} \supset ...$ such that: each K_n is a closed 2−dimensional submanifold of L whose boundary ∂K_n is diffeomorphic to the unit sphere S^1 and $\cap_n K_n = \emptyset$.

The *e-limit set* of L is defined by $e - lim(L) = \cap_i \overline{K_i}$; as usual $\overline{K_i}$ denotes the closure of K_i in M. An end $e = (K_n)_{n=1,2..}$ is called *cylindrical* if K_1 (and hence each K_i) is diffeomorphic to $S^1 \times [0, +\infty)$. Moreover the cylindrical end e will be called *compressible* if there exists a 2−dimensional disc D embedded in M such that:
(i) $\partial D \subset K_1$, and ∂D is a non-contractible curve in L,
(ii) D is transverse to L along ∂D.
The main result of this work is the following:

Theorem *If e is a cylindrical and compressible end of a leaf L, then the e-limit set of L is a torus.*

CELLULARIZATION OF CLASSIFYING SPACES

FLORES DÍAZ, RAMÓN JESÚS
UNIVERSIDAD AUTÓNOMA DE BARCELONA (SPAIN)

Given a group G, the p-primary part of the homotopy theory of its classifying space can be studied through Dror-Farjoun's cellularization functor CW with regard to the classifying space of $\mathbb{Z}/p$. In this talk we will consider the cases of finite groups and, more generally, compact Lie groups.

PRINCIPAL HOLOMORPHIC TORUS BUNDLES OVER TORI

FREDIANI, PAOLA
UNIVERSITÀ DI PAVIA (ITALY)

I'll report on a joint work with F. Catanese in which we develope the investigation of deformations in the large of torus fibrations over tori already started by Catanese in a previous paper. In particular it is possible to show that the class of principal elliptic bundles over tori whose topological extension class is non degenerate is closed for deformation in the large. We also use these techniques to study real structures on such bundles.

GENERALISED TEICHMÜLLER SPACES AND HIGGS BUNDLES (MAIN TALK)

GARCÍA-PRADA, OSCAR
CSIC (SPAIN)

It is well-known that the Teichmüller space of a compact surface parametrizes complex, conformal and hyperbolic structures on the surface. Teichmüller space can also be identified with a component of the moduli space of representations of the fundamental group of the surface in $PSL(2, \mathbf{R})$. It turns out that one can replace $PSL(2, \mathbf{R})$ by a large class of Lie groups rataining some of the special

features that characterize Teichmüller theory, but whose geometric meaning is still very mysterious. In this talk, we study some of these generalisations by means of the theory of Higgs bundles — a very powerful tool in holomorphic geometry.

Rational torus-equivariant cohomology theories and Jacobians of curves (main talk)

GREENLEES, JOHN
UNIVERSITY OF SHEFFIELD (UNITED KINGDOM)

By considering behaviour at various isotropy groups and taking account of the localization theorem, one may construct an explicit abelian category $A(G)$ which gives an algebraic approximation for rational G-equivariant cohomology theories when G is a torus.

The speaker and Shipley have proved that this actually gives a complete algebraic model. Since $A(G)$ is so explicit, one may construct cohomology theories by writing down suitable objects of $A(G)$, and one source of interesting examples comes from the geometry of complex curves (the values of the cohomology theory are then related to sheaf cohomology of suitable line bundles over the curve or its Jacobian). The most familiar example is when G is the circle and we use an elliptic curve. In this case the speaker and Ando have shown that the elliptic cohomology is also the target of an equivariant version of the Ando–Hopkins–Strickland sigma genus. The talk will attempt to describe some of these examples and speculate on higher versions.

Classifying spaces, diffraction and moduli spaces of point patterns (main talk)

HUNTON, JOHN
UNIVERSITY OF LEICESTER (UNITED KINGDOM)

The study of aperiodic but highly structured point sets in Euclidean space (such as the atomic positions of an ordered solid or 'quasicrystal') has led to the realisation of the importance of a number of associated topological spaces. In particular we have the 'continuous hull', a moduli space of patterns locally identical to the original pattern and whose K-theory mirrors the quantum mechanics of a particle in the solid, and the 'autocorrelation hull', whose geometry determines the X-ray diffraction properties of the solid. In turn these spaces have admitted a number of appealing structures which have aided specific calculations, such as descriptions in terms of fibre bundle structures or as pro-objects in various 'nice' geometric categories. In this talk we shall demonstrate the relationship between many of these spaces and descriptions by giving a unified approach in terms of classifying spaces of various interrelated topological categories.

Diagrams and torsors (main talk)

JARDINE, RICK
UNIVERSITY OF WESTERN ONTARIO (CANADA)

Maps between objects X and Y in a homotopy category can be identified with path components of a category of cocycles, in great generality. This correspondence is used to give a simple demonstration of the identification of isomorphism classes of torsors for sheaves of groups of with maps in the homotopy category of simplicial sheaves. For arbitrary index categories I, I-torsors are defined to be diagrams of equivalences which have trivial homotopy colimits. Homotopy colimit and derived pullback together define a bijection $[*, BI] \cong \pi_0(I - \mathbf{Tors})$; this bijection exists quite generally, and specializes to definitions of higher torsors and motivic torsors.

HAMILTONIAN QUANTUM PRODUCT IN EQUIVARIANT COHOMOLOGY

MUNDET, IGNASI
UNIVERSITAT DE BARCELONA (SPAIN)

We will explain how a certain generalization of the vortex equations allow to define invariants of compact symplectic manifolds endowed with a Hamiltonian action of the circle. These invariants are analogous to Gromov–Witten invariants, and in particular can be encoded in a new ring structure on the equivariant cohomology ring.

TRIANGULATED TRACK CATEGORIES

MURO, FERNANDO
MAX-PLANCK-INSTITUT FÜR MATHEMATIK (GERMANY)

An additive track category $\mathbf{A}$ is a category enriched in abelian groupoids whose homotopy category $\pi_0\mathbf{A}$ is additive. Suppose that such a category is endowed with a pseudofunctor $\Sigma\colon \mathbf{A} \rightsquigarrow \mathbf{A}$ which induces an additive equivalence of categories $\pi_0\Sigma$. In this talk we will show how, under two simple axioms, $\mathbf{A}$ and Σ determine an ordinary triangulated structure in $\pi_0\mathbf{A}$. All common examples of triangulated categories arise in this way. We will also show how this induced triangulated structure only depends on $\pi_0\mathbf{A}$, $\pi_0\Sigma$ and a characteristic cohomology class in the translation cohomology of the endofunctor $\pi_0\Sigma$.

ADDITIVITY FOR DERIVATOR K-THEORY (MAIN TALK)

NEEMAN, AMNON
AUSTRALIAN NATIONAL UNIVERSITY (AUSTRALIA)

Following work of Grothendieck defining derivators, Maltsiniotis formulated certain K-theoretic conjecture. Garkusha proved the additivity conjecture for derivators coming from Waldhausen models, and we (Cisinski, Keller, Maltsiniotis and the speaker) can now prove a general statement.

MIXED HODGE STRUCTURES AND INSTANTON BUNDLES

PENACCHIO, OLIVIER
CRM DE BARCELONA (SPAIN)

We will give a description of mixed Hodge structures in terms of instantons on some projective surfaces. The instanton numbers will be interpreted Hodge-theoretically. This description can be extended family-wise and yields a correspondence between families of instantons and families of mixed Hodge structures. Using this correspondence, we will then use moduli spaces of instantons to classify variations of mixed Hodge structures and next be interested in different compactifications of these moduli spaces.

FIBRATIONS OF LOW GENUS AND SURFACES WITH $q = p_g = 1$

PIGNATELLI, ROBERTO
UNIVERSITY OF TRENTO (ITALY)

I'll report on a joint work with F. Catanese (math.AG/0503294) where we gave structure theorems for fibrations (of surfaces to curves) of genus 2 and of genus 3 with nonhyperelliptic general fibre, and, among other applications, we have studied surfaces with $q = p_g = 1$, giving a complete classification of the case $K^2 = 3$ (in particular disproving a conjecture of Catanese and Ciliberto).

CW HOMOTOPY TYPE OF THE SPACE OF MAPS TO A $K(G, n)$

SMREKAR, JAKA
UNIVERSIDAD DE BARCELONA (SPAIN)

Let X and Y be CW-complexes. The space of maps from X to Y with the compact open topology does not necessarily have the homotopy type of a CW-complex. The question of whether it does or does not, for suitable choices of X and Y, sometimes relates or even reduces to well known problems of algebraic topology. We note in this context Miller's theorem on the Sullivan conjecture as well as the geometric Moore conjecture. Here we discuss this question for Y an Eilenberg–MacLane space $K(G, n)$ with G abelian, and give a complete answer in terms of homology of X.

ON KAN'S LOOP GROUP AND THE COBAR CONSTRUCTION

TONKS, ANDREW
LONDON METROPOLITAN UNIVERSITY (UNITED KINGDOM)

We discuss some new and somewhat surprising connections between the two classical constructions for loop spaces.

For K a 1-reduced simplicial set and CK the corresponding chain coalgebra, Adams' cobar construction ΩCK provides a free chain algebra which is cubical in nature, while Kan's construction GK is a free simplicial group model.

An explicit *quasi-isomorphism* of chain algebras

$$\phi : \Omega CK \to CGK$$

was given by Szczarba in 1961. In this talk we demonstrate that ϕ is a *homotopy equivalence* and has a homotopy inverse ψ which is also an algebra map.

In fact the cobar construction may be seen as a free subalgebra of CGK, and we have a *strong deformation retraction* of chain algebras

$$H \circlearrowright CGK \underset{\phi}{\overset{\psi}{\rightleftarrows}} \Omega CK\ , \qquad \psi\phi = 1,$$

in which $H : \phi\psi \simeq 1$ is a derivation homotopy.

ON THE COHOMOLOGY OF FINITE p-GROUPS

VIRUEL, ANTONIO
UNIVERSIDAD DE MÁLAGA (SPAIN)

It is well known that non isomorphic p-groups may have isomorphic mod p cohomology algebras (even as algebras over the Steenrod algebra). In this talk we show how matric Massey products may be used to distinguish these cases.

This is a joint work with A. Díaz and A. Ruiz.

STABLE AND UNSTABLE OPERATIONS IN p-LOCAL K-THEORY

WHITEHOUSE, SARAH
UNIVERSITY OF SHEFFIELD (UNITED KINGDOM)

In previous work, an explicit description of the ring of stable degree zero operations in p-local complex K-theory was obtained. We will explain how to give a similar description for unstable additive operations and how to relate the rings of stable and unstable operations.

This is joint work with Francis Clarke and Martin Crossley.

3. Approximation, Special Functions and Numerical Analysis

Ratio asymptotic for polynomials of multiple orthogonality

ÁLVAREZ ROCHA, IGNACIO
UNIVERSIDAD POLITÉCNICA DE MADRID (SPAIN)

Polynomials of multiple orthogonality associated to Angelesco and Nikishin systems have ratio asymptotic under general conditions for the measures. They satisfy a recurrence relation of more than three terms and the ratio asymptotic of the polynomials gives the asymptotic properties of the recurrence coefficients. In this work we investigate the connection between the properties of the recurrence coefficients and the ratio asymptotic for the corresponding polynomials as well as the connection with the band Hessenberg operators defined by the recurrence coefficients when general multiple orthogonal polynomials are considered. General conditions for the system of measures are assumed in such a way that at least Angelesco and Nikishin systems belong to the scope of the results presented here.

GMRES convergence bounds in terms of numerical range

BECKERMANN, BERNHARD
LABO PAINLEVÉ, UNIVERSITÉ DE LILLE 1 (FRANCE)

Recently, in some joint work with Gorenov and Tyrtyshnikov we proposed some improvement of the Elman error bound for GMRES for solving general systems of equations. Here we will speak about some improvement, namely that the kth relative residual is bounded in norm by 3 times the convergence factor to the power k obtained by the numerical range of the matrix of coefficients.

On asymptotics of L^p extremal polynomials

BENZINE, RACHID
UNIVERSITY BADJI MOKHTAR ANNABA (ALGERIA)

We study the asymptotic behavior of L^p extremal polynomials corresponding to a measure with infinite discrete part off the circle or the curve. This is a joint research with Laskri Yamina.

Riccati matrix differential equations in the orthogonal polynomials theory

BRANQUINHO, AMÍLCAR
UNIVERSIDADE DE COIMBRA (PORTUGAL)

In this talk we work with sequences of monic polynomials, $\{P_n\}$, orthogonal with respect to a positive Borel measure, μ, with support on the real line, such that the Stieltjes function $F(z) = \displaystyle\int_{\mathbb{R}} \frac{\mathrm{d}\,\mu(x)}{z-x}$ verify a Riccati differential equations with polynomial coefficients, i.e.

$$A(z)F'(z) = B(z)F^2(z) + C(z)F(z) + D(z)$$

where A, B, C, D are polynomials of bounded degree. These sequences of polynomials are usually called of Laguerre–Hahn type.

Let $\{P_n^{(1)}\}$ be the sequence of associated polynomials with respect to μ. We show that $\{P_n\}$ is of Laguerre–Hahn type if and only if, the sequences of matrix polynomials, $\{Y_n\}$ defined by

$$Y_n = \begin{pmatrix} P_{n+1} & P_n^{(1)} \\ P_n & P_{n-1}^{(1)} \end{pmatrix}, \quad n \in \mathbb{N},$$

verifies a matrix Riccati differential equation of type

$$AY_n' = \mathcal{B}_n Y_n - Y_n \mathcal{C}, \quad n \in \mathbb{N}, \tag{1}$$

where $\mathcal{B}_n$ is a matrix of polynomials and

$$\mathcal{C} = \begin{pmatrix} C/2 & -D \\ B & -c/2 \end{pmatrix}.$$

Moreover, by solving equation (1) we give an explicit form for the sequences of Laguerre–Hahn type, as well as the asymptotic behaviour for these type of orthogonal polynomials.

OPTIMIZATION BY THE HOMOGENIZATION METHOD FOR NONLINEAR ELLIPTIC DIRICHLET SYSTEMS

CALVO JURADO, CARMEN
UNIVERSIDAD DE EXTREMADURA (SPAIN)

Our aim is to study the existence of solution of control problems for nonlinear elliptic systems with Dirichlet boundary conditions. The control variables are the coefficients of the equations and the open set where they are posed. It is known that this class of problems has not solution in general, but using homogenization results about elliptic systems we can find at least a solution in a bigger set.

SOME QUESTIONS ABOUT THE CLASSIFICATION OF MATRIX ORTHOGONAL POLYNOMIALS

CANTERO, MARÍA JOSÉ
UNIVERSIDAD DE ZARAGOZA (SPAIN)

In the scalar case, the properties that characterize the classical OP (Hermite, Laguerre, Jacobi and Bessel) are very well known. In this talk we will expose different posibilities to translate such properties to matrix OP, showing that not all the translated properties are equivalent.

THE ALGEBRA OF MATRIX VALUED DIFFERENTIAL OPERATORS ASSOCIATED TO A GIVEN FAMILY OF MATRIX VALUED ORTHOGONAL POLYNOMIALS: SOME INSTRUCTIVE EXAMPLES

CASTRO SMIRNOVA, MIRTA MARÍA
UNIVERSIDAD DE SEVILLA (SPAIN)

Given a *fixed* family of orthogonal matrix polynomials P_n that are common eigenfunctions of *some* differential operator, with a *matrix valued* eigenvalue Λ_n, we consider the algebra of all such differential operators going along with P_n. Each differential operator will bring in its own sequence of matrix valued eigenvalues.

The richness of the problem is explored through a careful look at some explicit examples. Whereas in the scalar case (consisting exactly of the Hermite, Laguerre, Jacobi and Bessel polynomials) this algebra is always trivial, the examples here point to a very complex picture.

This is a joint research with F. A. Grünbaum, University of California, Berkeley.

SMALLEST EIGENVALUE OF AN INFINITE HERMITIAN DEFINITE POSITIVE MATRIX AND THE MOMENT PROBLEM IN THE COMPLEX PLANE

ESCRIBANO, CARMEN
UNIVERSIDAD POLITÉCNICA DE MADRID (SPAIN)

For an infinite Hermitian definite positive matrix M, we study the impact of the asymptotic behaviour of the smallest eigenvalue λ_n of the truncated matrix M_n of size $n \times n$ in some related topics of the moment problem in the complex plane. In particular, we show that the normality of the infinite Hessenberg matrix associated to M implies the convergence of λ_n to 0. We also study the relationship between the behaviour of the largest and smallest eigenvales of M_n and the absolute continuity of the measures associated with respect to the Lebesgue measure in the unit circle. This is a joint work with R. Gonzalo and E. Torrano.

AN ANALYSIS OF THE R-ORDER OF CONVERGENCE FOR NEWTON'S METHOD UNDER MORE GENERAL CONDITIONS THAN KANTOROVICH ONE'S

EZQUERRO FERNÁNDEZ, JOSÉ A.
UNIVERSIDAD DE LA RIOJA (SPAIN)

The problem of approximating a solution of a nonlinear equation $F(x) = 0$ is very interesting, since we can then solve a large number of different types of problems. So, if F is a nonlinear operator defined on a non-empty open convex subset Ω of a Banach space X with values in a Banach space Y, the equation $F(x) = 0$ can represent a differential equation, a boundary value problem, an integral equation, etc. The normal way to approximate a solution of $F(x) = 0$ is by means of iterative processes. An iterative process is defined by an algorithm such that, from an initial approximation x_0, a sequence $\{x_n\}$ is constructed satisfying $\lim_n x_n = x^*$, where $F(x^*) = 0$.

In the study of iterative methods there are two especially important sides: the convergence of the sequence $\{x_n\}$ to a solution x^* of $F(x) = 0$ and the speed of this convergence. So, we can do then different analysis of convergence: local, semilocal o global (depending on the required conditions).

The best known iteration to solve nonlinear equations is the Newton method:

$$x_{n+1} = x_n - F'(x_n)^{-1}F(x_n), \quad n \geq 0, \quad \text{given } x_0, \tag{1}$$

provided that $F'(x_n)^{-1}$ exists for all $n \geq 0$. Most authors have studied the convergence of (1) to a solution x^* of the equation $F(x) = 0$ under the original conditions of Kantorovich, where it is supposed that the second Fréchet derivative F'' is continuous and bounded in Ω or the first Fréchet derivative F' is Lipschitz continuous in Ω (see [1], [2], [5]).

On the other hand, the convergence properties depends on the choice of the distance $\|\cdot\|$, but for a given distance the speed of convergence of the sequence $\{x_n\}$ is characterized by the speed of convergence of the sequence of non-negative numbers $\|x^* - x_n\|$. An important measure of the speed of convergence is the R-order of convergence (see [6]). It is known that a sequence $\{x_n\}$ converges to x^* with R-order at least $\tau > 1$ if there are constants $C \in (0, \infty)$ and $\gamma \in (0, 1)$ such that $\|x^* - x_n\| \leq C\gamma^{\tau^n}$, $n = 0, 1, \ldots$ If F'' is continuous and bounded in Ω or F' is Lipschitz continuous in Ω, the convergence of the Newton iteration is R-quadratic.

For equations defined by differentiable operators, it has been considered the following generalizations of those conditions

$$\|F''(x)\| \leq \omega(\|x\|), \quad x \in \Omega, \tag{2}$$

$$\|F'(x) - F'(y)\| \leq \omega(\|x - y\|), \quad x, y \in \Omega, \tag{3}$$

where $\omega : \mathbb{R}_+ \to \mathbb{R}_+$ is a monotonous continuous real function such that $\omega(0) \geq 0$ (see [3–4]). Real majorizing sequences are usually used to prove the convergence of Newton's method and the R-order

of convergence two is analysed, but in [3] and [4], the difficulty in using majorizing sequences, when the required conditions are generalized, is laid out. An alternative technique, where some particular real sequences are involved, is provided. The application of this technique is very simple and allows us to generalized the results obtained under Newton-Kantorovich type conditions and establish the R-order of convergence of Newton's method under conditions (2) or (3). Studies about that are obtained and some sharp a priori error estimates are provided. So, the Newton method is of R-order at least two if (2) hold and $1+p$ if (3) is satisfied with $\omega(tz) \leq t^p\omega(z)$, for $z > 0$, $t \in [0,1]$, $p \in [0,1]$.

Finally, we apply the results mentioned above to nonlinear Hammerstein integral equations of the second kind.

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THE SYMMETRIC STANDARD ELLIPTIC INTEGRALS WITH TWO OR THREE LARGE PARAMETERS

FERREIRA, CHELO
UNIVERSIDAD DE ZARAGOZA (SPAIN)

Symmetric standard elliptic integrals are considered when two or three parameters are large and do not have any prescribed asymptotic relation between them. The analytic continuation method is used for deriving seven expansions of these integrals in inverse powers of the asymptotic parameters. Some of these expansions involve also logarithmic terms in the asymptotic variables. These expansions are uniformly convergent when the asymptotic parameters are greater than the remaining ones. Coefficients of these expansions involve hypergeometric functions with less parameters than the original integrals. Convergence speed of any of these expansions increases for increasing difference between the asymptotic variables and the remaining ones. All the expansions are accompanied by an error bound at any order of the approximation.

RIEMANN–HILBERT PROBLEMS FOR A GENERALIZED NIKISHIN SYSTEM

FOULQUIE MORENO, ANA
UNIVERSIDADE DE AVEIRO (PORTUGAL)

Recently it has been shown the multiple orthogonal polynomials as solutions of a Riemann–Hilbert problem. We try to extend to result to the class of Generalized Nikishin system and to give the normalization of this Riemann–Hilbert problem.

A PROBLEM ON GENERALIZED CONVEXITY AND SATURATION OF LINEAR SHAPE PRESERVING OPERATORS

GARRANCHO, PEDRO
I.E.S. ALBARIZA, MENGÍBAR, JAÉN (SPAIN)

Our main goal with this talk is to pose a problem in connection with a new definition of generalized convexity which extends the one detailed below stated by Bonsall in [1]. This is done in the first part. The second one deals with approximation theory and shows that the new definition, apart from the eventual theoretical interest, turns out to be useful to study the topic of saturation for certain sequences of linear shape preserving operators. In fact, here it lays the real motivation for the new notion of convexity and the necessity of solving the problem we are posing. The last part contains an application to the well-known operators of Meyer–König and Zeller.

Definition([1]) Let $L(y) = 0$ denote the second-order linear differential equation

$$L(y) \equiv D^2y + p_1(t)D^1y + p_2(t)y = 0.$$

Consider an interval (a, b) such that $L(y) = 0$ has a unique solution, continuous in (a, b), taking any given real values y_1 and y_2 at any two given t_1 and t_2 within (a, b). Assume that $p_1(t)$ and $p_2(t)$ are continuous and differentiable whenever this is required.

A real function $f(t)$, defined in (a, b) is said to be 'sub-(L) in (a, b)' if

$$f(t) \leq S(f, t_1, t_2)(t)$$

for every t, t_1, t_2 such that $a < t_1 < t < t_2 < b$, $S(f, t_1, t_2)$ being the solution of $L(y) = 0$ taking the values $f(t_1)$ and $f(t_2)$ at t_1 and t_2.

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This is a joint research with Daniel Cárdenas Morales.

DISCRETE SPECTRA OF COMPLEX JACOBI MATRICES

GOLINSKIY, LEONID
INSTITUTE FOR LOW TEMPERATURE PHYSICS AND ENGINEERING (UKRAINE)

We study the structure of the discrete spectrum of complex Jacobi matrices. In the case when such matrix is a compact perturbation of the discrete laplacian, we find the inclusion regions for its discrete spectrum provided that the first moment of perturbation is finite. If the matrix entries converge to their limits exponentially fast, we give a precise rate of convergence which implies the finiteness of the discrete spectrum. In the case when the background is real periodic we obtain conditions sufficient for the lack of the discrete spectrum.

MULTISYMPLECTIC DISCRETISATION OF HIGHER ORDER LAGRANGIANS

HERNÁNDEZ HEREDERO, RAFAEL
UNIVERSIDAD POLITÉCNICA DE MADRID (SPAIN)

A continuous Lagrangian system can be discretised in way that preserves the multisymplectic structure. A set of discrete Euler-Lagrange equations is obtained from a discretised Lagrangian, instead of discretising the continuous Euler-Lagrange equations. We report the state of our research in the case of higher order (> 1) Lagrangians.

ÉTUDE NUMÉRIQUE D'UN PROBLÈME DE COLONNES CHROMATOGRAPHIQUES À TROIS NIVEAUX

LIDOUH, ABDELUAAB
UNIVERSITÉ MOHAMED PREMIER, OUJDA (MOROCCO)

We study numerically a mathematical model describing a flux of gas through a chromatographic column to three levels: the zeolite crystals, the pellets (containing crystals) and the columns

A theoretical study, proving the existence and the uniqueness of the solution, and a sketch of the numerical study has already been made by the first author [1].

The difficulty of the numerical study resides in the fact that the equations are parabolic coupled, either by the conditions to the limits or by the second members. In addition several parameters, supposed known theoretically, are not given by the experimental device, what makes the problem more interesting of the numerical point of view.

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ASYMPTOTIC BEHAVIOUR OF $\int_0^\infty f(t)h(xt)dt$ BY MEANS OF ANALYTIC CONTINUATION

LÓPEZ, JOSÉ L.
UNIVERDIDAD PÚBLICA DE NAVARRA (SPAIN)

We present a method for deriving asymptotic expansions of $\int_0^\infty f(t)h(xt)dt$ for small x based on analytic continuation. Essentially, this technique only requires for $f(t)$ and $h(t)$ to have asymptotic expansions at $t = \infty$ and $t = 0$ respectively. It is inspired on the McClure and Wong's theory based on distributions. As well as in McClure and Wong's method, the expansion is given in

terms of two asymptotic sequences of powers of x. The coefficients of both sequences are given in terms of Mellin transforms of $h(t)$ and $f(t)$. The remainder term of the expansion is given by $\int_0^\infty f_n(t)h_m(xt)dt$, where $f_n(t)$ and $h_m(t)$ are the remainders in the expansions of $f(t)$ and $h(t)$ respectively. Error bounds for the remainder are derived under additional conditions on $f_n(t)$ and $h_m(t)$. Many known and unknown asymptotic expansions of important integral transforms are derived in a straightforward manner from the approach presented here. Uniform properties of the expansion and applications are discussed.

RATIO ASYMPTOTIC OF HERMITE–PADÉ ORTHOGONAL POLYNOMIALS FOR NIKISHIN SYSTEMS (MAIN TALK)

LÓPEZ LAGOMASINO, GUILLERMO
UNIVERSIDAD CARLOS III DE MADRID (SPAIN)

We prove the existence of ratio asymptotic for a sequence of polynomials which share orthogonality relations with a collection of m finite Borel measures supported on a bounded interval of the real line. The collection of measures form a so called Nikishin system. When $m = 1$ our result reduces to E. A. Rakhmanov's celebrated Theorem on ratio asymptotic for orthogonal polynomials on the real line. We also investigate general properties of the coefficients in the recurrence relation satisfied by such polynomials.

This is a joint research with A. I. Aptekarev and I. A. Rocha.

SPECTRAL TRANSFORMS AND HERMITIAN TOEPLITZ MATRICES

MARCELLÁN, FRANCISCO
UNIVERSIDAD CARLOS III DE MADRID (SPAIN)

Given a Hermitian Toeplitz matrix T, we can define a linear functional in the linear space of Laurent polynomials as well as a bilinear functional such that M is the corresponding Gram matrix.We analyze some perturbations of this bilinear functional with the spectral flavor as in the real case and we study the connection with the LU and QR factorizations of the Hessenberg matrices associated with the multiplication operator.

MULTIVARIATE FROBENIUS–PADÉ APPROXIMANTS

MATOS, ANA
UNIVERSITÉ DES SIENCES ET TECHNOLOGIES DE LILLE (FRANCE)

Let $\{P_k\}_k$ be a family of orthogonal polynomials and f a two variable function given by

$$f(x,y) = \sum_{i=0}^{\infty}\sum_{j=0}^{\infty} f_{ij}P_i(x)P_j(y)$$

that is, a function for which we know the first terms of its orthogonal expansion in $\{P_k\}_k$. Our aim is to construct rational approximants to f, $S(x,y) = P(x,y)/Q(x,y)$, with P and Q two polynomials satisfying an approximation property of the following type:

$$Q(x,y)f(x,y) - P(x,y) = \sum_{(i,j)\in\mathbb{N}^2\setminus E} r_{ij}P_i(x)P_j(y)$$

where E is an index set in which the coefficients of the error expansion vanishes. We call them **Frobenius–Padé approximants**. These ideas generalize the definition of multivariate Padé approximants (for power series) to the case of orthogonal series. The case of a univariate function, *Padé–Legendre approximants*, and the case of a vector function, *simultaneous Frobenius–Padé approximants*, have been studied before; algorithms for the recursive computation of sequences of these have been proposed, acceleration results for some classes of functions have been obtained and the numerical results are quite good.

For the two variable case, after giving the definitions and some elementary properties, we will be interested in the two following problems:

- the computation of the value of a sequence of approximants in a given point (x_0, y_0). For this we will develop a recursif algorithm based on the E-algorithm;
- the computation of the numerator and denominator coefficients for a sequence of approximants. We will show that the essential part of the computational effort corresponds to the solution of a linear system which gives the denominator coefficients. We will get for the system matrix a displacement rank structure, which will enable us to develop fast algorithms to solve the problem.

Finally we will consider the particular case of Tchebyshev series and we will give another definition for the Frobenius–Padé (–Tchebyshev) approximants in two variables. In this case, and using the properties of these polynomials (namely their recurrence relation), we will show that the matrix of the system we have to solve to obtain the denominator coefficients has a particular structure - block Toeplitz-plus-Hankel - which enables us to solve it by fast algorithms (in $\mathcal{O}\left(m^2(m+1)^2\right)$ operations instead of $\mathcal{O}(m^6)$ by Gauss elimination method).

Applications to the solution of partial differential equations by spectral methods are under study.

RELATIVE ASYMPTOTICS FOR ORTHOGONAL MATRIX POLYNOMIALS WITH VARYING RECURRENCE COEFFICIENTS

OULAD YAKHLEF, HOSSAIN
UNIVERSIDAD PÚBLICA DE NAVARRA (SPAIN)

We study relative asymptotic for matrix orthonormal polynomials under a perturbation of the related varying matrix of measures by the addition of a Delta matrix measure with positive definite matrix mass. Finally we deduce a relative asymptotic behavior of orthonormal polynomials with unbounded matrix recurrence coefficients.

CLASSICAL ORTHOGONAL POLYNOMIALS IN SEVERAL VARIABLES

PÉREZ, TERESA E.
UNIVERSIDAD DE GRANADA (SPAIN)

Classical orthogonal polynomials in one variable can be defined as the orthogonal polynomials associated to a moment functional u satisfying a Pearson differential equation in the form $D(\phi u) = \psi u$ $(*)$ where ϕ and ψ are polynomials with $\deg(\phi) = 2$ and $\deg(\psi) = 1$. In this work, we present old and new results on classical multivariate orthogonal polynomials.

We have introduced *classical orthogonal polynomials* in several variables as the multivariate orthogonal polynomials associated to a moment functional satisfying a partial differential equation analogue to $(*)$. From this approach, we recover the main results related to this theory, and some characterizations for multivariate classical orthogonal polynomials are given.

This is a joint research with M. Álvarez de Morales, T. E. Pérez and M. A. Piñar.

WEIERSTRASS' THEOREM IN WEIGHTED SOBOLEV SPACES

PORTILLA, ANA
UNIVERSIDAD CARLOS III DE MADRID (SPAIN)

We characterize the set of functions which can be approximated by smooth functions and by polynomials with the weighted Sobolev norm

$$\|f\|_{W^{k,\infty}(w)} := \sum_{j=0}^{k} \left\|f^{(j)}\right\|_{L^\infty(w_j)},$$

for a wide range of (even non-bounded) weights w_j's. We allow a great deal of independence among the weights w_j's.

This a joint research with Ana Portilla, Yamilet Quintana, José M. Rodríguez, Eva Tourís.

POWER ASYMPTOTIC FOR GENERAL CHEBYSHEV POLYNOMIALS

RABAH, KHALDI
UNIVERSITY BADJI MOKHTAR (ALGERIA)

Let σ be a finite positive Borel measure with an infinite compact support in the complex plane. Let P_n be the set of polynomials of degree n. For $p > 0$, one defines the $L_p(\sigma)$ general Chebyshev polynomials associated to the measure σ as the monic polynomials $T_{n,p}(z) = z^n + ...$ that minimize the $L_p(\sigma)$ norm in the set of monic polynomials of degree n:

$$\int |T_{n,p}(\xi)|^p \, d\sigma(\xi) := \min_{Q \in P_{n-1}} \int |\xi^n + Q(\xi)|^p \, d\sigma(\xi) = m_{n,p}(\sigma),$$

One studies the power asymptotic of general Chebyshev polynomials associated to a measure of the type $\alpha = \beta + \gamma$, where β is absolutely continuous measure and γ is a point measure.

APPROXIMATING ROOTS FOR QUADRATIC EQUATIONS WITH PREFIXED R-ORDER OF CONVERGENCE

ROMERO ÁLVAREZ, NATALIA
UNIVERSIDAD DE LA RIOJA (SPAIN)

In general, we cannot solve $f(x) = 0$ directly. The solution of these equations is habitually carried out by means of the approximation of its roots applying iterative processes. This is, to build a sequence of approximations $\{x_n\}$ such that $\lim_{n\to\infty} x_n = x^*$ and $f(x^*) = 0$. In this study, two fundamental aspects appear. On the one hand, how to build the sequence $\{x_n\}$; and on the other hand, the speed of convergence of the sequence to a solution x^* of the equation. In this work, we present a "multiparametric family" of iterative processes of Newton type. In the case of quadratic scalar equations, it has permitted us to establish tailored iterative processes to obtain the desired speed of convergence. The previous study is extended to $\mathbb{C}$ and it carries on us to generalize the study of quadratic equations in Banach spaces.

This is a joint research with M. A. Hernández.

MAJORIZATION AND TOEPLITZ TOOLS IN DISCRETIZED PDE SPECTRAL ANALYSIS AND PRECONDITIONING (MAIN TALK)

SERRA CAPIZZANO, STEFANO
UNIVERSITÀ DELL'INSUBRIA - SEDE DI COMO (ITALY)

In this talk we will focus on the use of majorization tools and Toeplitz for deducing clustering properties of the eigenvalues of (precondizioned) nonsymmetric matrix sequences. In particular, we show some examples of the quoted analysis in the case of (discretized) convection-diffusion equation.

ANOTHER CONNECTION BETWEEN ORTHOGONAL POLYNOMIALS AND L-ORTHOGONAL POLYNOMIALS

SRI RANGA, ALAGACONE
UNIVERSIDADE ESTADUAL PAULISTA (BRAZIL)

Given a strong positive measure ψ on $[a,b]$ the sequence of L-orthogonal polynomials (LOPs) $\{\mathcal{Q}_n^\psi\}$ are defined by: $\mathcal{Q}_n^\psi$ is a polynomial of degre n and

$$\int_a^b t^{-n+s}\mathcal{Q}_n^\psi(t)\,\mathrm{d}\psi(t)=0,\quad s=0,1,\ldots,n-1.$$

$\{t^{-\lfloor(n+1)/2\rfloor}\mathcal{Q}_n^\psi(t)\}$ is known as a sequence of orthogonal Laurent polynomials.

The strong positive measure ψ is said to be of the symmetric class $S^3[\tau,\beta,b]$ if

$$\frac{\mathrm{d}\psi(t)}{t^\tau}=-\frac{\mathrm{d}\psi(\beta^2/t)}{(\beta^2/t)^\tau},\ t\in(a,b),$$

where $0<\beta<b$, $a=\beta^2/b$ and $2\tau\in\mathbb{Z}$. The classification is according to τ.

Here we look at a connection between orthogonal polynomials (OPs) associated with positive measures on the real line and LOPs associated with strong measures of the class $S^3[0,\beta,b]$. As other contributions, we mention that

- Sri Ranga (Proc. Amer. Math. Soc., 1995) has considered a connection that exists between OPs associated with "symmetric" positive measures on the real line and LOPs associated with strong measures of the class $S^3[1/2,\beta,b]$.
- Vinet and Zhedanov (Integral Transforms Spec. Funct., 1999) have considered a connection that exists between OPs associated with "symmetric" positive measures on the real line and Szegő polynomials on the real line. The monic Szegő polynomials on the real line are the monic reciprocal polynomials of the LOPs $\mathcal{Q}_n^\psi$, defined when the measure ψ is of the class $S^3[0,\beta,b]$.
- As other attempts to connect OPs on the real line with orthogonal Laurent polynomials on the real line, we also mention the work of Hagler, Jones and Thron (Lecture Notes in Pure and Appl. Math., 199, Marcel Dekker, 1998).

However, non of these previous attempts have provided a method to obtain information on the orthogonal Laurent polynomials associated with the special $S^3[0,\beta,b]$ measure ψ given by

$$\mathrm{d}\psi(t)=\frac{1}{2\pi}\frac{1+\beta/t}{\sqrt{(b-t)(t-a)}}\,\mathrm{d}t.$$

Lagrange interpolation for continuous piecewise smooth functions

TRILLO MOYA, JUAN CARLOS
universidad politécnica de cartagena (spain)

In engineering applications, data collected from experiments are usually discrete and the physical meanings of the data are not always well known. To estimate the outcomes and, eventually, to have a better understanding of the physical phenomenon, a more analytically controllable function that fits the experimental data is desirable. The process of estimating the outcomes in between sampled data points is called interpolation.

The most usual interpolation formula is obtained considering polynomials. In order to control the error of the estimation the interpolated function is assumed smooth.

In this paper we present a family of interpolatory functions with error bounds for continuous piecewise smooth functions. We apply this study to the classical Lagrange interpolation controlling its error. This is a joint research with S. Amat, S. Busquier, and D. A. Escudero.

From orthogonal polynomials asymptotics to spectral measures: determinate versus indeterminate moment problems (main talk)

VALENT, GALLIANO
paris 7 and maths department luminy (france)

In the field of OP theory, the classical Markov theorem shows that for determinate moment problems the spectral measure is under control of the OP asymptotics. The situation seems to be completely different for indeterminate moment problems in which case the spectral measures are to be constructed using Nevanlinna theory. Nevertheless it is interesting to observe that some spectral measures can still be obtained from a Markov-like theorem. The exposition will be illustrated in the determinate case by examples due to Stieltjes and in the indeterminate case by an example brought to light recently.

Shohat–Favard Theorem and orthogonal series

VAN ISEGHEM, JEANNETTE
university of lille france (france)

The Shohat Favard theorem establishes the link between three terms recurrence relations and family of orthogonal polynomials. Similarly this link is establish between one special type of recurrence relation (five terms with polynomials coefficients of degree 0, 1 or 2) and the denominators of Frobenius–Pade approximants of a function expanded in an orthogonal series.

Superluminal systems and a bounded extremal problem in Hardy space

WIELONSKY, FRANCK
university of lille (france)

We describe the phenomenon of fast light in optical physics and explain how quantitative upper bounds on this phenomenon can be obtained in the framework of linear systems from the study of an extremal problem in Hardy space.

It is known from previous work of L. Baratchart, J. Leblond, and J. Partington that the unique solution to this extremal problem satisfies an implicit equation involving a specific Toeplitz operator. This equation allows for a practical implementation that leads to an effective computation of the solution.

This is a joint research with B. Macke and B. Segard.

4. Functional Analysis and its Applications

Propiedades de espacios de Banach y convergencia estadística

AIZPURU TOMÁS, ANTONIO
UNIVERSIDAD DE CÁDIZ (SPAIN)

El concepto de convergencia estadística fue introducido por Fast en 1951. En el año 2000 Connor, Ganichev y Kadets obtienen caracterizaciones de propiedades clásicas de los espacios de Banach a través de la convergencia estadística de sucesiones. En esta dirección aquí estudiamos una caracterización de las series débil incondicionalmente de Cauchy por medio de la convergencia estadística. También estudiamos una versión del teorema de Orlicz–Pettis con la convergencia estadística.

Trabajo conjunto con M. Nicasio-Llach y F. J. Pérez-Fernández.

Aplicaciones lineales que preservan el diámetro entre espacios de funciones continuas

AIZPURU TOMÁS, ANTONIO
UNIVERSIDAD DE CÁDIZ (SPAIN)

El estudio de las aplicaciones lineales y biyectivas, entre espacios de funciones continuas y escalares, que preservan el diámetro del rango fue iniciado por Gyori, Molnar, González y Uspenskij. En el año 2000 Cabello obtiene un resultado en el que describe este tipo de aplicaciones. En nuestro trabajo presentamos un estudio similar pero en el caso de funciones vectoriales. También presentamos un estudio del caso escalar y no sobreyectivo. Tratamos pues de dar con el diámetro los mismos pasos que se dieron en los teoremas tipo Banach–Stone.

Trabajo conjunto con M. Tamayo.

On the solvability of some differential equations with constant periodic

AL-MOMANI, RAID
QATAR UNIVERSITY (QATAR)

We prove the uniqueness of the solution of some operator differential equations with constant periodic coefficients with the help of Green's function,the operator coefficients are unbounded and their domain and range belongs the Hilbert space.

Boundary value problem for two-dimensional in time parabolic type

ASSIA, GUEZANE-LAKOUD
UNIVERSITY BADJI MOKHTAR (ALGERIA)

The aim of this paper is the study of Goursat boundary value problem generated by a class of parabolic differential operator equations with variable domains.

Let $D =]0, T_1[\times]0, T_2[$ be a bounded region in $\mathbb{R}^2$, H be a Hilbert space and $\{A(t)\}$ be a family of unbounded operators in H, such that for all $t = (t_1, t_2) \in D$, $A(t)$ are self-adjoint positive operators and densely definite. We suppose also that their domains $D(A(t))$ are dependent on t. We

search a H-valued function $u(t)$ which solves the following two-dimensional time Goursat boundary value problem:

$$\textbf{(GBVP)}\begin{cases} \mathcal{L}u = \dfrac{\partial u}{\partial t_1} + \dfrac{\partial u}{\partial t_2} + A(t)u = f(t) \\ l_1 u(t_1,t_2) = u(t_1,0) = \varphi(t_1); l_2 u(t_1,t_2) = u(0,t_2) = \psi(t_2). \end{cases}$$

Where f is an H-valued function, φ and ψ are given in H.

The main result of this work is the solvability of the posed problem. The proofs are obtained via a priori estimates, which follow from the energy inequality method.

SLICES IN THE UNIT BALL OF SYMMETRIC PROJECTIVE TENSOR PRODUCT OF JB*-TRIPLES

BECERRA GUERRERO, JULIO ANTONIO
UNIVERSIDAD DE GRANADA (SPAIN)

An abstract of this talk will be handed at the congress.

HOLDER INEQUALITY WITH RESPECT TO BILINEAR MAPS

BLASCO, OSCAR
UNIVERSIDAD DE VALENCIA (SPAIN)

Let (Ω, Σ, μ) be a finite measure space, $1 \leq p < \infty$, X be a Banach space X and $B : X \times Y \to Z$ be a bounded bilinear map. We say that an X-valued function f is p-integrable with respect to B whenever $\sup_{\|y\|=1} \int_\Omega \|B(f(w), y)\|^p d\mu < \infty$. We get an analogue to Hölder's inequality in this setting.

This is a joint research with José Calabuig.

AN ELLIPTIC SYSTEM MODELLING TWO SUBPOPULATIONS COMPETING FOR RESSOURCES IN A BOUNDED REGION

BOUGUIMA, SIDI MOHAMMED
UNIVERSITY OF TLEMCEN (ALGERIA)

We will consider an elliptic system modelling two aubpopulations living in a bounded region. A positive solution is obtained using the index theory. Some results concerning multiplicities are obtained.

UNITARY JORDAN BANACH ALGEBRAS

BURGOS NAVARRO, MARÍA
UNIVERSIDAD DE ALMERÍA (SPAIN)

In this talk we will focus on the generalization of the theory of unitary normed algebras to the non-associative setting. Since the set of all unitary elements of a norm-unital normed non-commutative Jordan Algebra need not be multiplicatively closed, we introduce weakly unitary normed non-commutative Jordan algebras, and the related concepts of maximality of the norm. We prove that unitary non-commutative JB* -algebras are strongly uniquely maximal and that weakly unitary norm-unital closed subalgebras of non- commutative JB*-algebras are non-commutative JB*-algebras. In the alternative case, we show that every finite-dimensional maximal unitary normed alternative complex algebra is isometrically isomorphic to an alternative C*-algebra.

LYAPUNOV-TYPE INEQUALITIES FOR DIFFERENTIAL EQUATIONS

CAÑADA, ANTONIO
UNIVERSIDAD DE GRANADA (SPAIN)

Classical Lyapunov inequality concerns with zeros of real-valued solutions of an equation of the form $u''(x) + a(x)u(x) = 0$. In particular, Lyapunov inequality states that if $a \in L^\infty(0, L)$, then a necessary condition for the boundary value problem

$$u''(x) + a(x)u(x) = 0,\ x \in (0, L),\ u(0) = u(L) = 0$$

to have nontrivial solutions is that $\displaystyle\int_0^L a^+(x)\ dx > 4/L$, where $a^+(x) = \max\{a(x), 0\}$.

An analogous result is true for Neumann boundary conditions. More precisely, if we consider the linear problem

$$u''(x) + a(x)u(x) = 0,\ x \in (0, L),\ u'(0) = u'(L) = 0 \tag{1}$$

where $a \in \Lambda_0$ and Λ_0 is defined by

$$\Lambda_0 = \{a \in L^\infty(0, L) \setminus \{0\} : \int_0^L a(x)\ dx \geq 0,\ \ (1) \text{ has nontrivial solutions } \}$$

then $\displaystyle\int_0^L a^+(x)\ dx > 4/L$ for any function $a \in \Lambda_0$. It is not difficult to see that the constant $4/L$ is optimal and that in the case of Neumann boundary conditions, the positivity of $\displaystyle\int_0^L a(x)\ dx$ is necessary in order to obtain this kind of result.

Let us note that Lyapunov inequality is given in terms of $\|a^+\|_1$, the usual norm in the space $L^1(0, L)$. In this talk we provide new results on L_p Lyapunov-type inequalities with $1 < p \leq +\infty$. For ordinary differential equations, we show a qualitative and quantitative complete treatment of the problem. In the case of partial differential equations on a bounded and regular domains in $\mathbb{R}^N$, it is proved that the relation between the quantities p and $N/2$ plays a crucial role, showing a deep difference with respect to the ordinary case. In the proof, the best constants are obtained by using a related minimization problem and Lagrange multiplier theorem. Finally, the linear study is combined with Schauder fixed point theorem to provide new conditions about the existence and uniqueness of solutions for resonant nonlinear problems of the form

$$u''(x) + f(x, u(x)) = 0,\ x \in (0, L),\ u'(0) = u'(L) = 0$$

when $f(x, u)/u$ behaves asymptotically as a function $a(x)$ such that the problem (1) has only the trivial solution. The partial differential equation case is also considered.

This is a joint research with J. A. Montero and S. Villegas.

MIXING CRITERIA FOR SEMIGROUPS OF OPERATORS

CONEJERO, JOSÉ A.
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

Let X be a separable Banach space and let Δ be R, R^+ or a sector in the complex plane. Let $\{T_t\}_{t\in\Delta}$ be a strongly continuous semigroup of linear and continuous operators $T_t : X \to X$ for all $t \in \Delta$. We say that $\{T_t\}_{t\in\Delta}$ is a **hypercyclic** semigroup if there is any element in X with dense

orbit by the semigroup. We say that $\{T_t\}_{t\in\Delta}$ is a **topologically mixing** semigroup if for every pair of non void open sets $U, V \subset X$ there exists $r > 0$ such that $T_t(U) \cap V \neq \emptyset$ for every $t \in \Delta$ with $|t| \geq r$. Every topologically mixing semigroup is hypercyclic, but the converse is false.

We give some criteria which are sufficient for a semigroup to be topologically mixing. We also characterize when these semigroups are topologically mixing in terms of the behavior of their operators. In this setting, we give some counterexamples that complete these results.

This is a joint research with T. Bermúdez, A. Bonilla and A. Peris.

[1] T. BERMÚDEZ, A. BONILLA, J. A. CONEJERO AND A. PERIS, *Hypercyclic, Topologically Mixing and Chaotic Semigroups on Banach Spaces*, Studia Math. To appear in 2005.

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AMENABLE C*-ALGEBRAS GENERATED BY A SINGLE HILBERT SPACE OPERATOR

EL HARTI, RACHID
UNIVERSITY HASSAN I (MOROCCO)

A Banach algebra $\mathcal{A}$ is said to be amenable if, for each Banach $\mathcal{A}$-bimodule $\mathcal{X}$, every bounded derivation $\mathcal{A} \to \mathcal{X}^*$ is inner, where $\mathcal{X}^*$ denotes the topological dual of $\mathcal{X}$. A C*-algebra is amenable if and only if it is nuclear. Classification results for nuclear C*-algebras are established by several authors. This talk will focus on the amenability (or the nuclearity) of the C*-algebras generated by a single Hilbert space operator.

A UNIFIED TREATMENT OF FINITELY ADDITIVE INTEGRATION

DEL CAMPO ACOSTA, RICARDO
UNIVERSIDAD DE ALMERÍA (SPAIN)

During the last two decades it has been developed what it can be called a Finitely Additive Integration Theory, which consist of several extension theories of a positive functional I on a vector lattice B without any monotone continuity hypothesis on I.

We now introduce the concept of bitermination of an upper integral q and we will see how this notion may be used to give a unified treatment of all these theories.

GEOMETRIC CHARACTERIZATION OF TRIPOTENTS IN REAL AND COMPLEX JB*-TRIPLES

FERNÁNDEZ POLO, FRANCISCO JOSÉ
UNIVERSIDAD DE GRANADA (SPAIN)

We establish a geometric characterization of tripotents in real and complex JB*-triples. As a consequence we obtain an alternative proof of Kaup's Banach-Stone theorem for JB*-triples.

Weak amenability of the second dual of a Banach algebra

FILALI, MAHMOUD
UNIVERSITY OF OULU (FINLAND)

We present some cases where the weak amenability of the second dual of a Banach algebra A implies that of A.

Linear functions and scalar products

KRAMER, ALPAR VAJK
POLITECNICO MILANO (ITALY)

The aim of this note is to take a look on a method generating on different linear spaces with help of a linear function and a scalar product. Some applications on concrete linear space are also discussed.

Malliavin calculus of Bismut type without probability

LEANDRE, REMI
UNIVERSITÉ DE BOURGOGNE (FRANCE)

Malliavin proved Hoermander's theorem by using probabilistic methods. Bismut avoids the functional analysis of Malliavin in order to prove again Hoermander's theorem by using probabilistic methods. We translate Bismut's way of Malliavin Calculus in semi-group theory, by avoiding probabilistic language.

Approximation methods by regular functions (main talk)

LLAVONA, JOSÉ G.
UNIVERSIDAD COMPLUTENSE DE MADRID (SPAIN)

The purpose of this talk is to expose three methods about approximation by regular functions. The first one is approximation by polynomials. We start with Weierstrass' theorem about polynomial approximation of continuously differentiable functions and show extensions of this theorem for infinite dimensional Banach spaces. Part two deals with approximation by C^k-functions. We discuss basic facts about smooth approximation in separable infinite dimensional Banach spaces using the method of smooth partitions of unity. Analytic approximation and approximation for the fine topology of order m is considered. Finally we present the infimal convolution methods. This method provided us an explicit formula for the approximating functions. Some statements of open problems are given.

Operators similar to partial isometries (main talk)

MBEKHTA, MOSTAFA
UNIV. DES SCIENCES ET TECH. DE LILLE I (FRANCE)

The Hilbert space bounded linear operator T is said to be regular if its range $R(T)$ is closed and the kernel $N(T)$ is included in $R^\infty(T)$. Here $R^\infty(T)$ is the intersection of the ranges of all iterates of T. We prove that if T is regular, then T is similar to a partial isometry if and only if T is power bounded and there exists a power bounded operator S such that $TST = T$. This is a generalization of a similarity criterion due to B. Sz.-Nagy. Counterexamples are given, showing that regularity cannot be avoided.

ABSTRACT DIFFERENCE EQUATIONS

MEDINA, RIGOBERTO
UNIVERSIDAD DE LOS LAGOS (CHILE)

We consider a class of semilinear difference equations in a Banach space with time-variant linear parts and nonlinearities satisfying the local Lipschitz conditions. Explicit stability and boundedness conditions are derived. Our approach is based on the generalization of the "freezing" method for ordinary difference equations as well as on the recent estimates for the norm of functions of quasi-Hermitian operators. Applications to infinite dimensional difference systems are also discussed.

THE WIDDER–KISYŃSKI THEOREM ON CONVOLUTION ALGEBRAS

MIANA, PEDRO J.
UNIVERSIDAD DE ZARAGOZA (SPAIN)

In this talk, we present main vector-valued versions of Widder's characterization of Laplace transform of bounded functions. The Widder–Kisynski on $L^1_\omega(\mathbb{R}^+)$ is one of them. We prove analogous results in other convolution algebras.

THE ALTERNATIVE DUNFORD–PETTIS AND THE KADEC–KLEE PROPERTIES ON C*-ALGEBRAS AND JB*-TRIPLES

PERALTA, ANTONIO M.
UNIVERSIDAD DE GRANADA (SPAIN)

We describe those C*-algebras and JBW*-triples satisfying the alternative Dunford–Pettis and the Kadec–Klee properties.

EMBEDDING THEOREMS FOR ANISOTROPIC LIPSCHITZ SPACES

PÉREZ LÁZARO, FRANCISCO JAVIER
UNIVERSIDAD PÚBLICA DE NAVARRA (SPAIN)

Anisotropic Lipschitz spaces are considered. For these spaces we obtain sharp embeddings in Besov and Lorentz spaces. The methods used are based on estimates of iterative rearrangements. We find a unified approach that arises from the estimation of functions defined as minimum of a given system of functions. The case of L^1-norm also is covered.

UNITARY BANACH ALGEBRAS (MAIN TALK)

RODRÍGUEZ-PALACIOS, ÁNGEL
UNIVERSIDAD DE GRANADA (SPAIN)

Unitary elements of a norm-unital Banach algebra A are defined as those invertible elements u of A satisfying $\|u\| = \|u^{-1}\| = 1$. By a unitary Banach algebra we mean a norm-unital Banach algebra A such that the convex hull of the set of its unitary elements is norm-dense in the closed unit ball of A. Examples of unitary Banach algebras are all unital C^*-algebras and the discrete group algebras $\ell_1(G)$ for every group G. In this talk we survey unitary Banach algebras since their introduction in Cowie's Ph. D. Thesis [4] (and later independent reconsideration by Hansen and Kadison [5]) to

the more recent works about them [1,2]. We put special emphasis in the question whether every semisimple unitary Banach algebra has an involution mapping each unitary element to its inverse. Banach spaces X such that the Banach algebra (X) (of all bounded linear operators on X) is unitary are also considered [1,3].

[1] J. BECERRA, M. BURGOS, A. KAIDI, AND A. RODRÍGUEZ, *Banach algebras with large groups of unitary elements*. To appear.

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[3] J. BECERRA, A. RODRÍGUEZ, AND G. WOOD, *Banach spaces whose algebras of operators are unitary: a holomorphic approach*. Bull. London Math. Soc. 35 (2003), 218–224.

[4] E. R. COWIE, *Isometries in Banach algebras*. Ph. D. Thesis, Swansea 1981.

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GREEN'S FUNCTION OF THE NEUMANN PROBLEM FOR THE HYPERBOLIC AXISYMMETRIC HEAT CONDUCTION IN A CIRCULAR PLATE

TRUJILLO GUILLÉN, MACARENA
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

We show the existence and uniqueness of Green's function for the Neumann problem associated to the hyperbolic heat equation in a circular plate. We also present an explicit and rigorous computation of this Green's function.Finally, we use this function to compute the temperature response of a circular plate that it is irradiated by a laser source with a specific spatial and temporal profile. Joint with J. A. López Molina.

THE SPECTRUM AND THE CONTINUITY OF DENSE RANGE HOMOMORPHISMS

VELASCO, M. VICTORIA
UNIVERSIDAD DE GRANADA (SPAIN)

We study the role of the spectrum for the automatic continuity of dense range homomorphisms from a complete normed algebra to a strongly semisimple complete normed algebra, in the general non-associative setting. Our approach will consist into carry on the associative technique to its maximum scope, clarifying at the same time what is going on in the associative case.

5. General Topology and its Applications

Dedicated to the 65th birthday of Gino Tironi

THE SET OF OMEGA-LIMIT POINTS IN DYNAMICAL SYSTEMS OF LOW DIMENSION

BALIBREA, FRANCISCO
UNIVERSIDAD DE MURCIA (SPAIN)

It is well known that the set of ω-limit points on dynamical systems of the type (I, f) ($I = [0, 1]$, $f \in C(I, I)$), denoted by Λ_f is a closed set. Since Λ_f is also an *f-invariant*-set ($f(\Lambda_f) = \Lambda_f$), we obtain that in the dynamical system we have an invariant set where concentrates almost all the relevant dynamics of the system.

In other one dimensional spaces like $\mathbb{S}^1$ and *finite graphs* and for general continuous maps, the set Λ_f is also closed.

Nevertheless, in the case of general Peano continua we have examples proving that the property does not hold. The same can be said of general two dimensional dynamical systems in I^2, even in the case of homeomorphisms on $\mathbb{R}^2$.

The aim of the lecture is to give positive results on dendrites (restricting the set of continuous maps) and in two dimensional systems on I^2 and $\mathbb{S}^2$ of the triangular and antitriangular forms. The idea is to explain also what are the dynamical consequences of not holding the property.

COMPLETION OF SEMI-UNIFORMITIES

BATÍKOVÁ, BARBORA
UNIVERSITY OF ECONOMICS (CZECH REPUBLIC)

For every uniform space there exists a completion in which the original space is dense and onto which every uniformly continuous mapping to a complete uniform space can be extended. The question is whether it holds also for semi-uniformities, which are the same as uniformities without the triangularity inequality.

We take just such semi-uniform spaces that induce a topology and call them t-semi-uniform spaces.

Recall that a filter $\mathfrak{f}$ in a uniform space $(X,\mathcal{U})$ is said to be Cauchy if for each $U \in \mathcal{U}$ there is an $F \in \mathfrak{f}$ such that $F \times F \subset U$ which is iff for every $U \in \mathcal{U}$ there exists $F \in \mathfrak{f}$ such that for every $x \in F$ holds $U[x] \in \mathfrak{f}$ and that is iff for every $U \in \mathcal{U}$ and every $F \in \mathfrak{f}$ there exists $x \in F$ such that $U[x] \in \mathfrak{f}$ and that is iff for each $U \in \mathcal{U}$ there is an $x \in X$ such that $U[x] \in \mathfrak{f}$.

In t-semi-uniform spaces these four properties do not coincide. We say that a space is complete if every Cauchy (Cauchy is a suitable property from above) filter converges . A completion is a complete superspace in which the originals space is dense.

The main results of my work are:

Firstly, if we take any of the properties above, the category of all Hausdorff complete semi-uniform spaces is epireflective in the category of all Hausdorff semi-uniform spaces but the reflection arrows need not be embeddings, moreover there is no epireflective subcategory of the category of all Hausdorff semi-uniform spaces (and also of the category of all Hausdorff topological spaces) in which all reflection arrows are embeddings.

Secondly, if we take the second property of the properties above, in the category of T_1 semi-uniform spaces the situation is different. For every T_1 semi-uniform space there exists a minimal (one-point) and maximal completions. The maximal one is used to be called a weak reflection and it is a T_1 semi-uniform superspace in which the original space is dense and onto which every uniformly continuous mapping to a complete semi-uniform space can be (not uniquely) extended.

REMARKS ON A THEOREM OF ŠAPIROVSKIĬ

BELLA, ANGELO
UNIVERSITÀ DI CATANIA (ITALY)

We present a generalization of a theorem of Šapirovskiĭ on the cardinality of a Lindelöf sequential space. We also discuss the possibility to extend this result to pseudoradial spaces.

ON SOME COINCIDENCE POINT THEOREMS

BENKAFADAR, NASREDDINE
UNIVERSITY OF CONSTANTINE (ALGERIA)

The coincidence point theory, which is a particular topic of Nielsen theory, requires two single-valued maps

$$f, g : X \to Y$$

defined between closed manifolds of same dimension and seeks to find the existence of solution of the equation $f'(x) = g'(x)$ for maps f', g' homotopic to f and g respectively.

Coincidence point theory, has found applications within topology as well as in many other fields of mathematics. For example, in non linear analysis, dynamics, differential and integral equations. In the note, one defines a topological invariant for some classes of morphisms

$$f, g : X \to E^n$$

defined from a Hausdorff topological space X to an euclidean vector space E^n. For this purpose, one uses the notion of decomposing maps and homological concepts of algebraic topology. For instance, one obtains a coincidence point index which allows to appraise the existence of coincidence points.

The results, can be considered as a natural generalization of the fixed point theorems of Lefschetz, Nielsen, Kakutani, Wallace, Dold, they include also know coincidence point theorems of Eilenberg–Montgomery.

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[2] K. BORSUK AND A. KOSINSKI, *On connections between the homology properties of a set and its frontiers*, Bull. Acad. Pol. Sc. 4 (1956), pp. 331–333.

[3] N. M. BENKAFADAR AND M. C. BENKARA-MOSTEFA, *A generalized coincidence point index*, Applied General Topology 6 (2005), no. 1, pp. 87–100.

[4] A. DOLD, *Lecture notes in Algebraic topology*, Springer-Verlag, 1972.

ON YI'S EXTENSION PROPERTY FOR TOTALLY PREORDERED TOPOLOGICAL SPACES

CAMPIÓN ARRASTIA, MARÍA JESÚS
UNIVERSIDAD PÚBLICA DE NAVARRA (SPAIN)

We show further results concerning the problem of extending total preorders (preferences) from a subset of a topological space to the entire space using the approach introduced by the Korean mathematical economist Gyoseob Yi. Yi considered the problem of *extending preferences* from closed subsets of a commodity space to the entire space.

It is a plain corollary of the well-known Tietze extension theorem that continuous preferences admit an extension if they are defined on closed subsets of a normal topological space and, in addition, they are representable by continuous utility functions. But even if a topological space is *normal*, it could happen, however, that there exist continuous preferences that do not admit a utility representation. Obviously, in those cases the problem of extending utility functions becomes different from the problem of extending preferences.

The problem of extension of preferences, and the problem of representability of preferences through continuous utility functions also have a close relationship. However, *in the general case, both questions are no longer equivalent*. Despite the problem of representability of preferences through continuous utility functions has been solved since long, the general problem of *characterizing Yi's extension property for preferences has not been solved*. We furnish some partial results related to such question. We introduce some necessary and sufficient conditions for a topological space to have Yi's extension property.

Then we analyze the relationship between Yi's extension property and some properties that involve continuous representability of preferences.

Finally, we analyze the analogous of Yi's extension property for the *semicontinuous* case, proving that *semicontinuous extensions always exist*, even without asking the subsets considered to be *closed* (as required in the "continuous" Yi's extension property). This means, in particular, that the original (continuous) Yi's extension property is more restrictive, because not every topological space satisfies the continuous Yi's extension property, but all satisfy its semicontinuous analogue.

ORDER RESOLUTIONS AND LEXICOGRAPHIC PRODUCTS

CASERTA, AGATA
SECONDA UNIVERSITÀ DEGLI STUDI DI NAPOLI (ITALY)

Let $(X, \preceq, \tau)$ and $(Y_x, \preceq_x, \tau_x)$ be linearly ordered topological spaces. We can endow the set $\bigcup_{x\in X}\{x\}\times Y_x$ with two natural topologies: (i) the order resolution, and (ii) the topology induced by the lexicographic sum. We study the relationship between these two topologies.

This is a joint research with Alfio Giarlotta and Stephen Watson.

UNIFORMLY DISCRETE HIT-AND-MISS HYPERTOPOLOGY: A MISSING LINK IN HYPERTOPOLOGIES

DI MAIO, GIUSEPPE
SECONDA UNIVERSITÀ DI NAPOLI (ITALY)

Recently it was shown that, the lower Hausdorff metric (uniform) hypertopology, is generated by families of uniformly discrete sets as *hit* sets. This result leads to new hypertopology which is the join of the above topology and the upper Vietoris topology. This *uniformly discrete hit-and-miss hypertopology* is coarser than the locally finite hypertopology and finer than both Hausdorff metric

(uniform) and Vietoris hypertopologies. We investigate this new hypertopology. Here is a Hasse diagram in which each arrow goes from a finer topology to a coarser one and equality follows *uc* or *tb* as indicated. The diagram clearly shows that the new topology provides the missing link.

$$\begin{array}{ccc} & \mathbf{uc} & \\ \textit{proximal locally finite} & \longleftarrow & \textit{Locally finite} \\ \downarrow \mathbf{uc} & \mathbf{uc} & \downarrow \mathbf{uc} \\ \textit{Hausdorff metric} & \longleftarrow & \textit{Uniformly discrete} \\ \downarrow \mathbf{tb} & \mathbf{uc} & \downarrow \mathbf{tb} \\ \textit{Proximal} & \longleftarrow & \textit{Vietoris} \end{array}$$

This is a joint research with S. Naimpally and E. Meccariello.

ON THE DYNAMICS OF A SHARKOVSKIS MAP ON A TRIANGLE

GARCÍA GUIRAO, JUAN LUIS
UNIVERSIDAD POLITÉCNICA DE CARTAGENA (SPAIN)

The aim of this talk is to prove that the map $F : (u, v) \to (u(4 - u - v), uv)$, stated by Sharkovski, and defined on the triangle $\Delta = \{u, v \geq 0 : u + v \leq 4\}$ has no periodic points which are no fixed. To obtain it, we prove that the map F is *strongly transitive*.

SOME PROBLEMS CONCERNING SPLITTING AND ADMISSIBLE TOPOLOGIES

GEORGIOU, DIMITRIS
UNIVERSITY OF PATRAS (GREECE)

We consider the set $C(Y, Z)$ of all continuous maps of a topological space Y into a topological space Z and put some problems concerning the (greatest) $\mathcal{A}-$splitting and $\mathcal{A}-$admissible topologies on $C(Y, Z)$, where $\mathcal{A}$ is a class of spaces. About the considering notions see [1].

[1] D. N. GEORGIOU, S. D. ILIADIS AND B. K. PAPADOPOULOS, *Topologies on function spaces, Studies in Topology*, VII, Zap. Nauchn. Sem. S.-Peterburg Otdel. Mat. Inst. Steklov (POMI), 208 (1992), 82–97 (Russian). English Translation: J. Math. Sci. 81 (1996), No.2, 2506–2514.

This is a joint research with S. D. Iliadis.

ON SOME RESULTS IN FUZZY METRIC SPACES

GREGORI, VALENTÍN
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

The problem of constructing a satisfactory theory of fuzzy metric spaces has been investigated by several authors from different points of view. In particular George and Veeramani have introduced and studied a notion of a fuzzy metric space. In this talk we make a little survey and give some new results about this class of fuzzy metric spaces.

This is a joint research with S. Romaguera.

HUTTON [0,1]-QUASI-UNIFORMITIES INDUCED BY FUZZY (QUASI-)METRIC SPACES

GUTIÉRREZ GARCÍA, JAVIER
UNIVERSIDAD DEL PAÍS VASCO-EUSKAL HERRIKO UNIBERTSITATEA (SPAIN)

It is well known that given a probabilistic metric space (Menger space) with continuous t-norm T [9] there is a Hausdorff topology associated (see also [8] for a discussion about necessary conditions). This association factorizes through strong uniformities (or (ε, λ)-uniformities, [9,10]). Similarly, any fuzzy metric space $(X, M, *)$ in the sense of [1,2] can be endowed with a Hausdorff topology τ_M, (in the case of fuzzy quasi-metric spaces [4], a T_1 topology), and again this association factorizes through (quasi-)uniform spaces (see [3,4]). In this paper we associate to each fuzzy (quasi-)metric space a Hutton $[0,1]$-quasi-uniformity $\mathfrak{U}_M$ [6]. This allows us to give a factorization of the previous association via Hutton $[0,1]$-quasi-uniformities (using Katsaras' functor). It is also proved that the topology τ_M is exactly the image under the Lowen's functor ι [7] of the $[0,1]$-topology induced by $\mathfrak{U}_M$. As a consequence, we get a class of Hutton $[0,1]$-quasi-uniformities which are probabilistic metrizable in the sense of [5].

This is a joint research with M. A. de Prada Vicente.

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[2] A. GEORGE AND P. VEERAMANI, *Some theorems in fuzzy metric spaces*, J. Fuzzy Math., 3 (1995), pp. 933–940.

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[5] U. HÖHLE, *Probabilistic topologies induced by L-fuzzy uniformities*, Manuscripta Math., 38 (1982), no. 3, pp. 289–323.

[6] B. HUTTON, *Uniformities on Fuzzy Topological Spaces*, J. Math. Anal. Appl., 58 (1977), pp. 559–571.

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[8] B. MORREL AND J. NAGATA, *Statistical metric spaces as related to topological spaces*, General Topology and its Applications, 9 (1978), pp. 233–237.

[9] B. SCHWEIZER AND A. SKLAR, *Statistical metric spaces*, Pacific J. Math., 10 (1960), pp. 314–334.

[10] B. SCHWEIZER AND A. SKLAR, *Probabilistic metric spaces*, North-Holland Series in Probability and Applied Mathematics, North-Holland Publishing Co., New York-Amsterdam, 1983.

SEPARABLE METRIC SPACES

HAGHNEJAD AZER, KAZEM
MOHGHEGH ARDABLY UNIVERSITY (IRAN)

Separable metric space possesses special properties that some of problem in analysis can be solved in this spaces easily. The questions which appears basically is what properties are needed for metric spaces to be separable. We well answer to this question exactly in this article and even will get a special structure for separable metric spaces that is the same topological and algebraic structure of real numbers.

REPRESENTABLE TOPOLOGIES AND LOCALLY CONNECTED SPACES

INDURAIN, ESTEBAN
UNIVERSIDAD PÚBLICA DE NAVARRA (SPAIN)

The objective of this note is to investigate the role of locally connected spaces in the theory of numerical representations of totally ordered structures. In the main result of the present paper we shall prove that every locally connected separable topology has the continuous representability property, that is: every continuous complete preorder defined on a locally connected separable topological space always admits a continuous real-valued order-preserving representation. In the last section, some generalizations are analyzed, and it is proved that the main result cannot be extended to the semicontinuous case.

This is a joint research with J. C. Candeal and G. B. Mehta.

THE MINIMUM TREE FOR A GIVEN ZERO-ENTROPY PERIOD

JUHER, DAVID
UNIVERSITAT DE GIRONA (SPAIN)

This work deals with 1-dimensional discrete dynamical systems given by continuous maps defined on trees.

The notion of topological entropy is defined for continuous maps on compact metric spaces and is a quantitative measure of the dynamical complexity of the map. It is an important topological invariant. The entropy of a map f will be denoted by $h(f)$, and the set of periods of all the periodic orbits of f will be denoted by $\mathrm{Per}(f)$. The number of endpoints of a tree T will be denoted by e_T. We answer the following question: given any $n \in \mathbb{N}$, which is the minimum size (number of endpoints) of a tree in order that a zero-entropy map f with $n \in \mathrm{Per}(f)$ can be defined on it? Let us denote this number by e_n. In other words,

$$e_n = \min\{i \in \mathbb{N} : \text{ there is a continuous tree map } f : T \longrightarrow T, e_T = i, h(f) = 0, n \in \mathrm{Per}(f)\}.$$

We prove that

$$e_n = s_1 s_2 \cdots s_k - \sum_{i=2}^{k} s_i s_{i+1} \cdots s_k,$$

where $n = s_1 s_2 \cdots s_k$ is the decomposition of n into a product of primes such that $s_i \leq s_{i+1}$.

A variant of Banach fixed point theorem

KHAN, MOHAMMAD
SULTAN QABOOS UNIVERSITY (OMAN)

There are several extensions and generalization of Banach Fixed Point Theorem in various spaces for single-valued as well as for multivalued mappings.In this talk, we present a variant of this theorem. Examples are given to support our results. Applications to homotopy invariance of fixed points will be discussed.

Open-multicommutativity of the probability measure functor

KOZHAN, ROMAN
LVIV NATIONAL UNIVERSITY (UKRAINE)

We consider the construction of space of probability measures P, which is functorial in the category Comp of compact Hausdorff spaces. The functor P is normal in the sense of E.V. Shchepin (1981). It is well-known that the functor P is open, i.e. it preserves the class of open surjective maps. This was first proved by Diter and Eifler (1972). Shchepin (1981) discovered tight relations between the properties of openness and bicommutativity. In particular, he proved that every open functor in Comp is bicommutative, that is preserves the class of the bicommutative diagrams in the sense of Kuratowski.

For the functors acting in the category of compact Hausdorff spaces, we introduce the so-called open multicommutativity property, which generalizes both bicommutatovity and openness and show that this property is satisfied by the functor P.

This is a joint research with Michel Zarichnyi.

Quasi-coincidence for intuitionistic fuzzy points

LUPIÁÑEZ, FRANCISCO. G.
UNIVERSIDAD COMPLUTENSE DE MADRID (SPAIN)

The introduction of intuitionistic fuzzy sets is due to K. T. Atanassov who, also, proposed some problems about this subject. D. Çoker defined the intuitionistic fuzzy topological spaces, and, with some co-workers studied these spaces. In this paper, we define and study the notion of quasi-coincidence for intuitionistic fuzzy points and obtain a characterization of continuity for maps between intuitionistic fuzzy topological spaces.

Chaotic multipliers and tensor products

MARTÍNEZ-GIMÉNEZ, FÉLIX
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

Devaney defined a continuous mapping f on a metric space X to be chaotic (*D-chaotic*) if it is *topologically transitive*, i.e. for each pair U, V of non-empty open sets there is $n \in \mathbb{N}$ such that $f^n(U) \cap V \neq \emptyset$; the periodic points of f form a dense subset of X; and f possesses the following *sensitivity to initial conditions*: There is an $\varepsilon > 0$ such that for all $\delta > 0$ and $x \in X$, there are $y \in X$ and $n \in \mathbb{N}$ such that $d(x, y) < \delta$ but $d(f^n x, f^n y) > \varepsilon$. When X is separable, complete and has no isolated points, transitivity is equivalent to the existence of a dense orbit. Following Auslander

and Yorke, we say that f is chaotic (*AY-chaotic*) if it admits a dense orbit and it has sensitive dependence to initial conditions.

A continuous and linear operator T on a Fréchet (complete and metric) space E is called *hypercyclic* if the orbit $\mathrm{orb}(T,x) := \{x, Tx, T^2x, \ldots\}$ is dense in E for some $x \in E$. In this case x is a *hypercyclic vector* for T. Godefroy and Shapiro showed that hypercyclic operators have sensitive dependence on initial conditions. In other words, for operators on Fréchet spaces, hypercyclicity is equivalent to AY-chaos, and T is D-chaotic if and only if T is hypercyclic and its periodic points form a dense subset of E.

Our purpose is to give a general tool which permits us to obtain (AY- or D-) chaos for operators that can be represented as tensor products of simpler operators. This is the case, e.g., of many operators defined on function spaces of several variables (e.g. translations on the space of entire functions $\mathcal{H}(\mathbb{C}^{\mathbb{N}})$, partial differential operators, etc.) that admit a tensorial representation with factors consisting of operators on function spaces of one variable.

We study when the tensor product $T\widetilde{\otimes}R$ of two operators defined on Fréchet spaces is chaotic. Using this tensor product technics we study chaos of multiplication operators $L_T(S) := TS$, $R_T(S) := ST$ defined on certain operator ideals like the nuclear, compact operators, or on the space of all operators. As a consequence we obtain the first examples of D-chaotic multipliers on Banach algebras.

This is a joint work with J. Bonet and A. Peris.

[1] J. BONET, F. MARTÍNEZ-GIMÉNEZ AND A. PERIS, *Universal and chaotic multipliers on operator ideals*, J. Math. Anal. Appl. **297** (2004), pp. 599–611.

[2] F. MARTÍNEZ-GIMÉNEZ AND A. PERIS, *Universality and chaos for tensor products of operators*, J. Approx. Theory **124** (2003), no. 1, pp. 7–24.

HYPERSPACE AND FUNCTION SPACE AS DUALS

MECCARIELLO, ENRICO
UNIVERSITÀ DEL SANNIO (ITALY)

Let $(X,\mathcal{U})$, $(Y,\mathcal{V})$ be separated uniform spaces. Let η be the compatible EF-proximity on Y induced by $\mathcal{V}$. We also consider spaces satisfying weaker separation axioms and with weaker proximities. Suppose $\alpha \subseteq CL(X)$ is a closed or compact network on X. We consider the proximal set open topology, depending on α and η, on $C(X,Y)$ and its dual, a hyperspace topology on α. This duality enables us to get results in function spaces from those in hyperspaces and vice versa.

This is a joint research with G. Di Maio and S. Naimpally.

AN ANALOGUE OF THE TIETZE EXTENSION THEOREM IN BITOPOLOGICAL SPACES

MOSHOKOA, SEITHUTI
UNIVERSITY OF SOUTH AFRICA (SOUTH AFRICA)

Maps that preserves Cauchy sequences in metric spaces have been studied in the literature, see [3] for example. Their advantage over uniformly continuous maps was also illustrated. In this talk we discuss the problem of extending these maps from a convex closed subspace of a quasi-pseudo metric to the whole space. This will be done in the context of bitopological spaces. Analogous results in the setting of metric spaces will also be presented.

[1] E. LOWEN-COLEBUNDERS, *Function classes of Cauchy continuous maps*, Marcel Dekker, Inc. New York and Basel, 1989.

[2] S. SALBANY, *Bitopological Spaces, Compactifications and Completions*, Math. Monographs University of Cape Town, Vol **1**, (1974).

[3] R. F. SNIPES, *Functions that preserves Cauchy sequences*, Nieuw Arch. Wisk. (1977) (3), 25, no. 3, 409–422.

DUALITY IN FUNCTION SPACES (MAIN TALK)

NAIMPALLY, SOMASHEKHAR
LAKEHEAD UNIVERSITY (CANADA)

We use Bartle's technique to study duality between a topological space and a function space. Normally such a duality forms an essential part of Functional Analysis. Let X, Y be regular or uniform spaces and $\mathcal{F}$ a subfamily of $C(X,Y)$. Let $\mathcal{F}$ be given some topology such as the topology of pointwise convergence τ_p, the compact-open topology τ_k or the topology of uniform convergence τ_u. We introduce several new topologies such as the *topology of even convergence* τ_e, the *closed-cocompact topology* $\tau_{k'}$, (strongly) locally proximal convergence. The evaluation map $\omega\colon \mathcal{F}\times X \to Y$, assigns to each $x \in X$, a function $\underline{x}\colon \mathcal{F} \to Y$ given by $\underline{x}(f) = \omega(f,x) = f(x)$. Let $\underline{X} = \{\underline{x} : x \in X\}$, have the topology of pointwise convergence. Some sample results:

(1) $\mathcal{F}$ has the topology τ_p if and only if for each $x \in X$, $\underline{x}$ is continuous on $\mathcal{F}$.

(2) $\mathcal{F}$ is equicontinuous if and only if the map $x \to \underline{x}$ from X to $\underline{X}$, with the topology τ_u, is continuous (Bourbaki).

(3) $\mathcal{F}$ is evenly continuous if and only if the map $x \to \underline{x}$ from X to $\underline{X}$, with the topology τ_e, is continuous.

Dually

($1^\star$) $\mathcal{F}$ has the uniform convergence topology τ_U if and only if $\underline{X}$ is equicontinuous.

($2^\star$) $\mathcal{F}$ has the topology of even convergence τ_e if and only if $\underline{X}$ is evenly continuous.

($3^\star$) $\mathcal{F}$ has the compact-open topology τ_k if and only if each compact subset of $\underline{X}$ is evenly continuous.

We explore the topological groups of self-homeomorphisms of a topological space and shed light on the earlier work of Arens, Dieudonne, Di Concilio. We also study the concepts such as evenly equidistant, functionally equicontinuous, due to Bouziad–Troallic and topologically equicontinuous due to Royden. This is a joint research with G. Di Maio and E. Meccariello.

SET-VALUED DISCRETE CHAOS

PERIS, ALFRED
UNIVERSITAT POLITÈCNICA DE VALÈNCIA (SPAIN)

Given a continuous map $f : X \to X$ on a (Hausdorff) topological space (X,d), we characterize topological transitivity for the (set-valued) map $\bar{f} : \mathcal{K}(X) \to \mathcal{K}(X)$ induced by f on the space $\mathcal{K}(X)$ of compact subsets of X, endowed with the Vietoris topology. More precisely, $\bar{f}$ is transitive if and only if f is weakly mixing. Some consequences are also derived for the dynamics on fractals and for (continuous and) linear maps on infinite-dimensional spaces.

NEW RESULTS ON SEMI-LIPSCHITZ FUNCTIONS THAT ARE VALUED IN A QUASI-NORMED LINEAR SPACE

SÁNCHEZ ÁLVAREZ, JOSÉ MANUEL
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

Let (X, d) be a quasi-metric space and (Y, q) be a quasi-normed linear space. We show that the normed cone of semi-Lipschitz functions from (X, d) to (Y, q) that vanish at a point $x_0 \in X$ is balanced in the sense of D. Doitchinov. We also prove that it is complete in the sense of Doitchinov whenever (Y, q) is a biBanach space.

This is a joint research with S. Romaguera and M. Sanchis.

ON QUIET FUZZY QUASI-METRIC SPACES

SAPENA, ALMANZOR
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

The notion of a quiet quasi-uniform space was introduced by D. Doitchinov in order to construct a satisfactory theory of completion in quasi-uniform and quasi-metric spaces. Furthermore, quietness provides a suitable framework to discuss many interesting properties in the realm of quasi-uniform spaces. In the light of these facts one can expect that an appropriate notion of a quiet fuzzy quasi-metric space provided a useful tool to the development of a consistent theory of asymmetric fuzziness. In this direction, we propose a notion of quietness that permits us to state, among other, the following results:

(1) A quasi-metric space is quiet if and only if its standard fuzzy quasi-metric space is quiet.

(2) Each quiet fuzzy quasi-metric space admits a compatible quiet quasi-metric.

(3) Each totally bounded quiet fuzzy quasi-metric space is a separable (fuzzy) metrizable space.

(4) Each quiet fuzzy quasi-metric has an (up to quasi-isomorphism) unique quiet bicompletion and an (up to quasi-isomorphism) unique quiet D-completion.

This is a joint research with S. Romaguera and O. Valero.

AXIAL MAPPINGS

SZYSZKOWSKI, MARCIN
GDANSK UNIVERSITY (POLAND)

A mapping $f : R^2 \to R^2$ is called horizontal (vertical) if $f(x, y) = (g(x, y), y)$ $(f(x, y) = (x, g(x, y)))$ for some $g : R^2 \to R^2$. It has been known that every permutation of the plane R^2 is a composition of at most four (4) such axial mappings. Not every continuous permutation of the plane can be even approximated (in the supremum metric) by a finite composition of axial continuous mappings but every continuous permutation can be pointwise approximated by a finite (but not bounded) composition of axial continuous mappings. We discuss what happens if we replace permutation by (not one-to-one) function.

A mapping $f : R^2 \to R^2$ is called a slide if $f(x, y) = (x + g(y), y)$ or $f(x, y) = (x, y + g(x))$ for some $g : R \to R$. A slide is a special axial mapping. Again every permutation is a composition of finitely many (this time 209) slides. The situation is different when we try approximate a continuous permutation by continuous slides.

THE BANACH FIXED POINT THEOREM IN FUZZY QUASI-METRIC SPACES

TIRADO, PEDRO
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

We obtain quasi-metric extensions of the well-known fuzzy version of M. Grabiec [1] of the classical Banach fixed point theorem. In particular, and by using the corresponding generalizations of the notions of B-contraction [3] and G-completeness [1] to fuzzy quasi-metric spaces in the sense of V. Gregori and S. Romaguera [2], we state the following results.

Theorem 1. *Let $(X, M, *)$ be a G-bicomplete fuzzy quasi-metric space such that $\lim_{t\to\infty} M(x, y, t) = 1$ for all $x, y \in X$. Then every B-contraction on X has a unique fixed point.*

Theorem 2. *Let $(X, M, *)$ be a G-right complete Hausdorff fuzzy quasi-metric space such that $\lim_{t\to\infty} M(x, y, t) = 1$ for all $x, y \in X$. Then every B-contraction on X has a unique fixed point.*

These results apply to some fuzzy quasi-metrics on the domains of words that are useful in the study of semantics models of programming languages.

This is a joint research with S. Romaguera and A. Sapena.

[1] M. GRABIEC, *Fixed points in fuzzy metric spaces,* Fuzzy Sets and Systems **27** (1988), pp. 385–389.

[2] V. GREGORI AND S. ROMAGUERA, *Fuzzy quasi-metric spaces,* Appl. Gen. Topology **5** (2004), pp. 129–136.

[3] V. M. SEHGAL AND A. T. BHARUCHA-REID, *Fixed points of contraction mappings on PM-spaces,* Math. Systems Theory **6** (1972), pp. 97–100.

PSEUDORADIAL PROBLEMS: RESULTS AND PROBLEMS (MAIN TALK)

TIRONI, GINO
UNIVERSITY OF TRIESTE (ITALY)

In this talk a survey is given of principal results (old and new) concerning the class of pseudoradial spaces. Cardinal invariants and their inequalities in this class are considered. The behaviour of pseudoradial spaces under the operations of taking topological products and subspaces are examined. A particular attention is dedicated to the so called "small cardinals" in connection with pseudoradiality. Finally several open problems are presented.

A CHARACTERIZATION OF GENERALIZED MONOTONE NORMED CONES

VALERO, OSCAR
UNIVERSIDAD DE LAS ISLAS BALEARES (SPAIN)

Let C be a convex cone and consider a quasi-norm p defined on it. We study the structure of the couple (C, p) as a topological space in the case that the function p is also monotone. We characterize when the topology of a quasi-normed cone can be defined by mean of a monotone norm. We also define and study the dual cone of a monotone normed cone and the monotone quotient of a general

cone. We provide a descomposition theorem which allows to write a cone as a direct sum of a monotone subcone that is isomorphic to the monotone quotient and other particular sudcone.

This is a joint research with S. Romaguera and E. A. Sánchez-Pérez.

CLASSIFYING DISCRETE MORSE FUNCTIONS

VILCHES ALARCÓN, JOSÉ ANTONIO
UNIVERSIDAD DE SEVILLA (SPAIN)

Using the notion of discrete Morse function introduced by R. Forman, we shall prove that there is a natural classification of discrete Morse functions defined on infinite simplicial complexes. It can be done by means of the discrete gradient vector field induced by every discrete Morse function. Moreover, we shall try to get another classification by considering the critical elements of a discrete Morse function and we shall find that it is only possible for the one-dimensional case.

6. Probabilistic Spaces, Copulae and T-norms. Applications

ON SOME NEW FORMS OF CYCLE-TRANSITIVITY AND THEIR RELATION TO COMMUTATIVE COPULAS

DE SCHUYMER, BART
UNIVERSITY OF GHENT (BELGIUM)

Recently, we introduced the framework of cycle-transitivity as a general means of representing transitivity conditions on probabilistic relations. In this framework, for probabilistic relations, the concepts of T-transitivity and stochastic transitivity can be cast. The upper bound functions encountered in this framework for product-transitivity and dice-transitivity, conceptually related to the probabilistic sum, lead to natural questions concerning the meaning of similar upper bound functions. These questions are answered and connections to quasi-copulas and copulas are laid bare.

A NEW CLASS OF COPULAS

DURANTE, FABRIZIO
UNIVERSITY OF LECCE (ITALY)

In the last few years there has been an increasing interest in the construction of new multivariate families of distribution functions (shortly d.f.'s) and a large choice of these objects has been put at the disposal of researchers for the modelling and the simulation. In this talk, based on a joint work with J. J. Quesada-Molina and C. Sempi, a class of bivariate copulas depending on two univariate functions is presented. Specifically, given two real functions φ and ψ from $[0,1]$ into $[0,+\infty]$, it was studied when the mapping $C : [0,1]^2 \to [0,1]$, given by

$$C_{\varphi,\psi}(x,y) := \varphi^{[-1]}(\varphi(min(x,y)) + \psi(max(x,y))), \tag{1}$$

is a copula. This class of copulas is of great interest because it includes the well–known Archimedean and the Cuadras–Augé families of copulas. Several examples and some results about the concordance ordering are provided. The same circle of ideas will also enable us to construct and characterize a new family of quasi–copulas, a generalization of the concept of copula, which has a statistical motivation, for instance, in the study of the best-possible bounds in the set of bivariate d.f.'s.

ON SOME STOCHASTIC DIFFERENTIAL EQUATIONS AND FRACTIONAL BROWNIAN MOTION

EL-NADI, KHAIRIA EL-SAID
UNIVERSITY OF ALEXANDRIA (EGYPT)

Let $\{B_t^H, t \in [0,1]\}$ be a fractional Brownian motion with Hurst parameter H. In this paper, we proved the existence and uniqueness of strong solution for a stochastic partial differential equation of the following type,

$$u(x,t) = u_o(x) + B_t^H + \int_0^t \sum_{|q|\leq 2m} a_q(x) D^q u(x,s) ds + \int_0^t f(x,t,s,u(x,s)) ds,$$

where $D^q = D_1^{q_1} ... D_n^{q_n}$, and $D_j = \frac{\partial}{\partial x_j}$ and $|q| = q_1 + q_2 + ... + q_n$, $q = (q_1, q_2, ..., q_n)$ is an n-dimensional multi-index. It is assumed that the operator $\frac{\partial}{\partial t} - \sum_{|q|=2m} a_q(x) D^q$ is uniformly parabolic.

THE ORIGIN AND DEVELOPMENT OF THE THEORY OF COPULAS (MAIN TALK)

QUESADA MOLINA, JOSÉ JUAN
UNIVERSIDAD DE GRANADA (SPAIN)

The concept of copula was introduced in 1959 by Abe Sklar in the context of probabilistic metric spaces. Since then, and during the last 45 years, the theory of copulas has been developed by a number of authors. Today, it represents a very useful scientific tool in probability and statistics, among other disciplines. More recently, the number of applications in insurance, actuarial science, finance, economy, hydrology, and other sciences, has been growing extensively.

CALCULATING THE RETURN PERIODS VIA COPULAS

SALVADORI, GIANFAUSTO
UNIVERSITÀ DI LECCE (ITALY)

In this work we provide a general theoretical framework exploiting copulas for studying the return periods of random events; in particular, we consider events depending upon the joint behavior of two non-independent random variables, an approach which can easily be generalized to the multivariate case. We show that using copulas may greatly simplify the calculations, and even yield analytical expressions for the isolines of the return periods, both in the unconditional and in the conditional case. In addition, we show how a probability distribution may be associated with the return period of specific events, and introduce the new definitions of sub-, super-, and critical events, as well as those of primary and secondary return periods. An illustration of the techniques proposed is provided by analyzing some hydrological case studies, where the return period is fundamental during the design phase.

A SHORT AND PARTIAL HISTORY OF PROBABILISTIC NORMED SPACES (MAIN TALK)

SEMPI, CARLO
UNIVERSITÀ DI LECCE (ITALY)

This contribution has the, possibly too ambitious, aim to present a survey of the theory of Probabilistic Normed spaces. No result will be proved, so that, for the proofs, the reader is referred to the original sources. The theory of PN spaces has many facets and touches on many branches of mathematics, for instance, geometry, functional analysis, topology, probability, not in all of which the present author is an expert. Moreover, the author has tastes and ideas that may well not be shared by many researchers in the area. This justifies the adjective "partial"that appears in the title. Therefore, it is perhaps better to declare from the start what one may expect from this theory. It is only natural to investigate which "classical" properties of normed spaces are preserved in the new setting. But it is probably more interesting to look for those properties that pertain to the new theory and which have no corresponding analogue in the classical theory. It must also be added that Probabilistic Normed spaces may be approached from different standpoints: they may be studied for their own sake, as a special subject in functional analysis or in topology that is worth investigating simply because it is there, or because it provides a tool to approach open problems or, again, to shed light on topics that one thought had been thoroughly investigated. In this, one thinks immediately of the possible applications in probability and statistics.

Properties of multvariate measures of concordance

TAYLOR, MICHAEL
UNIVERSITY OF CENTRAL FLORIDA (UNITED STATES)

We explore the consequences of a set of axioms which extend Scarsini's axioms for bivariate measures of concordance to the multivariate case. The multivariate setting is richer and, surprisingly, in some ways more constrained than the bivariate setting. Measures of concordance may be thought of as operating on either random vectors or their associated copulas. We exhibit the following results:

(1) A method of extending measures of concordance from low to arbitrarily high dimensions.

(2) A formula expressing the measure of concordance of the random vectors $(\pm X_1, \cdots, \pm X_n)$ in terms of the measures of concordance of the "marginal" random vectors $(X_{i_1}, \cdots, X_{i_k})$.

(3) A method of expressing the measure of concordance of an odd-dimensional copula in terms of the measures of concordance of its even-dimensional marginals.

(4) A family of relations which exist between the measures of concordance of the marginals of a given copula.

New classes of multivariate copulas

ÚBEDA FLORES, MANUEL
UNIVERSIDAD DE ALMERÍA (SPAIN)

Recently, Rodríguez-Lallena and Úbeda Flores [Statist. Probab. Lett. 66, 2004] introduced a class of bivariate copulas which generalizes some known families such as the Farlie–Gumbel–Morgenstern. We now study multivariate generalizations of this class providing several examples.

A comment on the probabilistic metric spaces

VAEZPOUR, SEYED MANSOUR
UNIVERSITY OF YAZD (IRAN)

Throughout this talk we will consider some topological properties of probabilistic metric spaces.

On Log-concavity of the Maximum statistic from Friday and Patil bivariate exponential model

VIVO MOLINA, JUANA MARÍA
UNIVERSIDAD DE MURCIA (SPAIN)

In the classical risk theory, it is often used that different type dimensions can be aggregated into a single dimensional statistic, as well as the assumption of properties on log-concavity of this aggregation; the maximum statistic might be used as aggregate statistic. In this paper, we discuss the conditions based on the weights and parameters of the generalized mixtures of a gamma and one or two exponential distributions to be true probability models. Likewise, we analyze the log-concavity properties of these generalized mixtures, extending the papers of Baggs and Nagaraja (1996) and Franco and Vivo (2002) devote to the log-concavity of the generalized mixtures of three or fewer

exponential distributions, and consequently, we determine the log-concavity properties of the maximum statistic from Friday and Patil bivariate exponential model, which closes one question given in Baggs and Nagaraja (1996) and Franco and Vivo (2002).

This is a joint research with Manuel Franco.

[1] Baggs, G. E. and Nagaraja, H. N. (1996). Reliability properties of order statistics from bivariate exponential distributions. Commun. Statist. Stochastic Models, 12, 611–631.

[2] Franco, M. and Vivo, J. M. (2002). Reliability properties of series and parallel systems from bivariate exponential models. Commun. Statist. Theory Methods, 12, 2349–2360.

7. Random Models and Design of Experiments

New ideas for random graphs

LAURENTIU, MODAN
faculty of computer science in bucharest (romania)

A new Boolean representing for the 2 classical types of random graphs will be introduced. A list of some properties for this kind of graphs will be quickly proved.

Centrality of individuals and cohesiveness of subgroups in economical networks a game theoretical approach (main talk)

MANUEL GARCÍA, CONRADO MIGUEL
universidad complutense de madrid (spain)

In social and economical networks, two of the major concerns are the identification of individuals that have a high centrality and the identification of cohesive subgroups within the network.

In this conference we give a game theoretical approach to those well-known problems. We will assume that a social or economical network is given by a graph (N, Γ) where $N = \{1, 2, \ldots\}$ is a finite set of individuals (nodes) and Γ is a collection of (unordered) pairs $\{i, j\}$ of elements of N (edges) which shows the possible communications. To reflect the interests that motivate the interactions among the actors, we consider an $n-$personal game in characteristic function form (N, ν), being $N = \{1, 2, \ldots\}$ the set of graph nodes.

From the graph and the game, the graph-restricted game is obtained. Shapley value in a game is considered as actor's power. Then, the centrality of an individual is defined as the difference between his/her power in the new game and his/her power in the original one. This defined measure satisfies some appealing properties for a centrality measure.

In the same context, cohesiveness of a subgroup of actors (essentially the extent to which their relations are relatively strong, direct an frequent) is defined as the proportion of its value (measured with the Myerson value) that the players in subset retain when the originally deterministic graph became a probabilistic one (in a specific manner). Again, under conditions that are not very restrictive, this cohesiveness measure satisfies some desirable properties.

Scheduling parallel tasks of Linear Algebra on heterogeneous clusters

MORAIS, CELESTE
instituto politécnico de bragança (portugal)

The aim of data and task parallel scheduling for dense linear algebra kernels is to minimize the processing time of an application composed by several linear algebra kernels. The scheduling strategy presented here combines the task parallelism used when scheduling independent tasks and the data parallelism used for linear algebra kernels. This approach is also called as scheduling malleable tasks. A malleable task is one whose execution time is a function of the number of processors allotted to it. This problem has been studied for scheduling independent tasks on homogeneous machines. Here it is proposed a methodology for heterogeneous clusters and it is shown that significant improvements can be achieved with this strategy.

The aim of the work herein presented is to improve the performance of heterogeneous clusters in the processing of applications composed by linear algebra kernels. The optimization of the processing time of a given parallel application is achieved by obtaining an optimal scheduling for the tasks that form the algorithm. Static scheduling methods use Directed Acyclic Graphs (DAGs) to describe parallel algorithms, where the tasks to process and the precedence among them are represented by an acyclic graph. A weighted DAG can represent different amounts of data to communicate between tasks or different communication costs. The scheduling consists on the distribution of the DAG nodes among the machine nodes, so that the *makespan* is minimum, this is the total length of the schedule. Finding a scheduling that minimizes the processing time of the parallel algorithm is a NP-complete problem. Therefore, since the optimal scheduling is not feasible to obtain, many researchers have presented heuristic algorithms. These algorithms exploit the task parallel paradigm, this is one task to one processor.

The parallel implementation of dense linear algebra kernels in a distributed memory computer (cluster) consists in rewriting state of the art sequential algorithms in order to extract their intrinsic parallelism, by using the data parallel model. These kernels are highly constrained, having a predefined pattern of computation and communication, limiting the advantages of a DAG representation and the scheduling methods. Another approach more efficient for linear algebra kernels is to apply data parallelism by determining beforehand which data element goes to each processor. Several studies present solutions for homogeneous as well as heterogeneous clusters.

The approach presented in this paper mixes both solutions referred to above, this is, task parallel and data parallel scheduling. The DAG represents an algorithm to be scheduled as a task parallel paradigm where each task can be a dense linear algebra kernel. Each task can be itself scheduled as a data parallel paradigm. The motivation for this approach is to maximize the usage of processor capacity available in a cluster by using the data parallel scheduling which achieves better results for linear algebra kernels. This approach is also called as scheduling malleable tasks, this is scheduling tasks that can be executed on any number of processors with its execution time being a function of the number of processors allotted to it.

This is a joint research with Jorge Barbosa and Pedro Tadeu.

A MATRICIAL METHOD TO OBTAIN A FAMILY OF DISCRETE STATIONARY PROCESSES

RUÍZ MORCILLO, VICTOR M.
UNIVERSIDAD COMPLUTENSE DE MADRID (SPAIN)

We describe here a method to obtain discrete stationary processes in discrete time. We define the distribution of the process through an irreducible aperiodic matrix, which we can suppose stochastic. This method allows to obtain stationary and ergodic Markov chains and other stationary and strong-mixing, and hence ergodic, processes of different nature.

8. Financial Mathematics and Mathematical Economics

Utility theory in infinite dimensional spaces

CANDEAL, JUAN C.
universidad de zaragoza (spain)

We study the problem of the existence of continuous and order preserving functions for preference relations defined on infinite dimensional spaces. Then, the so-called, Continuous (Semicontinuous) Representabilty Property (in short, CRP) for a topology is introduced. Among other results, we prove that the weak topology of a Banach space has CRP. The relevance of these topics in mathematical economics is also discussed.

Ideal point methods for MCDM problems with partial. A financial application

CONTRERAS RUBIO, IGNACIO
universidad pablo de olavide (sevilla) (spain)

The financial decisions on an organization are usually considered in the context of multicriteria decision making (MCDM) problems. One of the most applied multicriteria techniques, reference point methods, propose to evaluate a set of alternatives on the basis of their relative closeness from a reference or ideal point. Existing reference point methods require the decision maker (DM) to express his/her preferences about the criteria in a complete way. That is, these methods consider that the relative weight of each criterion is known precisely. The goal of this paper is to extend these procedures to the case in which DM only provides incomplete information about his/her preferences. In particular, we consider the cases in which the information in given by means of linear relations of the weighting coefficients. We propose a general procedure to determine a weighting vector that permit us to consider different criteria to measure the separation of each alternative from the ideal point, minimax and minisum criteria are considered, and different distance norms. In cases where minimax criterion are considered, we propose a lexicographical procedure that determines such solution that best represents such criterion.

Valuation method of the two survival functions as a proxy methodology in risk analysis

FRANCO, MANUEL
universidad de murcia (spain)

In this paper, we have developed an alternative methodology to the well known valuation method of the two distribution functions (VMTDF), this technique is based on the two survival functions which correspond to two probability models of an asset, and we denote by valuation method of the two survival functions (VMTSF). Within this framework, we present the VMTSF to find the market value of an asset, under uncertainty, from its one-dimensional quality index, and its equivalence to the VMTDF. Likewise, using a bidimensional or multidimensional quality index of an asset, we discuss the assessment properties of its market value by the VMTSF, i.e. by means of the two survival functions of the market value and quality index, respectively. Furthermore, we apply both valuation methods in two examples on land pricing, which allows us to compare between the market assessments of both methodologies.

This is a joint research with Rafael Herrerías, Juana María Vivo and José Callejón.

LEXICOGRAPHIC UTILITY THEORY

GIARLOTTA, ALFIO
UNIVERSITÀ DI CATANIA (ITALY)

A linear ordering L is representable (in the sense of Utility Theory) if it can be order-embedded into the usual ordering of the real numbers. We extend the notion of representability and define an ordinal measure of the lexicographic complexity of L, the representability number of L. We study the representability number of several linear orderings, e.g., lexicographic powers of the reals, Aronszajn and Souslin lines, small chains.

APPROACH TO THE FINANCIAL-ACTUARIAL FORMULATION OF A LONG-TERM CARE INSURANCE

HERRANZ PEINADO, PATRICIA
UNIVERSIDAD PABLO DE OLAVIDE (SPAIN)

In the work that is presented, we approach, from a theoretical point of view, the financial-actuarial formulation of an insurance that, so much at the present time, as in coming years, it will be part of our environment, it is the Long-Term Care Insurance. This means when the elderly people have a functional impossibility of carrying out certain tasks of the daily life considered as basic, to be precise, severe limitations of physical or mental order that require of other people help. Our study is based on the use of the Markov and semi-Markov stochastic processes for the analysis of the situations of risk with multiple states, as it is in the case of the disability. This powerful tool frequently used in the actuarial science, we use it to determine the probabilities of occurrence of the event that it occupies us and the quantification of the risk premiums that they are necessary for their covering.

This is a joint work with Flor María Guerrero Casas and Manuela Segovia González.

MATHEMATICAL PROPERTIES OF SUBADDITIVITY

MUÑOZ TORRECILLAS, MARÍA JOSÉ
UNIVERSIDAD DE ALMERÍA (SPAIN)

Many empirical studies try to find the mathematical function that best fits the individuals' behaviour when discounting future rewards. From a temporal discounting perspective, the interesting issue is the nature of the mathematical relation between delay and value. From the economic and psychological fields, two different approaches have usually been employed to determine this function. Economists have taken a rational approach to the problem and have attempted to derive a formula from theoretical assumptions, often based on normative models of what organisms ought to do. In contrast, psychologists have taken an empirical approach and have attempted to find the formula that best describes what organisms are observed to do. In this paper we study three characteristics of such empirical discount functions (delay and interval effects, and subadditivity) and their mathematical relationships.

This is a joint research with Salvador Cruz Rambaud.

OPTIMALITY IN BINARY AND NON-BINARY SETTINGS: TOPOLOGICAL CHARACTERIZATIONS

RODRÍGUEZ ALCANTUD, JOSÉ CARLOS
UNIVERSIDAD DE SALAMANCA (SPAIN)

The aim of this talk is twofold. We first provide necessary and sufficient continuity-type conditions for the existence of maximal elements for irreflexive binary relations defined on compact sets. The results answer a question raised by Campbell and Walker [Journal of Economic Theory 50 (1990), 459–464], who established a sufficient continuity condition for interval orders only. Then we achieve the first necessary and sufficient conditions in the literature for the existence of maximal elements in a non-binary choice framework. As an application, a characterization of the existence of maximal elements for acyclic binary relations is deduced as a Corollary, a fact that can be deduced from the aforementioned binary study too. Further characterizations in different settings given by Tian and Zhou [Journal of Mathematical Economics 24 (1995), 281–303] follow as well. Analogous characterization problems in the k-acyclic binary cases are posed and solved too.

This is a joint research with Carlos Rodríguez Palmero.

FUNCTIONAL PRINCIPAL COMPONENTS ANALYSIS IN THE AUTOMOBILE

SEGOVIA GONZÁLEZ, M. MANUELA
UNIVERSIDAD PABLO DE OLAVIDE (SPAIN)

The functional principal component analysis (functional PCA) is an exploratory data analysis tool that generalizes multivariate principal component analysis. In this technique, the interpretations of the results are not always objective. Because of this reason, in this report we show a method that allows us to interpret the results obtained when applying the functional PCA. To do this, we use the correlation functions between the original process and each principal component. We also describe a real application in the automobile sector. In order to help the insurance company to choose their client portfolios, we define different behaviors. Our final empirical aim is to give the company a description of the insured's behavior which can be interesting when they apply a bonus-malus system to the risk premium.

This is a joint research with Flor M. Guerrero Casas and Patricia Herranz Peinado.

TOPOLOGICAL INTERPRETATION ON INPUT-OUTPUT ANALYSIS

TENORIO VILLALÓN, ANGEL FRANCISCO
UNIVERSIDAD PABLO DE OLAVIDE (SEVILLA) (SPAIN)

In this paper we use some mathematical technics in relation with the Input-Output Analysis. These tools are seldom used for this purpose, and we actually consider some concepts on Graph Theory and develop them to explain and determine three usual concepts of Input-Output Analysis: fundamental products, autonomous sets and indecomposable matrices.

Firstly, we define a directed graph associated with the given economic system (i.e., with the matrix of technological coefficients). Secondly, we consider topological properties of this graph to study the economical concepts previously mentioned. We also show some conditions to determine the fundamental products and the autonomous sets, describing different algorithms to make the calculations easier. Finally, we relate connectivity of digraphs to the decomposability of the matrix of technological coefficients.

This is a joint research with Eugenio M. Fedriani Martel.

THE DOUBLE-PARETO UNIFORM DISTRIBUTION (MAIN TALK)

VAN DORP, JOHAN RENÉ
THE GEORGE WASHINGTON UNIVERSITY (UNITED STATES)

In this paper we propose a novel four parameter continuous univariate distribution that can be motivated from at least two perspectives. The first one views the distribution as a generalization of the uniform distribution that allows for uncertainty specification at its bounds gradually represented via two Pareto tails. The second one is that of an asymmetric heavy-tailed peaked distribution with an unbounded domain with the property that the location of the mode is not uniquely determined but rather is described by an uniform range. Properties of the distribution are described and a maximum likelihood estimation (MLE) procedure for the mode location and Pareto tails parameters is presented. The MLE procedure is illustrated by means of an i.i.d. sample of standardized logdifferences of bi-monthly 30-year US mortgage interest rates for the period from 1971-2004. This sample is constructed utilizing the Auto-Regressive Conditional Heteroscedastic (ARCH) time series model devised in 1982 by the Nobel Laureate R.F. Engle. This is a joint research with Amita Singh and Thomas A. Mazzuchi.

EXTREME STATISTICS IN THE VALUATION METHODS BASED ON TWO PROBABILITY MODELS

VIVO MOLINA, JUANA MARÍA
UNIVERSIDAD DE MURCIA (SPAIN)

In this paper, the extreme statistics, minimum and maximum, are used in the field of valuation of an asset from a bidimensional quality index. Specifically, we study the application of these statistics to find the market assessments under uncertainty by the following methodologies: valuation method of the two distribution functions (VMTDF) and valuation method of the two suvirval functions (VMTSF). In this context, we analyze the boundary assessment properties, in both VMTDF and VMTSF, of the market value of an asset by means of the minimum and maximum statistics which correspond to the bidimensional quality index of this asset. Furthermore, we discuss the log-concavity properties of these extreme statistics from some common bivariate probability models in the valuation methodologies, which may be usefulness to assign a probability model for the market value.

This is a joint research with Manuel Franco, Rafael Herrerías and José Callejón.

9. Mathematics Education

Statistical Literacy: challenges for teaching and research

BATANERO BERNABÉU, CARMEN
UNIVERSIDAD DE GRANADA (SPAIN)

The ability to understand and critically evaluate statistical results is essential in the information society, yet psychological research has shown that many adults, even those that we can consider to be statistically well trained, tend to make erroneous stochastic judgements in their day to day life. These errors also extend to problems posed in a teaching setting or in professional use of statistics and have been widely documented in relation to concepts such as randomness, compound probability, association in contingency tables, conditional probabilities, Bayes problems and sampling (Kahneman, Slovic, & Tversky, 1982; Sdlemeier, 1999).

In this presentation we first describe statistical literacy as a complex construct that includes basic knowledge of statistics, understanding of the scientific approach to the study of phenomena, and ability to make use of statistical skills to cope with the practical demands of everyday life. At the same time positive attitudes, valuation of the role of statistics in modern society and a critical stance to the use of data in supporting an argument are critical components of statistical literacy (Gal, 2002, in press)

Secondly we will propose the audience some examples of situations such as screening medical tests or reading statistical information in media reports where statistical reasoning should be applied to come to a conclusion. Participants will be given the chance to test their intuitions against the mathematical solutions of the tasks and revise their conclusions in case they are mislead in their first approach.

Even when technology has had a major impact in the practice and teaching of statistics in expanding the range of processes that users of statistics can use to collect, analyse, and interpret data it has not solved all the teaching problems. There is an increasing demand for statistics education, since many people can now apply a method with scarce knowledge of the complex mathematical calculation behind the user-friendly software that it is apparently easy to learn. We conclude that statistical literacy is an area that needs more attention from both mathematics teaching and mathematics education research.

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Resolución de problemas de división en educación infantil. Una investigación en curso

BOSCH SALDAÑA, MARÍA ASUNCIÓN
UNIVERSIDAD DE ALMERÍA (SPAIN)

Esta comunicación muestra los resultados parciales de un estudio empírico sobre el desarrollo del pensamiento multiplicativo en los primeros niveles. Concretamente, se han realizado entrevistas a niños de 3er curso de 2 ciclo de Educación Infantil (5 años) en las que se han planteado, mediante situaciones manipulables, varios problemas de división tanto de tipo partitivo como de tipo cuotitivo, así como algunas preguntas sobre razonamiento relacional.

En un primer análisis de las respuestas de los niños, hemos apreciado que aparecen fundamentalmente dos tipos de estrategias de resolución de los problemas planteados. Así, al problema en el que se pregunta por el multiplicando aparecen respuestas en las que se aprecian estrategias de conteo, con o sin uso de unidades múltiples, mientras que ante el problema en que la incógnita es el multiplicador, las estrategias que utilizan los niños son principalmente de estimación, tanto en cálculo como en medida. También hemos descubierto que los problemas de tipo partitivo se muestran significativamente más complicados que los de tipo cuotitivo, así como que para grupos de dos o tres objetos, los niños generalmente usan la subitización, mientras que para grupos de 4 o más objetos los niños suelen contar. Asimismo no hemos obtenido ninguna relación directa entre la madurez de conteo (para la medida de la cual se hace una entrevista paralela) y la resolución exitosa de los problemas planteados o las estrategias empleadas al resolver los mismos.

Nuevas Tecnologías en la Enseñanza de las Matemáticas

CODINA SÁNCHEZ, ANTONIO
UNIVERSIDAD DE ALMERÍA (SPAIN)

Presentaremos el uso del Aula Virtual para la enseñanza y aprendizaje de las matemáticas con profesores en formación, reflexionando acerca de su pontencial y peligro, así como el papel del docente en el desarrollo de entornos de trabajo virtual.

Resolución de Poblemas

FRÍAS ZORRILLA, ANTONIO
UNIVERSIDAD DE ALMERÍA (SPAIN)

An abstract of this talk will be handed at the congress.

Autoevaluación en Matemáticas

GIL CUADRA, FRANCISCO
UNIVERSIDAD DE ALMERÍA (SPAIN)

En la actualidad existe cierto consenso internacional sobre la naturaleza del aprendizaje matemático: es una construcción personal, se desarrolla en un marco social, adquiere su significado en contextos donde puede usarse y de propósitos para los que es útil. Sustentándose en estos supuestos la evaluación supone: el establecimiento de un contrato didáctico operativo en el aula, juega un papel en la determinación de las competencias de los alumnos y tiene influencia en la instrucción y en los aprendizajes posteriores. Hay estrategias de evaluación que encarnan mejor estos principios, entre

las que se incluye la autoevaluación (Clarke, 1996). En este tema hay que distinguir la autoevaluación (establecer citerior de evaluación) de la autocalificación (ponerse una nota). En este trabajo se analizan las ventajas y los inconvenientes de seguir un proceso de autoevaluación en matemáticas. Se discuten aspectos como la interiorización de criterios de juicio, la motivación, su valor formativo, la retroalimentación, la relaciones de "poder" y el stress.También se compara con otras técnicas como la evaluación por compañeros y se extraen consecuencias para la práctica de la autoevaluación en matemáticas.

Importance of mathematics in school

HAMMED ABIODUN, AZEEZ
LAGOS STATE COLLEGE OF EDUCATION (GAMBIA)

Mathematic as a core subject in universities and colleges.

Profesores de matemáticas de secundaria en formación y algunas preguntas utilizadas en el estudio PISA

MORENO CARRETERO, MARÍA FRANCISCA
UNIVERSIDAD DE ALMERÍA (SPAIN)

El conocido como informe PISA, Programme for Internacional Student Assessment, es un estudio internacional de evaluación promovido por la OCDE que se realiza cada tres años: 2000, 2003, 2006. Examina las competencias de los alumnos de quince años en Matemáticas principalmente (en el año 2003), y también en Lectura, Ciencias y el área transversal de Solución de problemas. El foco de evaluación del programa se centra en cómo los estudiantes pueden utilizar lo que han aprendido en situaciones usuales de la vida cotidiana y no sólo, ni principalmente, en conocer qué contenidos del currículo han aprendido. Esto es, se considera el modo en que los sistemas educativos preparan a los estudiantes de 15 años para desempeñar un papel como ciudadanos activos. A primeros de diciembre de 2004 se hizo público el informe Learning for tomorrows world: first results from PISA 2003 y los resultados obtenidos por nuestro país aportaron nuevos argumentos al antiguo debate sobre la situación de nuestro sistema educativo. En el caso concreto de las Matemáticas, PISA incide en la Alfabetización Matemática (Mathematical Literacy), entendida como: la capacidad individual para identificar y entender el papel que las matemáticas tienen en el mundo, hacer juicios bien fundados y usar e implicarse con las matemáticas en aquellos momentos en que se presenten necesidades en la vida de cada individuo como ciudadano constructivo, comprometido y reflexivo. Al comenzar el curso 2004/05 se disponía de una reciente publicación del INECSE: Aproximación a un modelo de evaluación: el proyecto PISA 2000, donde se planteaban algunas preguntas utilizadas en PISA 2000, respetando su agrupación original en forma de unidades (11 de lectura, 5 de matemáticas y 2 de ciencias). Para cada pregunta se acompañaban los criterios de corrección, el grado de dificultad y el porcentaje de aciertos obtenido por los alumnos españoles.

Dado que el planteamiento implícito en este informe sobre la alfabetización matemática no tiene necesariamente que corresponderse con el tratamiento de las matemáticas en secundaria, se decidió indagar la reacción de los futuros profesores de matemáticas al enfrentarse a estas tareas. Para ello se diseñó una actividad con los estudiantes que cursaban, en el curso 2004/05, las siguientes asignaturas en la universidad de Almería:

- Didáctica de la Matemática en la Educación Secundaria, optativa de la Licenciatura de Matemáticas, 4.5 créditos, y
- Didáctica de las Matemáticas, módulo teórico del Curso de Aptitud Pedagógica, 30 horas.

En este trabajo se describe el diseño y el desarrollo de la actividad y se resumen los principales resultados encontrados.

NÚMEROS NEGATIVOS EN ESPAÑA DURANTE EL SIGLO XVIII: EVOLUCIÓN DE UN CONCEPTO EN LOS LIBROS DE TEXTO (MAIN TALK)

RICO ROMERO, LUIS
UNIVERSIDAD DE GRANADA (SPAIN)

La evolución de los conceptos matemáticos pone de manifiesto que las matemáticas son parte importante de la cultura. En cada época apreciamos la integración de nuevas ideas, reconocemos nuevos modos de transmisión de conceptos y destacamos la constitución de estructuras complejas racionalmente coherentes, útiles para estudiar y controlar fenómenos físicos y sociales, así como para abordar los problemas que surgen del ambiente intelectual y científico de cada periodo histórico.

La España del siglo XVIII es un periodo de fuertes cambios políticos, que comienza con un cambio de dinastía y concluye con una crisis derivada de la Revolución Francesa y la Guerra de la Independencia. La actividad intelectual en España durante el siglo XVIII experimenta cambios importantes, cambios en las instituciones educativas y en el papel de las universidades. La expulsión de los jesuitas y el desarrollo de grupos profesionales, universitarios y militares en España durante la Ilustración afectan a la actividad y a la enseñanza matemática en España durante el siglo XVIII.

La evolución cultural muestra que los conceptos matemáticos evolucionan de acuerdo con su época, permite explicar porqué se estabilizan durante determinados periodos y cómo se modifican ante nuevos retos intelectuales, técnicos o teóricos.

Los números negativos son uno de los conceptos que evolucionan en Europa en esta época. La Geometría de Descartes, la Enciclopedia de D'Alambert, tratados de Álgebra de autores como Euler y la obra de Kant, contribuyen a la interpretación de los negativos y a su progresiva formalización durante el siglo XVIII, con influencia contrastada en España. ¿Cómo nos hablan los textos de los números negativos? Las nociones de cantidad y número en los libros de matemáticas españoles del siglo XVIII contribuyen a interpretar distintas nociones de cantidad negativa y de número negativo presentes en los libros de texto de matemáticas. Una selección de autores y su ubicación en la época, muestra cómo la evolución del concepto de negativo está vinculada con el contexto social, político, intelectual y científico del momento. Nociones aritméticas y algebraicas centrales en esta interpretación son las de cantidad y fenómeno, número natural y representación, cualidad de una cantidad y tipos de números, orden y operación, secuencia, ecuación y estructura.

En este trabajo se presentan los resultados de un estudio realizado sobre un grupo significativo de libros de texto escritos por matemáticos españoles del siglo XVIII, en el contexto de su época, vinculados con las corrientes filosóficas, escuelas matemáticas y movimientos educativos del momento; también mostramos su cercanía con sus tareas profesionales, actividades ciudadanas y compromisos políticos. Un análisis conceptual sobre las principales ideas matemáticas, junto con un análisis de contenido de los textos, muestran la evolución del concepto de número negativo, enmarcado en la evolución intelectual y cultural de este siglo.

LA TUTORÍA DE TRABAJOS EN DIDÁCTICA DE LAS MATEMÁTICAS Y DIDÁCTICA DE LAS CIENCIAS A ALUMNOS UNIVERSITARIOS. UNA EXPERIENCIA DE INNOVACIÓN SISTEMÁTICA

ROMERO, ISABEL
UNIVERSIDAD DE ALMERÍA (SPAIN)

La formación didáctica del profesorado universitario español de Matemáticas y de Ciencias queda reducida al interés personal por la calidad de su enseñanza y, en la mayoría de los casos, suele ser autodidacta. Son escasas las propuestas de autoformación colectiva en el ámbito universitario. De ahí el interés en presentar la que estamos llevando a cabo, conjuntamente, un equipo de profesores de Didáctica de la Matemática y de Didáctica de las Ciencias Experimentales de la Universidad de Almería, en el marco del Proyecto Andaluz de Formación del Profesorado Universitario.

El proyecto, que lleva por título "Las tutorías: otra forma de enseñar en la Universidad", responde a varios objetivos de los profesores que lo integran. Por una parte, a al objetivo de fomentar en los alumnos universitarios competencias, como la indagación sistemática, la resolución de problemas profesionales, la conexión de conocimientos interdisciplinares, la ampliación del currículo siguiendo los propios intereses, etc., que con la metodología de enseñanza predominante no tienen ocasión de desarrollarse. Por otra parte, a la finalidad de preparar el terreno a la convergencia con el Espacio Europeo de Educación Superior, en el que el trabajo autónomo de los estudiantes y el papel de guía del profesor se ven potenciados. Y por último, pero no menos importante, al propósito de dotar de contenido al espacio dedicado a la acción tutorial, que hasta ahora viene suponiendo en nuestro sistema universitario alrededor del 43% de nuestra actividad docente, frente al 57% de docencia en clases presenciales.

La actividad que venimos realizando responde a una metodología de innovación sistemática (Petrucci y Campannini, 2002), por cuanto resume el trabajo en equipo interdisciplinar e internivelar, basado en el análisis continuo y periódico, que apunta a evaluar y mejorar los resultados de la tarea docente y a sentir la satisfacción en el proceso de trabajo. La sistematización suele ser una de las características de la investigación; sin embargo, ésta no se convierte en el objetivo primordial del grupo docente, cuya finalidad no es generar conocimiento nuevo en el marco de la comunidad científica, sino discutir y resolver problemas profesionales que se plantean en nuestras aulas.

En la actualidad, el grupo se encuentra en el segundo año de andadura y funciona a base de reuniones periódicas semanales, en las que, colectivamente, hemos delimitado problemáticas e intereses conjuntos, así como modos de proceder. Al final del primer año, perfilamos una Guía general para tutorar trabajos de didáctica de las Matemáticas y Didáctica de las Ciencias a nuestros alumnos. Dicha Guía tenía como propósito servir de marco para estructurar y dar cabida a los diversos tipos de trabajos que estábamos realizando de modo informal y a los que nos proponíamos realizar en el siguiente curso. Este año hemos llevado a cabo nuestras primeras experiencias siguiendo la organización planeada, hemos observado y analizado los resultados y hemos realizado reformulaciones para tener en cuenta en las sucesivas puestas en práctica. Dichas experiencias han sido realizadas por pares de profesores del grupo, dos de ellas en asignaturas de Didáctica de las Matemáticas, en los niveles de Infantil y Primaria, y otra en colaboración por las profesoras de Didáctica de las Matemáticas y de las Ciencias Experimentales para un grupo de maestros de Primaria en formación.

La Guía y las experiencias mencionadas, junto con una valoración de la experiencia de autoformación e implicaciones para el futuro serán compartidas en la presentación oral.

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POLYGONS, MATRICES AND INVERSES. COULD BE CONNECTED?

TADEU, PEDRO
INSTITUTO POLITÉCNICO DE BRAGANÇA (PORTUGAL)

Thought times teaching and learning Geometry as been considerate a difficult job, many teachers and students share that difficult. Starting from this point we begin an investigation that intent to desmitify that idea, it is easy to be involved by the sense of experimentation, innovation and creation. Using new technologies, such a computer and more concrete the program MatLab we construct a new kind of polygons, namely circulant descending and ascending polygons. This concept of polygon appears thanks to the close connection of Geometry and Linear Algebra.

Starting from a regular polygon with n vertices and a determinate circulant matrix, we find the circulant descending polygons, in other way using the same polygon and the pseudo-inverse of a circulant matrix we find the ascending circulant polygons.

There are relations linking this polygons, areas and perimeters, between the circulant ascending and descending polygons. As curiosity we construct some interesting figures such the known Sierpinski fractal and the original Circulant Carpets.

Geometry is firmly connected to the study of space and shapes, this study could be conducted with the help of a computer, using programs such Cabri-Geometre, MatLab or Mathematica. This programs gives the necessary experimentations to involve the student in the discovery of relations, in the test of conjectures and more important it creates a critic mind. We think that investigations of this type are very important to development the realization of experiences in the classroom and/or in Maths labs.

The work presented here, were the strategies have a significant role, show a new approach to the teaching and learning of Geometry, we previlegy the test of hypothesis, conjectures are made from the usage of programs and the ideas are discussed by the feedback offer from the computer, until stable properties appears.

Posters

1. Algebras and their Representations

Maximal left quotient rings for graded associative structures

ARANDA PINO, GONZALO
UNIVERSIDAD DE MÁLAGA (SPAIN)

The notion of left quotient ring, introduced by Utumi in 1956, is a widely present notion in the mathematical literature. Several authors have studied graded rings and modules of quotients from a categorical point of view and considering unital rings. In this work we develop a theory in the non-unital case and construct the graded maximal left quotient algebra of every right faithful algebra as the direct limit of graded homomorphisms of left A-modules from graded dense left ideals of A into an arbitrary graded left quotient algebra B of A. In the case of a superalgebra, and with some extra hypotheses, we prove that there exists an algebra isomorphism between the neutral component of the maximal graded algebra of quotients and the maximal algebra of quotients of the neutral element of the algebra. These results can be applied to the context of associative pairs and triple systems.

1. Algebras and their Representations

6−dimensional 2−filiform Leibniz algebras

CAMACHO, LUISA M.
UNIVERSIDAD DE SEVILLA (SPAIN)

The knowledge of the naturally graded algebras for a family of no associative algebras is important because it contributes to obtain relevant information about the structure of the family, about its irreducibles components and about some cohomologic problems. It is well known the classification of naturally graded p-filiform Lie algebras [6], [5], [3]. The Leibniz algebras appear as generalizations of the Lie algebras, so it is waited that the naturally graded algebras will play an important role in the study of the Leibniz algebras. Considering that it only exists one single algebra 0-filiform [1] the study only has sense if $p \geq 1$. The case 1-filiform was studied in [2]. The case $p = 2$, that is, the naturally graded 2-filiform Leibniz algebras, has been studied too ([4]) obtaining that in each dimension there exist two Leibniz non Lie algebras, non splits and non isomorphic. Now, by using software *Mathematica*, we apply the obtained results for naturally graded 2-filiform Leibniz algebras to classify the 2-filiform Leibniz algebras of dimension 6.

This is a joint research with J. R. Gómez, A. J. González and B. Omirov

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1. Algebras and their Representations

Models of E_8

DRAPER FONTANALS, CRISTINA
UNIVERSIDAD DE MÁLAGA (SPAIN)

If h is a reductive maximal rank subalgebra of a simple Lie algebra L, the decomposition of L as a sum of h-irreducible modules provides a grading of L over an abelian group in such a way that the nonzero components of the grading, L_g, are irreducible submodules. Moreover, the set of homomorphisms $Hom(L_g \otimes L_h, L_{g+h})$ is generated by the projection of the bracket in L; so that we can recover the bracket in L from the homomorphisms between the components.

We apply the above to give models of the exceptional Lie algebra E_8 based on its semisimple subalgebras of rank 8.

In particular we give expressions of the homomorphisms between the tensor products of the D_n-modules of the spin and natural types, and among the basic modules for A_n.

1. Algebras and their Representations

Lie algebras with d.c.c. on principal inners ideals

GÓMEZ LOZANO, MIGUEL ÁNGEL
UNIVERSIDAD DE MÁLAGA (SPAIN)

In this work we give a definition of socle for nondegenerate Lie algebras which is only based on minimal inner ideals. The socle turns out to be an ideal of the whole algebra, and it is sum of simple components. All the minimal inner ideals contained in a simple component are conjugated under elementary automorphisms, which allows us to associate a division Jordan algebra to any of the simple component containing abelian minimal inner ideals. All Classical Lie algebras coincide with their socles, while relevant examples of infinite dimensional simple Lie algebras with socle can be found within the class of finitary Lie algebras. The notion of socle is compatible with the associative and Jordan definitions of socle, and satisfies the descending chain condition on principal inner ideals. Furthermore, we give a structure theory for nondegenerate Lie algebras containing abelian minimal inner ideals, and show that a simple Lie algebra over an algebraically closed field of characteristic zero is finitary if and only if it is nondegenerate and contains nonzero reduced elements; i.e., contains one-dimensional inner ideals.

1. Algebras and their Representations

An application of natural graduation of Leibniz algebra

GONZÁLEZ REGAÑA, ALFONSO J.
UNIVERSIDAD DE EXTREMADURA (SPAIN)

An abstract of this poster will be handed at the congress.

1. Algebras and their Representations

Lie groups associated with solvable Lie algebras of dimension ≤ 3

MORALES LÓPEZ, MARÍA DOLORES
UNIVERSIDAD DE SEVILLA (SPAIN)

In this talk we will start from a result stating that every solvable Lie group can be represented as a matrix Lie group formed by square upper-triangular matrices with exponential elements in their main diagonal. However, that result does not specify which is the minimum order of the matrix involved. This is the aim of this talk: to find among the matrix representations of a solvable Lie group that which is of the minimum order. We will deal with simply connected solvable Lie groups of dimensions two and three.

For it, we merely will not compute the minimum matrix order for each simply connected solvable Lie group, but we will search and compute a matrix representation for each of these simply connected Lie groups by using matrices as the previously described.

This is a joint research with J. C. Benjumea, M. D. Morales, J. Núñez and A. F. Tenorio.

1. Algebras and their Representations

Maximal abelian dimensions of nilpotent Lie algebras

TENORIO VILLALÓN, ANGEL FRANCISCO
UNIVERSIDAD PABLO DE OLAVIDE (SEVILLA) (SPAIN)

In this paper we study abelian Lie algebras considered as Lie subalgebras of the Lie algebra $\mathfrak{g}$ associated with a certain simply connected Lie group G. Indeed, we wish to know how many non-isomorphic abelian Lie algebras can be obtained as Lie subalgebras of the Lie algebra $\mathfrak{g}$. Since there only exists one non-isomorphic abelian Lie algebra for each dimension, we can reduce the above mentioned problem to compute the greatest possible dimension of an abelian Lie subalgebra of the Lie algebra $\mathfrak{g}$.

We deal with the Lie groups G_n (with $n \in \mathbb{N}$) formed by square upper-triangular matrices of order n and whose elements in the main diagonal are "1". These groups are used in Representation Theory, since every nilpotent simply connected Lie group can be represented as a Lie subgroup of some Lie group G_n. Hence, every nilpotent Lie algebra can be represented as a Lie subalgebra of some Lie algebra $\mathfrak{g}_n$ associated with G_n.

In this way, the main goal of this paper is to compute the value of the dimension previously commented for every $\mathfrak{g}_n$ and to determine the maximal abelian dimension in such a Lie algebra. For the maximal abelian dimension of a Lie algebra we mean the greatest dimension of an abelian Lie subalgebra which is contained in this Lie algebra.

We also show in the paper an algorithm which allows us to obtain an abelian Lie algebra whose dimension is precisely the one that we think it is the maximal abelian dimension in the Lie algebra $\mathfrak{g}_n$. This algorithm depends on the parity of the order n of $\mathfrak{g}_n$.

Besides, we briefly give the scheme used to prove the impossibility of finding an abelian Lie subalgebra whose dimension is one unit greater than the indicated in the mentioned algorithm. Such a proof requires the previous introduction of the concept of main fields of the abelian Lie subalgebra.

This is a joint research with J. C. Benjumea, F. J. Echarte and J. Núñez.

2. Geometry and Topology

On semifields

BANI ATA, MASSHHOUR
UNIVERSITY OF MUTAH (JORDAN)

The aim of this work is to construct examples of semifields admitting free automorphism groups of the form $\mathbb{Z}_2 \times \mathbb{Z}_2$.

2. Geometry and Topology

the Witten genus and quasimodular forms

GÁLVEZ, IMMA
LONDON METROPOLITAN UNIVERSITY (UNITED KINGDOM)

We are going to consider the Witten genus as originally defined in the 80's. We observe that each of its coefficients makes sense whenever it is computed for a Spin manifold. We consider its image in the ring of quasimodular forms as defined by Zagier. This is a very interesting differential ring and has many good properties. The values of the genus have been studied in other works, and moreover we have recently found some more nice combinatorics associated to it. Questions about the relation between this invariant and other invariants taking values in the ring of quasimodular forms will be raised.

Along the lines of Landweber, Ravenel and Stong, a generalized cohomology theory associated to this genus can be constructed using some localization. Of course, this is to be closely related to complex oriented modified versions of topological modular forms spectra. The "theorem of the cube" holds as well for this genus. Cooperations are obtained as integral divided congruences, and their generating series satisfies differential equations, in particular a very simple PDE in terms of the modular parameter. Adams and Hecke operations make sense, and there is more room for "Ramanujan" operators than in elliptic cohomology...

2. Geometry and Topology

A new characterization of Gromov hyperbolicity

TOURÍS, EVA
UNIVERSIDAD CARLOS III DE MADRID (SPAIN)

We try to find conditions which guarantee whether or not a metric space is hyperbolic in the Gromov sense. We are going to show two different ways to approach the problem of Gromov hyperbolicity. On the one hand, we obtain global information about Gromov hyperbolicity of a metric space from local information. And, on the other hand, we thought the following question: Is there any privileged kind of triangle in which it is sufficient to check Rips condition? The answer is yes. In fact, in the context of Riemann surfaces, we have got a new characterization for Gromov hyperbolicity.

3. Approximation, Special Functions and Numerical Analysis

Ajuste de cocientes de mortalidad

ABAD MONTES, FRANCISCO
UNIVERSIDAD GRANADA, SPAIN

HUETE MORALES, MARÍA DOLORES
UNIVERSIDAD DE GRANADA, SPAIN

VARGAS JIMÉNEZ, MARAVILLAS
UNIVERSIDAD GRANADA, SPAIN

El trabajo pretende analizar el modelo usualmente utilizado para el ajuste de cocientes o probabilidades de muerte en tablas de mortalidad(funciones con un gran número de parámetros) con otros modelos más recientes con menos parámetros, incluyendo además el tiempo como factor que permita analizar la evolución temporal de dichos parámetros.

3. Approximation, Special Functions and Numerical Analysis

Aproximative Construction of primitives of $L^2(R)$ in $L^2(R)$

AGUD-ALBESA, LUCÍA
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

Let $f \in L^2(\mathbb{R})$, we are going to build a new differentiation operator and a new special family for associating suitable primitives for any function of L^2. Also, we show one construction of functions of L^2 whose derivatives approach an arbitrary function of integrable square. We will call ϵ-primitives to functions with this property. This construction will provide us a density result too.

3. Approximation, Special Functions and Numerical Analysis

Weighted Sobolev Spaces on curves

ÁLVAREZ GONZÁLEZ, VENANCIO
UNIVERSIDAD DE MALAGA (SPAIN)

In this paper we present a definition of weighted Sobolev spaces on curves and find general conditions under which the spaces are complete for non-closed compact curves. We also prove the density of the polynomials in these spaces and, finally, we find conditions under which the multiplication operator is bounded in the space of polynomials.

3. Approximation, Special Functions and Numerical Analysis

Application of the discrete wavelet transform for the diagnosis of rotor bar breakages in induction machine

ANTONINO DAVIU, JOSÉ ALFONSO
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

An application of the wavelet multiresolution analysis is used for the diagnosis of rotor bar failures in electrical machines. More precisely, we develop numerical methods based on the approximation signal, at certain level, of the startup stator current, with respect to a Daubechies wavelet family. Our main purpose with this method is to discriminate between healthy and faulty machines and, in the second case, to quantify the degree of the fault's severity.

This is a joint research with Martín Riera Guasp, Alfredo Peris Manguillot and Félix Martínez Giménez.

3. Approximation, Special Functions and Numerical Analysis

Rational approximation and orthogonal polynomials

BELLO HERNÁNDEZ, MANUEL
UNIVERSIDAD DE LA RIOJA (SPAIN)

We show a density theorem for rational functions in the H^p space for a rectifiable Jordan curve. A particular attention is given to rational functions whose denominators are orthogonal polynomials.

3. Approximation, Special Functions and Numerical Analysis

Zero asymptotics of orthogonal polynomials and the Lauricella function $F_D^{(5)}$

MARTÍNEZ GONZÁLEZ, PEDRO
UNIVERSIDAD DE ALMERÍA (SPAIN)

ZARZO ALTAREJOS, ALEJANDRO
UNIVERSIDAD POLITÉCNICA DE MADRID (SPAIN)

The asymptotic contracted measure of zeros of a large class of orthogonal polynomials $\{Pn(x)\}_{n=1}^{\infty}$ is explicitly given in the form of a Lauricella function $F_D^{(5)}$. The polynomials P_n are defined by means of a three-term recurrence relation whose coefficients may be unbounded but vary regularly and have a different behavior for even and odd indices. Several previous findings of a number of authors are found as particular cases. Subclasses of systems of orthogonal polynomials having their contracted measure of zeros of regular, uniform, Wigner, Weyl, Karamata and hypergeometric types are explicitly identified. Some illustrative examples are given.

3. Approximation, Special Functions and Numerical Analysis

Optimization codes for designing optical fibers. Deterministic and Monte Carlo procedures

MONREAL MENGUAL, LLÚCIA
UNIVERSIDAD POLITÉCNICA DE VALENCIA (SPAIN)

The search of an optical fibre of optimal characteristics is interesting to improve the transmission and to diminish losses and we handle and design optimization codes for this purpose. The necessity of developing such optimization algorithms is due to the complexity of the kind of the optimizing fibres: the photonic crystal fibres -that constitute the last optical fibre generation and it is supposed that they will render a high technological impact in the next years. This design requires, in first place, the definition of the required properties and, secondly, the development of an automatic numerical procedure to select the parameters that determine the ideal fibre. Our group is facing this objective using both deterministic and heuristic (Monte Carlo) procedures. We define and study a set of algorithms, stressing the analysis of CPU time of the codes.

3. Approximation, Special Functions and Numerical Analysis

Iterative diffusion image denoising controlled by Shannon–Wiener entropy approximations

RODENAS ESCRIBA, FRANCISCO
UNIVERSIDAD POLITECNICA DE VALENCIA (SPAIN)

Different methods based on the use of nonlinear diffusion equations have been proposed for image restoration from noisy images (see [1] and references therein). We report here our work on the use of a particular nonlinear diffusive filter that gives account of the distance between the original and the restored image. We evaluate the possibility of using the Shannon–Wiener differential entropy of the image to develop an automatic stopping criterion for the image restoration process.

The diffusion equation employed must be spatially and temporally discretized to be applied to the digital images. We select an standard spatial discretization and for the time discretization we use an additive operator splitting (AOS) scheme [2,1], which has some advantages from the computational point of view.

The model for noisy images is: let f be the observed image and let us assume that $f = \tilde{f}+n$, being $\tilde{f}$ a noise-free image n a noise signal ($n \sim N(0,\sigma)$). The initial point of the diffusion process is the observed image $f = u(0)$ and the iterative filtering produces a family of images $u(t)$ $(t = 0, 1, 2...)$. An ideal diffusion filter which works optimally for a denoising task would first eliminate the noise before significantly affecting the signal. One should choose the stopping time T such that the restored image is as near to the free-noise image as possible, this means that the euclidean distance $\|u(T) - \tilde{f}\|$ is as small as possible.

In this work we propose a method to select the stopping time based on the Shannon-Wiener differential entropy of the difference $(f - u(t))$. Let us consider the series $(f - u(t))$, $(t = 0, 1, 2...)$, each term is a estimation of the 'noise' signal, then it is reasonable that the stopping time maximizes the gaussianity of the $(f - u(t))$. Using the entropy as the measure of the gaussianity, the stopping time can be chosen as the time that maximizes the entropy of the 'noise' $(f - u(t))$.

Computationally, the entropy is easily estimated by using the approximations of the Shannon-Wiener entropy function introduced by Hyvärinen in the context of independent component analysis [3].

The proposed method has been evaluated in experiments. The results show that entropy criterion is a valid and robust method to estimate the stopping time in the diffusion process and the performance of the denoising method is very satisfactory.

This is a joint research with F. Rodenas, P. Mayo, D. Ginestar and G. Verdú.

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[3] A. Hyvärinen, Advances in Neural Information Processing Systems, no. 10 (1998), pp. 273–279.

3. Approximation, Special Functions and Numerical Analysis

Weierstrass' theorem with weights

RODRÍGUEZ, JOSÉ MANUEL
UNIVERSIDAD CARLOS III DE MADRID (SPAIN)

We characterize the set of functions which can be approximated by continuous functions in the L^∞ norm with respect to every weight. This allows to characterize the set of functions which can be approximated by polynomials for any weight with compact support.

4. Functional Analysis and its Applications

Estimates for solutions of some classes of second order differential equations

ARTAMONOV, NIKITA
MOSCOW (RUSSIAN FEDERATION)

The second order differential equation

$$u''(t) + (B + iD)u'(t) + (T + iS)u(t) = 0$$

in Hilbert space is considered. Under some conditions on (in general case unbounded) operators T, S, B and D the correct solvability of Cauchy problem on semiaxes in "energy" space is proved and nonimproved estimates for solutions are obtained.

4. Functional Analysis and its Applications

On locally convex H^*-triple systems

CALDERÓN MARTÍN, ANTONIO J.
UNIVERSIDAD DE CÁDIZ (SPAIN)

We introduce and study locally convex H^*-triple systems as the natural ternary extension of locally convex H^*-algebras and classical H^*-triple systems. The classes of locally convex H^*-algebras and classical H^*-triple systems are both extensions of classical (Ambrose) H^*-algebras.

5. General Topology and its Applications

Exponentiable monomorphism in the category of DCPO

CAGLIARI, FRANCESCA
BOLOGNA UNIVERSITY (ITALY)

A poset D is said to be a directed complete poset, or *dcpo*, if every directed subset of D has a supremum. A map $f : D \to D'$ is continuous if it preserves suprema of directed subset.

The category **DCPO**, so obtained has power objets, that is the poset of the continuous maps between D and D' is again a *dcpo*. This means that the category **DCPO** is cartesian closed.

In other words, for any object D in **DCPO** the endofunctor $- \times D : \mathbf{DCPO} \to \mathbf{DCPO}$ has a right adjoint $:-^D$.

Unfortunately $\mathbf{DCPO}/B$ fails to be local cartesian closed. In fact, when we consider the sliced category $\mathbf{DCPO}/B$, whose object are the continuous maps with codomain B, we find that the endofunctor $- \times f : \mathbf{DCPO}/B \to \mathbf{DCPO}/B$ not always has a right adjoint.

We characterize those object $f : D \to B$ in $\mathbf{DCPO}/B$ which are monomorphism and such that the endofunctor $- \times f : \mathbf{DCPO}/B \to \mathbf{DCPO}/B$ has a right adjoint.

5. General Topology and its Applications

Characterizations of closed sets in product spaces

GEORGIOU, DIMITRIS
UNIVERSITY OF PATRAS (GREECE)

In this paper, we characterize different types of closed sets in product spaces by utilizing the notion of upper limit.

This is a joint research with S. Jafari and T. Noiri.

6. Probabilistic Spaces, Copulae and T-norms. Applications

Further results on generalized r-orderings

ORTEGA PASTOR, EVA MARÍA
UNIVERSIDAD MIGUEL HERNÁNDEZ (SPAIN)

Several concepts of generalized orderings and generalized ageing classes have been considered in literature from the r-equilibrium distribution of a renewal process. Applications are developed in reliability, economics or actuarial sciences. In this communication we provide new results about comparisons of excess lifetimes at different times of a renewal process in the sense of some generalized orderings when the underlying distribution belongs to some generalized ageing class. A discussion as well as some interpretations are derived from the results.

This is a joint research with Félix Belzunce, Asok. K. Nanda and José M. Ruiz.

7. Random Models and Design of Experiments

Diseño de investigación en un estudio sobre los juegos mediterráneos en la provincia de Almería

ARTÉS RODRÍGUEZ, EVA MARÍA
UNIVERSIDAD DE ALMERÍA (SPAIN)

Con la finalidad de servir como retroalimentación para el Comité Organizador de los Juegos Mediterráneos Almería 2005, se viene realizando una investigación que tuvo su inicio en el año 2002, y que se ha ido replicando durante los años 2003, 2004 y 2005. Para ello, ha sido elaborado un cuestionario entre un grupo de investigadores formado por expertos (psicólogos, estadísticos, gestores deportivos, licenciados y doctores en Educación Física), todos ellos pertenecientes al Comité Organizador de los JJMM Almería 2005 (COJMA) y/o a la Universidad de Almería (UAL), en el marco de un convenio firmado entre dichas Instituciones. De este modo, el estudio longitudinal puede analizar cómo percibe el ciudadano la evolución, incidencia y repercusión de los cambios en las infraestructuras de la provincia, así como la imagen externa del COJMA. Existen dos objetivos generales en esta investigación. El primero es analizar la percepción que los ciudadanos de la provincia de Almería tienen sobre el Proyecto de preparación de los Juegos Mediterráneos del año 2005: conocimientos, intereses, actitudes, comportamientos y expectativas de dicha población, con respecto a la preparación del evento. El segundo gran objetivo general es conocer los hábitos de práctica físico-deportiva de los ciudadanos almerienses. En este sentido, el propósito ha sido conocer si la organización de un gran evento deportivo puede favorecer un impulso de la práctica del deporte para todos. El objetivo de la presente investigación determina que la información recogida mediante la encuesta se centre en cuatro poblaciones objetivo: la primera ha sido Almería capital y Huércal de Almería, la segunda está formada por las Subsedes de los JJMM 2005 (El Ejido, Roquetas de Mar, Cuevas del Almanzora,

Gádor y Vícar), la tercera considera el resto de los pueblos de la Provincia de Almería, y finalmente toda la Provincia de Almería (suma de las tres anteriores). El diseño de muestreo que se ha aplicado en la investigación ha sido estratificado por distrito censal, edad y sexo (con afijación proporcional), y, en segunda etapa, por rutas aleatorias. Ha sido similar en cada una de las tres poblaciones objetivo principales (Almería y Huércal de Almería, Resto de Subsedes de los JJMM Almería 2005 y Resto de la Provincia de Almería), aunque con ligeras modificaciones que comentaremos con detalle en nuestro artículo. La muestra para toda la Provincia de Almería se obtuvo a partir de las tres submuestras anteriores. En cuanto al tamaño de las muestras seleccionadas, en cada estudio ha estado en torno a 1100 sujetos, con un nivel de confianza del 95% y un error de muestreo aproximado de ±3%. El trabajo de campo ha sido llevado a cabo por un conjunto de encuestadores que previamente hemos formado por un seminario específico, y han empleado el método de la entrevista personal para la recogida de la información. Para la fase de tratamiento estadístico de los datos, y depuración de los mismos se ha utilizado el paquete informático SPSS/PC (V. 12). Finalmente, todo el conjunto de conclusiones obtenidas en el informe, e hipótesis comprobadas, están basadas en un profundo análisis estadístico de los datos, donde se han aplicado desde técnicas descriptivas y exploratorias, hasta técnicas inferenciales y correlacionales, como el análisis de correspondencias, que nos permiten extrapolar las relaciones observadas entre variables y otros resultados obtenidos, a toda la provincia de Almería.

7. Random Models and Design of Experiments

Wavelet-Vaguelette Spatio-Temporal Estimation

FERNANDEZ-PASCUAL, ROSAURA
UNIVERSITY OF JAEN (SPAIN)

The least-squares linear estimation problem is considered for a class of spatiotemporal processes affected by additive fractal noise. Conditions under which the integral equations involved have a stable inversion are studied. A solution is then derived based on infinite spatio-temporal wavelet-based orthogonal expansions, given in terms of dual Riesz bases obtained from the factorization of the space-time covariance operator. Truncation at specific resolution levels of these orthogonal expansions allow us to obtain the least-squares linear estimate at every location and at any time of interest, for temporal prediction and spatial extrapolation problems.

This is a joint research with M. D. Ruiz-Medina and J. M. Angulo.

7. Random Models and Design of Experiments

Spatiotemporal Models for Generation of Anisotropic Long-Range Dependence

FRÍAS BUSTAMANTE, MARÍA DEL PILAR
UNIVERSIDAD DE JAÉN (SPAIN)

Statistical analysis of spatiotemporal models is of great interest in many areas of application, such as environmental sciences, economics and others. In the past few years, several efforts have been made for the definition of valid spatiotemporal models. A common assumption is the separability of the covariance function, but in real applications spatiotemporal processes are not usually separable. Then an important extension in this context is to consider processes with nonseparable covariance (see, for example, Christakos, 2000).

On the other hand, in several applied fields data often display long-range dependence in space and/or time. Furthermore, the strong dependence can be different in time and in each spatial direction. Hence, new families of parametric models must be introduced in order to represent such

anisotropic behaviors, as extension of isotropic case (see, for example, Anh, Angulo and Ruiz-Medina, 1999, Kelbert, Leonenko and Ruiz-Medina, 2005).

In this work, we introduce a generation procedure of anisotropic long-range dependence for spatiotemporal processes. Self-similarity of the linear filter involved in the generation is controlled through moment conditions assumed on the test functions considered. Such a framework allows the implementation of parameter estimation methods, based on the integrated periodogram, variogram, and wavelet transform. In particular, for the implementation of the periodogram method, a kernel-based second-order generalized approximation is studied. In the spectral domain, a window sequence is constructed, in terms of a resolution of unity, with supports defining a decreasing-ring sequence around the zero frequency. A simulation study is carried out to illustrate the methodology proposed. Final comments and concluding remarks on possible extensions are also given.

This is a joint research with M. D. Ruiz-Medina, J. M. Angulo and F. J. Alonso.

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7. Random Models and Design of Experiments

Generalized estimation of the variance under successive sampling

GARCÍA LUENGO, AMELIA VICTORIA
UNIVERSIDAD DE ALMERÍA (SPAIN)

Different aspects of estimation of change in surveys have been examined including the change in the sampling structure of population as well as the change in the parameters under study. In such surveys, one may be interest in any of the following aspects.

1. The population parameters for the most recent period.
2. Change taking place in the population parameters.
3. The population parameters for the entire period under consideration.

Many times it may be of interest to estimate linear function of variances of several occasions. The estimation of variance for the current occasion, change over occasion, average over all occasions can be shown as particular case of estimation of linear function of the average of occasions. For two occasions let us consider a weighted function of variances of two occasions as $A\sigma_x^2 + B\sigma_y^2$ where $\sigma_x^2 =$ Variance of previous occasion; $\sigma_y^2 =$ Variance of current occasion; A y B are weights.
The particular cases of the proposed generalized estimation are:

If $A = 0, B = -1$ then above expression reduces to σ_y^2 i.e. variance of the current occasion.

If $A = 1, B = -1$ the above expression reduces to the change of variances over two occasions.

If $A = B = 1/2$ then it reduces to the average of variances over two occasions.

It is, therefore, of interest to develope an appropriate estimation procedure in such situations. The usefulness of the results are illustrated with the help of numerical illustration.

This is a joint research with I. Oña Casado.

7. Random Models and Design of Experiments

Calibration approach to estimate the distribution function

MARTÍNEZ PUERTAS, SERGIO
UNIVERSIDAD DE ALMERÍA (SPAIN)

In sample surveys, supplementary population information is often used at the estimation stage to increase the precision of estimators of a population mean or total. The use of auxiliary information for estimating a finite population mean has been extensively studied, but relatively less effort has been devoted to the development of efficient methods for estimating the distribution function.

In the presence of auxiliary information, there exist several procedures to obtain more efficient estimators for the population means and totals, (in particular, customary ratio and regression estimators). Many of these techniques, when applied directly to the estimation of a distribution function, will produce unsatisfactory results. For instance, the ratio and regression type estimators for the distribution function suffer from several drawbacks, the obvious one being that they may not be a distribution function and can take values outside $[0, 1]$.

In this work we propose an estimator for the finite population distribution function using the calibration technique proposed by Deville and Särndal, 1992. This estimator is a genuine distribution function and possesses a number of attractive features which are studied.

For this, we consider a finite population $U = \{1, \ldots, k, \ldots, N\}$, consisting of N different elements. Let $s = \{1, \ldots, n\}$ be the set of n units included in a sample, selected according to a specified sampling design with inclusion probabilities π_k and π_{kl} assumed to be strictly positive. Let y_k be the value of the study variable y, for the kth population element, with which also is associated and auxiliary vector value $\mathbf{x}_k = (x_{k1}, x_{k2}, \ldots, x_{kJ})'$. The values $\mathbf{x}_1, \mathbf{x}_2, \ldots, \mathbf{x}_N$ are known for the entire population but y_k is known only if the kth unit is selected in the sample s.

The finite population distribution function of the study variable y, is given by

$$F_y(t) = \frac{1}{N} \sum_{k \in U} \Delta(t - y_k)$$

with

$$\Delta(t - y_k) = \begin{cases} 0 & \text{if } t < y_k \\ \\ 1 & \text{if } t \geq y_k \end{cases}$$

The distribution function $F_y(t)$ can be estimated by the Horvitz-Thompson estimator, defined by

$$\widehat{F}_{YH}(t) = \frac{1}{N} \sum_{k \in s} d_k \Delta(t - y_k)$$

with $d_k = 1/\pi_k$, the basic design weights.

The estimator $\widehat{F}_{YH}(t)$ is unbiased, but in general, is not a distribution function and does not use the auxiliary information provided by the vector $\mathbf{x}$. We shall modify the estimator $\widehat{F}_{YH}(t)$ to obtain new estimators of $F_y(t)$, replacing the basic design weights d_k by new weights ω_k. This new set of weights is constructed with the calibration techniques proposed by Deville and Särndal 1992.

We consider a new calibration estimator by first defining a new variable $g_k = \widehat{\beta}' \mathbf{x}_k$ for $k = 1, 2, ...N$, where

$$\widehat{\beta} = \left(\sum_{k \in s} d_k q_k \mathbf{x}_k \mathbf{x}_k^{'} \right)^{-1} \cdot \sum_{k \in s} d_k q_k \mathbf{x}_k y_k \qquad (1)$$

is a weighted estimator of the multiple regression coefficient β between y and $\mathbf{x}$.
We then define the calibration estimator

$$\widehat{F}_{yc}(t) = \frac{1}{N}\sum_{k\in s}\omega_k\Delta(t-y_k)$$

where the new weights ω_k are modified from $d_k = 1/\pi_k$ minimizing the chi-square distance measure

$$\Phi_s = \sum_{k\in s}\frac{(\omega_k - d_k)^2}{d_k q_k} \tag{2}$$

with q_k known positive constants unrelated to d_k, subject to the calibration equations

$$\frac{1}{N}\sum_{k\in s}\omega_k\Delta(t_k - g_k) = F_g(t_k) \quad k = 1, 2, \ldots, n \tag{3}$$

where the points t_k; $k = 1, 2, \ldots, n$, are the sample values of the variable g, that is: $t_k = g_k$ for $k = 1, 2, \ldots, n$. Thus, with the new weights w_k we pretend to obtain a calibrated estimator that: (a) Be a distribution function. (b) Be a asymptotic unbiased estimator. (c) Give perfect estimates for the distribution function of the auxiliary variable g, evaluated at the points t_k; $k = 1, 2, \ldots, n$.

Once determined the calibration estimator the following aim of the work is to study the properties that this new estimator presents. Finally, comparisons are made with existing estimators in a simulation study using a natural population.

This is a joint research with M. Rueda, S. Martínez, H. Martínez, and A. Arcos.

7. Random Models and Design of Experiments

El proceso de difusi

NAFIDI, AHMED
UNIVERSIDAD DE GRANADA (SPAIN)

En este trabajo se estudia el proceso estocástico de difusión homogéneo Brennan-Schwartz, que es una generalización del proceso de difusión lognormal homogéneo y que es considerado en la teoría estocástica de Finanzas como Modelo de *Short-term interest rate* y de *Option prices*. Se obtienen en el presente trabajo, a partir de la ecuación de Ito del proceso, las funciones tendencia (condicionada y no condicionada) y se establece una metodología para estimar los parámetros de la tendencia en el base al método de Máxima verosimilitud con muestreo continuo. Se obtiene también una aproximación numérica, por la metodología de Chesney–Elliot, para el coeficiente de difusión (Volatilidad). Mediante el algoritmo de Taylor, se simulan trayectorias del proceso y finalmente se aplica a un ejemplo con datos reales.

7. Random Models and Design of Experiments

Estimación de la mediana poblacional utilizando información auxiliar

OÑA CASADO, INMACULADA
UNIVERSIDAD DE ALMERÍA (SPAIN)

En este trabajo, bajo un diseño de muestreo en dos ocasiones, estimamos la mediana poblacional mediante un estimador combinado compuesto por dos dos estimadores independientes de la mediana:

un estimador de regresión de doble muestreo para la parte apareada de la muestra y un estimador simple de la mediana para la parte no apareada. Determinando los valores que minimizan la varianza de dicho estimador, obtenemos el estimador de la mediana, junto con la expresión de su varianza y la fracción óptima que debe aparearse. Se obtiene la curva que da la ganancia en precisión del estimador propuesto sobre el estimador simple que no utiliza la información sobre la primera ocasión.

This is a joint research with A. V. García Luengo and E. M. Artés Rodríguez.

7. Random Models and Design of Experiments

Confidence intervals for the median based on Edgeworth expansion

ROMÁN MONTOYA, YOLANDA
UNIVERSIDAD DE GRANADA (SPAIN)

A parameter of practical interest is the median of a finite population. The estimation of median in the presence of auxiliary information has received considerable attention recently is sample surveys.

Kuk and Mak (1989) suggested two methods for estimating the finite population median, M_y, when the median of an auxiliary variable x, M_x, is available. Rao et al (1990) obtained ratio and difference estimator and Rueda et al. (2003) obtained an alternative difference estimator for the median in this context. When the population showing a linear relationship between x and y, these indirect estimators perform considerably better than the usual estimator only based on the values of y-variable.

This paper considers median estimation by confidence intervals. To construct confidence intervals it is necessary to estimate their variances. The usual method to obtain confidence intervals for the parameters in finite populations is to proof the asymptotic normality of a estimator, $\hat{M}_y$ and then use an variance estimation, $\hat{V}(\hat{M}_y)$. This estimation provides the standard interval,

$$\left[\hat{M}_y - z_{\alpha/2}\hat{V}(\hat{M}_y), \hat{M}_y + z_{\alpha/2}\hat{V}(\hat{M}_y)\right].$$

This type of intervals have two problems:

1. They use that the asymptotic distribution of estimators are normal which could be inappropriate in many practical situations and also when the considered sample sizes are small.

2. In some occasions it's not possible to obtain a direct estimation of the variances.

The second problem can be resolved by resampling techniques like bootstrapping, jackknifing and pseudosampling (or half replication). Bootstrap methodology (Efron, 1987) gives an important tool to construct confidence intervals parameters without assuming normality suppositions. This technique has a high computational cost, and for quantiles it is not proved that gets an important improve for length of confidence intervals respect standard intervals based on normal distributions.

Another alternative that it's presented to construct confidence intervals is jackknife technique. Jackknife techniques are the resampling method more used actually in practice and they provide an important tool to determine estimators of the variances for quantiles. Román et al (2005) shows that the jackknife intervals for the quantiles (in finite population sampling) have bigger length than standard interval, but he coverage of jackknife interval based on the simple estimator of median (which only use the y values) has smaller converage (it doesn't happen with indirect estimators). This coverage problem for jackknife intervals based on the simple estimator of median, was studied by Kovar, Rao and Wu. (1998), and it's due to the use of normal approximation.

In this work we propose alternative confidence intervals for the population medians which are not based on normal approximations, under simple random sampling. First we determine a bound for the

difference between the studentized (direct and indirect) estimators of median and their empirical Edgeworth expansion, and latter we use the distribution function of these empirical Edgeworth expansion to obtain the correspondent confidence intervals for the median.

This is a joint research with M. Rueda, S. González, A. Arcos, S. Martínez, J. F. Muñoz.

7. Random Models and Design of Experiments

Kernel methods in Bayesian networks

RUMÍ RODRÍGUEZ, RAFAEL
UNIVERSIDAD DE ALMERÍA (SPAIN)

The main problem of hybrid Bayesian networks is the estimation of the (conditional) density functions needed to specify the numerical representation of the network. This paper deals with the use of kernel density estimation as a way to learn these density functions from data. Kernel density estimation methods may be impossible to use in the inference process due to the computational effort required, so we approximate it using Mixture of Truncated Exponential densities. Some experiments are conducted in order to show the benefits of kernel density estimation.

7. Random Models and Design of Experiments

Filtering over time of Spatial Functional Data from POP Analysis

SALMERÓN, ROMÁN
UNIVERSIDAD DE GRANADA (SPAIN)

The problem of diagonalization of autoregressive time series models with spatial functional parameters is studied. The models considered are able to represent the evolution of spatial functional data with time-uncorrelated space-colored measurement errors. Diagonalization of the functional parameters is achieved from POP analysis. The results are applied to solve the filtering problem for the class of space-time statistical models formulated. Simulated numerical examples are given for illustration.

This is a joint research with M. D. Ruiz-Medina and J. M. Angulo.

8. Financial Mathematics and Mathematical Economics

On a class of inverse problems in stochastic optimal control with applications to economics

JOSA FOMBELLIDA, RICARDO
UNIVERSIDAD DE VALLADOLID (SPAIN)

This main concern of the paper is to address the following question: Is it possible to identify an interesting class of stochastic control problems such that the optimal control law is also optimal for the deterministic problem? We can affirmatively answer this question by introducing a new approach to the study of stochastic control problems, which is based in the introduction of a system of PDEs that directly characterize the optimal control. This is an interesting aim, that the classic approach of the Hamilton-Jacobi-Bellman equation can not solve. The results are applied to some classical models appearing in Economics, but the range of application is broader.

8. Financial Mathematics and Mathematical Economics

Two methods for proportional social choice

RAMÍREZ GONZÁLEZ, VICTORIANO
UNIVERSIDAD DE GRANADA (SPAIN)

We show a frequent behavior of the electors in front of the pluripersonal elections corresponding to the Spanish Senate, the Ecuadorian Congress and the 'Juntas de centro' and 'Claustro' of the Spanish Universities. This behavior repeats in many other social choice political process or in others in which the electors have ease to organize themselves and to cast an strategic vote.

As a consequence, we introduce the concept of proportionality in the social choice, and we show two proportional social choice methods. The first one is a Borda-type method. The second one is new. It is an iterative method that choose the winner alternatives one by one by pairwise comparisons following an agenda, and with weights that achieve proportionality.

We make a comparative study of both methods and we analize their properties, like the proportionality in pluripersonal elections and other properties when the method is applied to unipersonal elections.

This is a joint research with Antonio Palomares and María Luisa Márquez.

9. Mathematics Education

Mathematics in the study of Economics

GARCÍA PINEDA, PILAR
UNIVERSIDAD COMPLUTENSE DE MADRID (SPAIN)

NÚÑEZ DEL PRADO, JOSÉ ANTONIO
UNIVERSIDAD COMPLUTENSE DE MADRID (SPAIN)

The aim of this paper is to make a study of the use of Mathematics in different subjects as tools for others subjects in Economics and Business Administration.

Methodology employed: Rasch, based on the techniques of statistics which allows, firstly, to build an objective measure known as *Rasch measure*, of the importance of the different topics studied in Mathematics subjects in the Colleges of Economics and Business Administration; and secondly, to find out based on this measure the use of the different Mathematics topics in the rest of the subjects found in the syllabus programmes of Economics and Business Administration degrees.

9. Mathematics Education

Teaching Statistics on web: a didactic experience from the Project "Aula Virtual" in University Miguel Hernández

ORTEGA PASTOR, EVA MARÍA
UNIVERSIDAD MIGUEL HERNÁNDEZ (SPAIN)

Obtaining a credit system as like ECTS and comparable criteria and methodology are some of the main goals considered by the European Higher Education Area. These aspects are changing the traditional methods in our lecture lessons. The requirement of advanced skilled professionals has led many people to study via web. In this setting, a teaching system via Internet is required to provide students quite autonomy in learning on web, but it also should be an interactive system. In this communication we analyze some features about teaching Statistics in Social Sciences that have to be considered in order to describe the contents and the methodology of the related subjects. We describe a proposal for teaching Statistics in Social Sciences following this methodological focus and we present a didactic experience in the framework of the Project "Aula Virtual" in University

Miguel Hernández for the subject "Methods for Social Research" in Political Sciences degree. The three main tools of the methodological system are e-Tutorials, "Notebook of Learning" and "Units of Learning" on web. An exhaustive description of the structure of "Units of Learning" is provided as well as their objectives. An example of a particular lesson is discussed by means of this methodology. Finally, we comment the advantages of our didactic experience.

This is a joint research with Javier Reig and José L. Ruiz.

List of Participants

ABAD MONTES, FRANCISCO (GRANADA, SPAIN); fabad@ugr.es
ABDELLATIF, ROCHDI (CASABLANCA, MOROCCO); abdellatifroc@hotmail.com
AGUD-ALBESA, LUCÍA (ALICANTE, SPAIN); lagudal@mat.upv.es
AHCENE, DJOUDI (ANNABA, ALGERIA); adjoudi@yahoo.com
AHMADZADEH-RAJI, MEHRDAD (KERMANSHAH, IRAN); mraji@razi.ac.ir, m.raji@ex.ac.uk
AHMED, EL FDIL (RABAT, MOROCCO); ieea20042000@yaho.fr
AHMED OLALEKAN, OBANLA (LAGOS, NIGERIA); obanlaahmola@yahoo.ca
AINOUZ, ABDELHAMID (ALGIERS, ALGERIA); aainouz@usthb.dz
AIZPURU TOMÁS, ANTONIO (CÁDIZ, SPAIN); antonio.aizpuru@uca.es
AKILA, YECHOUI (ANNABA, ALGERIA); a_yechoui@yahoo.fr
ALAIDI, MONTHER (IVANOVO, BELARUS); monther013@hotmail.com
ALFARO, MANUEL (ZARAGOZA, SPAIN); alfaro@unizar.es
ALFARO GARCÍA, MARÍA PILAR (ZARAGOZA, SPAIN); palfaro@unizar.es
ALIMOHAMMADY, MOHSEN (BABOLSAR, IRAN); amohsen@umz.ac.ir
AL-MOMANI, RAID (DOHA, QATAR); raid@yu.edu.jo
ÁLVAREZ DE MORALES, MARÍA (GRANADA, SPAIN); alvarezd@ugr.es
ÁLVAREZ GONZÁLEZ, VENANCIO (MÁLAGA, SPAIN); nancho@anamat.cie.uma.es
ÁLVAREZ ROCHA, IGNACIO (MADRID, SPAIN); igalvar@euitt.upm.es
AMEL, BERHAIL (AIN BEIDA, ALGERIA); berhail_amel@yahoo.fr
AMO ARTERO, ENRIQUE DE (ALMERÍA, SPAIN); edeamo@ual.es
ANGULO IBÁÑEZ, JOSÉ MIGUEL (GRANADA, SPAIN); jmangulo@goliat.ugr.es
ANTONINO DAVIU, JOSÉ ALFONSO (VALENCIA, SPAIN); joanda@die.upv.es
ARA, PERE (BARCELONA, SPAIN); para@mat.uab.es
ARANDA PINO, GONZALO (MÁLAGA, SPAIN); gonzalo@agt.cie.uma.es
ARENAS, FRANCISCO G. (ALMERÍA, SPAIN); farenas@ual.es
ARTAMONOV, NIKITA (MOSCOW, RUSSIAN FEDERATION); nikita.artamonov@rambler.ru
ARTÉS RODRÍGUEZ, EVA MARÍA (ALMERÍA, SPAIN); eartes@ual.es
ASADOLLAHI DEHAGHI, JAVAD (SHAHRE-KORD, IRAN); asadollahi@ipm.ir
ASSIA, GUEZANE-LAKOUD (ANNABA, ALGERIA); a_guezane@yahoo.fr
AZIZI, ABDULRASOOL (SHIRAZ, IRAN); a_azizi@yahoo.com
BALIBREA, FRANCISCO (MURCIA, SPAIN); balibrea@um.es
BANI ATA, MASSHHOUR (MUTAH, JORDAN); mashhour_ibrahim@yahoo.com
BARBULESCU, ALINA (CONSTANTA, ROMANIA); abarbulescu@univ-ovidius.ro
BARRY, MAMADOU (DAKAR, SENEGAL); mamadou.barry@ucad.sn
BATANERO BERNABÉU, CARMEN (GRANADA, SPAIN); batanero@ugr.es
BATÍKOVÁ, BARBORA (PRAGUE, CZECH REPUBLIC); babatikova@yahoo.com
BAUER, INGRID (BAYREUTH, GERMANY); Ingrid.Bauer@uni-bayreuth.de
BAZZONI, SILVANA (PADOVA, ITALY); bazzoni@math.unipd.it

BECERRA GUERRERO, JULIO ANTONIO (GRANADA, SPAIN); juliobg@ugr.es
BECKERMANN, BERNHARD (VILLENEUVE D'ASCQ, FRANCE); bbecker@math.univ-lille1.fr
BELHAJ, ADIL (OTTAWA, CANADA); abelh633@mathstat.uottawa.ca
BELLA, ANGELO (CATANIA, ITALY); bella@dmi.unict.it
BELLO HERNÁNDEZ, MANUEL (LOGROÑO, SPAIN); mbello@dmc.unirioja.es
BELMESNAOUI, AQZZOUZ (KENITRA, MOROCCO); baqzzouz@hotmail.com
BENHISSI, ALI (MONASTIR, TUNISIA); ali_benhissi@yahoo.fr
BENKAFADAR, NASREDDINE (EL KHROUB, ALGERIA); benkafadar@caramail.com
BENKART, GEORGIA (MADISON, UNITED STATES); benkart@math.wisc.edu
BENZINE, RACHID (ANNABA, ALGERIA); Rabenzine@yahoo.fr
BICAN, LADISLAV (PRAHA, CZECH REPUBLIC); bican@karlin.mff.cuni.cz
BLASCO, OSCAR (BURJASSOT, SPAIN); oblasco@uv.es
BOSCH SALDAÑA, MARÍA ASUNCIÓN (ALMERÍA, SPAIN); mabosch@ual.es
BOUGUIMA, SIDI MOHAMMED (TLEMCEN, ALGERIA); bouguima@yahoo.fr
BOUIAROV, VLADIMIR (MOSCÚ, RUSSIAN FEDERATION); buyarov@yahoo.com
BRANQUINHO, AMÍLCAR (COIMBRA, PORTUGAL); ajplb@mat.uc.pt
BRUSTENGA, MIQUEL (BARCELONA, SPAIN); mbrusten@mat.uab.es
BURGOS NAVARRO, MARÍA (ALMERÍA, SPAIN); mburgos@ual.es
CAENEPEEL, STEFAAN (BRUSSELS, BELGIUM); scaenepe@vub.ac.be
CAGLIARI, FRANCESCA (BOLOGNA, ITALY); cagliari@dm.unibo.it
CALABUIG, JOSÉ (VALENCIA, SPAIN); jmcalabu@mat.upv.es
CALDERÓN MARTÍN, ANTONIO J. (CÁDIZ, SPAIN); ajesus.calderon@uca.es
CALVO JURADO, CARMEN (CÁCERES, SPAIN); ccalvo@unex.es
CAMACHO, LUISA M. (SEVILLA, SPAIN); lcamacho@us.es
CAMMAROTO, FILIPPO (MESSINA, ITALY); camfil@unime.it
CAMPIÓN ARRASTIA, MARÍA JESÚS (PAMPLONA, SPAIN); mjesus.campion@unavarra.es
CANDEAL, JUAN C. (ZARAGOZA, SPAIN); candeal@unizar.es
CANTERO, MARÍA JOSÉ (ZARAGOZA, SPAIN); mjcante@unizar.es
CAÑADA, ANTONIO (GRANADA, SPAIN); acanada@ugr.es
CÁRDENAS-MORALES, DANIEL (JAÉN, SPAIN); cardenas@ujaen.es
CARMONA TAPIA, JOSÉ (ALMERÍA, SPAIN); jcarmona@ual.es
CASACUBERTA, CARLES (BARCELONA, SPAIN); carles.casacuberta@ub.edu
CASERTA, AGATA (MARCIANISE, ITALY); agata.caserta@tin.it
CASTAÑO IGLESIAS, FLORENCIO (ALMERÍA, SPAIN); fci@ual.es
CASTRO SMIRNOVA, MIRTA MARÍA (SEVILLA, SPAIN); mirta@us.es
CATANESE, FABRIZIO (BAYREUTH, GERMANY); Fabrizio.Catanese@uni-bayreuth.de
CHARITOS, CHARALAMPOS (ATHENS, GREECE); bakis@aua.gr
CHOULLI, HANAN (FES, MOROCCO); hchoulli@hotmail.com
CODINA SÁNCHEZ, ANTONIO (ALMERÍA, SPAIN); acodina@ual.es
CONEJERO, JOSÉ A. (VALENCIA, SPAIN); aconejero@mat.upv.es
CONTRERAS RUBIO, IGNACIO (SEVILLA, SPAIN); iconrub@upo.es
CORTÉS IZURDIAGA, MANUEL (ALMERÍA, SPAIN); mizurdia@ual.es
COSTA, CECILIA (PORTO, PORTUGAL); mcosta@utad.pt
COUSELO HERNÁNDEZ, ELENA (OVIEDO, SPAIN); couselo@orion.ciencias.uniovi.es
CRIVEI, SEPTIMIU (CLUJ-NAPOCA, ROMANIA); crivei@math.ubbcluj.ro
CRUZ RAMBAUD, SALVADOR (ALMERÍA, SPAIN); scruz@ual.es
CUADRA, JUAN (ALMERÍA, SPAIN); jcdiaz@ual.es
CUENCA MIRA, JOSÉ ANTONIO (MÁLAGA, SPAIN); cuenra@agt.cie.uma.es
DE MARCO, GIUSEPPE (PADOVA, ITALY); gdemarco@math.unipd.it
DE OÑA ESTEBAN, FRANCISCO (ALMERÍA, SPAIN); oesteban@ual.es

DE SCHUYMER, BART (GENT, BELGIUM); Bart.DeSchuymer@UGent.be
DEL CAMPO ACOSTA, RICARDO (ALMERÍA, SPAIN); rcampo@ual.es
DI MAIO, GIUSEPPE (CASERTA, ITALY); giuseppe.dimaio@unina2.it
DÍAZ, ANTONIO (MÁLAGA, SPAIN); adiaz@agt.cie.uma.es
DRAPER FONTANALS, CRISTINA (MÁLAGA, SPAIN); cdf@uma.es
DURÁN, ANTONIO JOSÉ (SEVILLA, SPAIN); duran@us.es
DURANTE, FABRIZIO (LECCE, ITALY); fabrizio.durante@unile.it
EDDAHBI, MHAMED (MARRAKECH, MOROCCO); eddahbi@fstg-marrakech.ac.ma
EL HARTI, RACHID (SETTAT, MOROCCO); relharti@hotmail.com
EL HASSAN, EL KINANI (ERRACHIDIA, MOROCCO); hassankinani@math.net
EL KAOUTIT, LAIACHI (GRANADA, SPAIN); kaoutit@ugr.es
ELDUQUE, ALBERTO (ZARAGOZA, SPAIN); elduque@unizar.es
EL-NADI, KHAIRIA EL-SAID (ALEXANDRIA, EGYPT); khairia_el_said@hotmail.com
ENOCHS, EDGAR E. (LEXINGTON, UNITED STATES); enochs@ms.uky.edu
ESCORIZA LÓPEZ, JOSÉ (ALMERÍA, SPAIN); jescoriz@ual.es
ESCRIBANO, CARMEN (MADRID, SPAIN); cescribano@fi.upm.es
ESSANNOUNI, HASSANE (RABAT, MOROCCO); esanouni@fsr.ac.ma
ESTRADA DOMÍNGUEZ, SERGIO (CEUTA, SPAIN); sestrada@ugr.es
EUGENY IVANOVICH, SMIRNOV (YAROSLAVL, ROMANIA); smirn@gw.yspu.yar.ru
EZQUERRO FERNÁNDEZ, JOSÉ A. (LOGROÑO, SPAIN); jezquer@dmc.unirioja.es
FATEH, ELAGGOUNE (ANNABA, ALGERIA); aggounefateh@yahoo.fr
FATTAHI, ABDOLMAJID (KERMANSHAH, IRAN); majidzr@razi.ac.ir
FELISATTI, MARCELLO (LEICESTER, UNITED KINGDOM); mf46@mcs.le.ac.uk
FEMIC, BOJANA (ALMERÍA, SPAIN); BFEMIC@UAL.ES
FERNÁNDEZ, LIDIA (GRANADA, SPAIN); lidiafr@ugr.es
FERNÁNDEZ POLO, FRANCISCO JOSÉ (GRANADA, SPAIN); pacopolo@ugr.es
FERNANDEZ-PASCUAL, ROSAURA (GRANADA, SPAIN); rpascual@ujaen.es
FERREIRA, CHELO (ZARAGOZA, SPAIN); cferrei@unizar.es
FILALI, MAHMOUD (OULU, FINLAND); mfilali@cc.oulu.fi
FLORES DÍAZ, RAMÓN JESÚS (BARCELONA, SPAIN); ramonj@mat.uab.es
FOULQUIE MORENO, ANA (AVEIRO, PORTUGAL); foulquie@mat.ua.pt
FRANCESCA, MANTESE (VERONA, ITALY); mantese@sci.univr.it
FRANCO, MANUEL (MURCIA, SPAIN); mfranco@um.es
FREDIANI, PAOLA (PAVIA, ITALY); paola.frediani@unipv.it
FRÍAS BUSTAMANTE, MARÍA DEL PILAR (JAÉN, SPAIN); mpfrias@ujaen.es
FRÍAS ZORRILLA, ANTONIO (ALMERÍA, SPAIN); afrias@ual.es
GÁLVEZ, IMMA (LONDON, UNITED KINGDOM); i.galvezicarrillo@londonmet.ac.uk
GARCÍA GUIRAO, JUAN LUIS (CARTAGENA, SPAIN); juan.garcia@upct.es
GARCÍA HERNÁNDEZ, JOSEFA MARÍA (GRANADA, SPAIN); jgarciah@ugr.es
GARCÍA LUENGO, AMELIA VICTORIA (ALMERÍA, SPAIN); amgarcia@ual.es
GARCÍA PÉREZ, JOSÉ (ALMERÍA, SPAIN); jgarcia@ual.es
GARCÍA PINEDA, PILAR (MADRID, SPAIN); mpigarci@ccee.ucm.es
GARCÍA ROZAS, JUAN RAMÓN (ALMERÍA, SPAIN); jrgrozas@ual.es
GARCÍA RUBIRA, JOSÉ MARÍA (ALMERÍA, SPAIN); jrubira@gmail.com
GARCÍA-PRADA, OSCAR (MADRID, SPAIN); oscar.garcia-prada@uam.es
GARCÍA-SÁNCHEZ, PEDRO A. (GRANADA, SPAIN); pedro@ugr.es
GARRANCHO, PEDRO (JAÉN, SPAIN); pgarranch@supercable.es
GEORGIOU, DIMITRIS (PATRAS, GREECE); georgiou@math.upatras.gr
GHADIRIHERATI, MANSOUR (YAZD, IRAN); mghadiri@yazduni.ac.ir
GHOMRASNI, RAOUF (BERLIN, GERMANY); ghomrasni@math.tu-berlin.de

GIARLOTTA, ALFIO (CATANIA, ITALY); giarlott@math.uiuc.edu
GIL CUADRA, FRANCISCO (ALMERÍA, SPAIN); fgil@ual.es
GIRALDO, ANTONIO (madrid, SPAIN); agiraldo@fi.upm.es
GOLINSKIY, LEONID (KHARKIV, UKRAINE); golinskii@ilt.kharkov.ua
GÓMEZ LOZANO, MIGUEL ÁNGEL (MÁLAGA, SPAIN); magomez@agt.cie.uma.es
GONZÁLEZ REGAÑA, ALFONSO J. (BADAJOZ, SPAIN); agonzale@unex.es
GONZÁLEZ RODRÍGUEZ, RAMÓN (VIGO, SPAIN); rgon@dma.uvigo.es
GONZALO, RAQUEL (MADRID, SPAIN); rngonzalo@fi.upm.es
GREENLEES, JOHN (SHEFFIELD, UNITED KINGDOM); j.greenlees@sheffield.ac.uk
GREGORI, VALENTÍN (VALENCIA, SPAIN); vgregori@mat.upv.es
GRUBER, GÜNTHER (MÜNCHEN, GERMANY); grbrg@gmx.net
GRUNBAUM, F. ALBERTO (BERKELEY, UNITED STATES); grunbaum@math.berkeley.edu
GUIL ASENSIO, PEDRO ANTONIO (MURCIA, SPAIN); paguil@um.es
GUTIÉRREZ GARCÍA, JAVIER (BILBAO, SPAIN); mtpgugaj@lg.ehu.es
HAGHNEJAD AZER, KAZEM (ARDABIL, IRAN); hagnazhad@yahoo.com
HAMMED ABIODUN, AZEEZ (BANJUL, GAMBIA); abbymarx2000@yahoo.com
HASHEMI, EBRAHIM (SHAHROOD, IRAN); eb_hashemi@shahrood.ac.ir
HAWETE, HATTAB (GHANNOUCHE, TUNISIA); thwtwtt@yahoo.fr
HERNÁNDEZ HEREDERO, RAFAEL (MADRID, SPAIN); rafahh@euitt.upm.es
HERRANZ PEINADO, PATRICIA (SEVILLA, SPAIN); pherpei@upo.es
HUETE MORALES, MARÍA DOLORES (GRANADA, SPAIN); mdhuete@ugr.es
HUNTON, JOHN (LEICESTER, UNITED KINGDOM); J.Hunton@mcs.le.ac.uk
INDURAIN, ESTEBAN (PAMPLONA, SPAIN); steiner@unavarra.es
IRANMANESH, A. (TEHRAN, IRAN); iranmana@modares.ac.ir
JANSSEN, KRIS (BRUSSELS, BELGIUM); krjansse@vub.ac.be
JARA, PASCUAL (GRANADA, SPAIN); pjara@ugr.es
JARDINE, RICK (LONDON, CANADA); jardine@uwo.ca
JENDA, OVERTOUN (AUBURN, UNITED STATES); jendaov@auburn.edu
JIMÉNEZ VARGAS, ANTONIO (ALMERÍA, SPAIN); ajimenez@ual.es
JOSA FOMBELLIDA, RICARDO (VALLADOLID, SPAIN); ricar@eio.uva.es
JUHER, DAVID (GIRONA, SPAIN); david.juher@udg.es
KAIDI, EL AMIN (ALMERÍA, SPAIN); elamin@ual.es
KHAIREDDINE, FERNANE (GUELMA, ALGERIA); kfernane@yahoo.fr
KHALED, BOUKERRIOUA (ANNABA, ALGERIA); khaledv2004@yahoo.fr
KHAN, MOHAMMAD (MUSCAT, OMAN); mohammad@squ.edu.om
KIRIK, EKATERINA (KRASNOYARSK, RUSSIAN FEDERATION); kirik@icm.krasn.ru
KOZHAN, ROMAN (LVIV, UKRAINE); geysa@mail.lviv.ua
KRAMER, ALPAR VAJK (MILANO, ITALY); vajk@personal.ro
L HOUSSAIN, EL FADIL (FES, MOROCCO); lhouelfadil@hotmail.com
LAFUERZA GUILLÉN, BERNARDO (ALMERÍA, SPAIN); blafuerz@ual.es
LAKHDAR, CHITER (SETIF, ALGERIA); chiterl@univ-setif.dz
LAURENTIU, MODAN (BUCHAREST, ROMANIA); modanl@inforec.ase.ro
LEANDRE, REMI (DIJON, FRANCE); Remi.leandre@u-bourgogne.fr
LIDOUH, ABDELUAAB (OUJDA, MOROCCO); lidouh@sciences.univ-oujda.ac.ma
LLAVONA, JOSÉ G. (MADRID, SPAIN); JL_Llavona@mat.ucm.es
L'MOUFADAL, BEN YAKOUB (TÉTOUAN, MOROCCO); benyakoub@hotmail.com
LOPATIN, ARTEM (OMSK, RUSSIAN FEDERATION); artem_lopatin@yahoo.com
LÓPEZ, JOSÉ L. (PAMPLONA, SPAIN); jl.lopez@unavarra.es
LÓPEZ ARTÉS, PEDRO (ALMERÍA, SPAIN); plopez@ual.es
LÓPEZ LAGOMASINO, GUILLERMO (MADRID, SPAIN); lago@math.uc3m.es

LÓPEZ PEÑA, JOSÉ JAVIER (GRANADA, SPAIN); jlopez@ugr.es
LÓPEZ RAMOS, JUAN ANTONIO (ALMERÍA, SPAIN); jlopez@ual.es
LÓPEZ-PERMOUTH, SERGIO (ATHENS, UNITED STATES); slopez@math.ohio.edu
LUPIÁÑEZ, FRANCISCO. G. (MADRID, SPAIN); FG_Lupianez@mat.ucm.es
MAKHLOUF, ABDENACER (MULHOUSE, FRANCE); N.Makhlouf@uha.fr
MANUEL GARCÍA, CONRADO MIGUEL (MADRID, SPAIN); conrado@estad.ucm.es
MANUILOV, VLADIMIR (MOSCOW, RUSSIAN FEDERATION); manuilov@mech.math.msu.su
MARCELLÁN, FRANCISCO (MADRID, SPAIN); pacomarc@ing.uc3m.es
MARRERO, OSVALDO (VILLANOVA, UNITED STATES); Osvaldo.Marrero@villanova.edu
MARTÍNEZ LÓPEZ, CONSUELO (OVIEDO, SPAIN); chelo@pinon.ccu.uniovi.es
MARTÍNEZ FINKELSHTEIN, ANDREI (ALMERÍA, SPAIN); andrei@ual.es
MARTÍNEZ GONZÁLEZ, PEDRO (ALMERÍA, SPAIN); pmartine@ual.es
MARTÍNEZ MORENO, JUAN (GRANADA, SPAIN); jmmoreno@ugr.es
MARTÍNEZ PUERTAS, SERGIO (ALMERÍA, SPAIN); spuertas@ual.es
MARTÍNEZ-GIMÉNEZ, FÉLIX (VALENCIA, SPAIN); fmarting@mat.upv.es
MATOS, ANA (VILLENEUVE D'ASCQ CEDEX, FRANCE); matos@math.univ-lille1.fr
MAZAHERI, HAMID (YAZD, IRAN); hmazaheri@yazduni.ac.ir
MBEKHTA, MOSTAFA (VILLENEUVE D'ASCQ, FRANCE); Mostafa.Mbekhta@math.univ-lille1.fr
MECCARIELLO, ENRICO (BENEVENTO, ITALY); meccariello@unisannio.it
MEDINA, RIGOBERTO (OSORNO, CHILE); rmedina@ulagos.cl
MELERO SALVADOR, DAVID JAVIER (ALMERÍA, SPAIN); djmeleros@hotmail.com
MENA, JUAN F. (GRANADA, SPAIN); jfmena@ugr.es
MERINO, LUIS (GRANADA, SPAIN); lmerino@ugr.es
MIANA, PEDRO J. (ZARAGOZA, SPAIN); pjmiana@unizar.es
MILLIONSCHIKOV, DMITRI (MOSCOW, RUSSIAN FEDERATION); million@mech.math.msu.su
MOHAMED SGHIR, EL YAAQUOUBI (TETOUAN, MOROCCO); mohameds@fst.ac.ma
MOHAMMADIAN, ALI (TEHRAN, IRAN); ali_m@mehr.sharif.edu
MONREAL MENGUAL, LLÚCIA (VALENCIA, SPAIN); lmonreal@mat.upv.es
MONTANER LAVEDÁN, JESÚS MARÍA (ZARAGOZA, SPAIN); montaner@unizar.es
MORAIS, CELESTE (BRAGANÇA, PORTUGAL); celmorais@ipb.pt
MORAL, LEANDRO (ZARAGOZA, SPAIN); LMORAL@POSTA.UNIZAR.ES
MORALES CAMPOY, ANTONIO (ALMERÍA, SPAIN); amorales@ual.es
MORALES LÓPEZ, MARÍA DOLORES (CÓRDOBA, SPAIN); lolamlo@hotmail.com
MORENO CARRETERO, MARÍA FRANCISCA (ALMERÍA, SPAIN); mfmoreno@ual.es
MORENO GALINDO, ANTONIO (GRANADA, SPAIN); agalindo@ugr.es
MORENO-BALCÁZAR, JUAN JOSÉ (ALMERÍA, SPAIN); balcazar@ual.es
MOSHOKOA, SEITHUTI (PRETORIA, SOUTH AFRICA); moshosp@unisa.ac.za
MOSTAFA EL-BORAI, MAHMOUD M. (ALEXANDRIA, EGYPT); m_m_elborai@yahoo.com
MULLER, CHRISTOPHE (ALICANTE, SPAIN); cmuller@merlin.fae.ua.es
MUNDET, IGNASI (BARCELONA, SPAIN); ignasi.mundet@ub.edu
MUÑOZ TORRECILLAS, MARÍA JOSÉ (ALMERÍA, SPAIN); mjmtorre@ual.es
MURO, FERNANDO (BONN, GERMANY); muro@mipm-bonn.de, muro@mpim-bonn.mpg.de
NAFIDI, AHMED (GRANADA, SPAIN); nafidiah@ugr.es
NAGHIPOUR, REZA (TABRIZ, IRAN); naghipour@tabrizu.ac.ir
NAIMPALLY, SOMASHEKHAR (TORONTO, CANADA); somnaimpally@yahoo.ca
NAVARRO GARULO, GABRIEL (GRANADA, SPAIN); gnavarro@ugr.es
NAVARRO PASCUAL, JUAN CARLOS (ALMERÍA, SPAIN); jcnav@ual.es
NAVARRO PASCUAL, MIGUEL ÁNGEL (ALMERÍA, SPAIN); manav@ual.es
NEEMAN, AMNON (CANBERRA, AUSTRALIA); amnon.neeman@anu.edu.au
NEUMANN, FRANK (LEICESTER, UNITED KINGDOM); fn8@mcs.le.ac.uk

NEZAKATI, AHMAD (SHAHROOD, IRAN); nezakati@shahrood.ac.ir
NÚÑEZ DEL PRADO, JOSÉ ANTONIO (MADRID, SPAIN); janunez48@hotmail.com
OBERSNEL, FRANCO (TRIESTE, ITALY); obersnel@units.it
OMONIYI, HENRY ELVIS (JUDAMIX LTD, NIGERIA); henryelvis@usa.com
OÑA CASADO, INMACULADA (ALMERÍA, SPAIN); iocasado@ual.es
ORTEGA ESPARZA, EDUARD (BARCELONA, SPAIN); eortega@mat.uab.es
ORTEGA PASTOR, EVA MARÍA (ALICANTE, SPAIN); evamaria@umh.es
OULAD YAKHLEF, HOSSAIN (PAMPLONA, SPAIN); houlad@unavarra.es
OYONARTE, LUIS (ALMERÍA, SPAIN); oyonarte@ual.es
PENACCHIO, OLIVIER (BARCELONA, SPAIN); openacchio@crm.es
PEÑA, ANA (ZARAGOZA, SPAIN); anap@unizar.es
PERALTA, ANTONIO M. (GRANADA, SPAIN); aperalta@ugr.es
PERALTA LÓPEZ, JUSTO (ALMERÍA, SPAIN); jperalta@ual.es
PÉREZ, TERESA E. (GRANADA, SPAIN); tperez@ugr.es
PÉREZ LÁZARO, FRANCISCO JAVIER (LOGROÑO, SPAIN); francisco.perez@unavarra.es
PERIS, ALFRED (VALÈNCIA, SPAIN); aperis@mat.upv.es
PESETSKAYA, TATIANA (MINSK, BELARUS); tanya_pesetskaya@yahoo.com
PIGNATELLI, ROBERTO (POVO (TN), ITALY); pignatel@science.unitn.it
POPOVICI, DAN EMANUEL (TIMISOARA, ROMANIA); popovici@math.uvt.ro
POPOVICI, ADRIANA (TIMISOARA, ROMANIA); dianap@math.uvt.ro
PORTILLA, ANA (MADRID, SPAIN); apferrei@math.uc3m.es
QUARTERONI, ALFIO (LAUSANNE, SWITZERLAND); alfio.quarteroni@epfl.ch
QUESADA MOLINA, JOSÉ JUAN (GRANADA, SPAIN); jquesada@ugr.es
RABAH, KHALDI (ANNABA, ALGERIA); rkhadi@yahoo.fr
RAKHNIN, ANDRIY (KHARKIV, UKRAINE); rakhnin@univer.kharkov.ua
RAMBLA BARRENO, FERNANDO (PUERTO REAL, SPAIN); fernando.rambla@uca.es
RAMÍREZ ÁLVAREZ, MARIBEL (ALMERÍA, SPAIN); mramirez@ual.es
RAMÍREZ GONZÁLEZ, VICTORIANO (GRANADA, SPAIN); vramirez@ugr.es
REZOLA, M LUISA (ZARAGOZA, SPAIN); rezola@unizar.es
RICO ROMERO, LUIS (GRANADA, SPAIN); lrico@ugr.es
RODENAS ESCRIBA, FRANCISCO (VALENCIA, SPAIN); frodenas@mat.upv.es
RODRÍGUEZ, JOSÉ L. (ALMERÍA, SPAIN); jlrodri@ual.es
RODRÍGUEZ, JOSÉ MANUEL (MADRID, SPAIN); jomaro@math.uc3m.es
RODRÍGUEZ ALCANTUD, JOSÉ CARLOS (SALAMANCA, SPAIN); jcr@usal.es
RODRÍGUEZ LALLENA, JOSÉ ANTONIO (ALMERÍA, SPAIN), jarodri@mat.ual.es
RODRÍGUEZ-LÓPEZ, JESÚS (ALICANTE, SPAIN); jrlopez@mat.upv.es
RODRÍGUEZ-PALACIOS, ÁNGEL (GRANADA, SPAIN); apalacio@ugr.es
RODRÍGUEZ-PALMERO, CARLOS (VALLADOLID, SPAIN); cpalmero@eco.uva.es
ROMAGUERA, SALVADOR (VALENCIA, SPAIN); sromague@mat.upv.es
ROMÁN MONTOYA, YOLANDA (GRANADA, SPAIN); yroman@ugr.es
ROMERO, ISABEL (ALMERÍA, SPAIN); imromero@ual.es
ROMERO ÁLVAREZ, NATALIA (LOGROÑO, SPAIN); natalia.romero@dmc.unirioja.es
RUÍZ MORCILLO, VICTOR M. (MADRID, SPAIN); vruiz@estad.ucm.es
RUIZ-MEDINA, MARÍA DOLORES (GRANADA, SPAIN); mruiz@ugr.es
RUMÍ RODRÍGUEZ, RAFAEL (ALMERÍA, SPAIN); rrumi@ual.es
SALARIAN, SHOKROLLAH (ISFAHAN, IRAN); salarian@ipm.ir
SALMERÓN, ROMÁN (GRANADA, SPAIN); romansg@ugr.es
SALVADORI, GIANFAUSTO (LECCE, ITALY); gianfausto.salvadori@unile.it
SÁNCHEZ ÁLVAREZ, JOSÉ MANUEL (VALENCIA, SPAIN); jossnclv@doctor.upv.es
SÁNCHEZ CAMPOS, ESPERANZA (MÁLAGA, SPAIN); esperanz@agt.cie.uma.es

SÁNCHEZ GRANERO, MIGUEL ANGEL (ALMERÍA, SPAIN); misanche@ual.es
SÁNCHEZ LARA, JOAQUIN F. (ALMERÍA, SPAIN); jlara@ual.es
SÁNCHEZ ORTEGA, JUANA (MÁLAGA, SPAIN); jsanchez@agt.cie.uma.es
SÁNCHEZ-DEHESA, JESÚS (GRANADA, SPAIN); dehesa@ugr.es
SÁNCHEZ-LIROLA ORTEGA, MARÍA GRACIA (ALMERÍA, SPAIN); mgsanche@ual.es
SANCHIS, MANUEL (CASTELLO, SPAIN); sanchis@mat.uji.es
SANGHARE, MAMADOU (DAKAR, SENEGAL); mamsanghare@hotmail.com
SANTISTEBAN MARTÍNEZ, JOAQUÍN (ALMERÍA, SPAIN); jsmartin@ual.es
SANTOS, EVANGELINA (GRANADA, SPAIN); esantos@ugr.es
SAPENA, ALMANZOR (GRAO DE GANDÍA, SPAIN); alsapie@mat.upv.es
SASTRE, M. ASUNCIÓN (MADRID, SPAIN); masastre@fi.upm.es
SCHÖPF, VERONIKA (MÜNCHEN, GERMANY); v.schoepf@gmx.net
SEGOVIA GONZÁLEZ, M. MANUELA (SEVILLA, SPAIN); mmseggon@upo.es
SEMPERE MONTERO, LOURDES (ALMERÍA, SPAIN); LSEMPERE@UAL.ES
SEMPI, CARLO (LECCE, ITALY); carlo.sempi@unile.it
SERRA CAPIZZANO, STEFANO (COMO, ITALY); stefano.serrac@uninsubria.it
SHCHIGOLEV, VLADIMIR (ULYANOVSK, RUSSIAN FEDERATION); vkshch@vens.ru
SHCHUKIN, MIKHAIL (MINSK, BELARUS); MS@TUT.BY
SHEVCHENKO, GEORGIY (KYIV, UKRAINE); zhora@univ.kiev.ua
SHTEPIN, VADIM (DONETSK, UKRAINE); shtepina@stels.net
SHTEPINA, TATYANA (DONETSK, UKRAINE); shtepina@stels.net
SILES, MERCEDES (MÁLAGA, SPAIN); mercedes@agt.cie.uma.es
SMAIL, KELAIAIA (EL-HADJAR, ALGERIA); kelaiaiasmail@yahoo.fr
SMALL, LANCE (SAN DIEGO, UNITED STATES); lwsmall@ucsd.edu
SMITH, PATRICK (GLASGOW, UNITED KINGDOM); p.smith@maths.gla.ac.uk
SMREKAR, JAKA (BARCELONA, SPAIN); smrekar@ub.edu
SRI RANGA, ALAGACONE (SÃO JOSÉ DO RIO PRETO, BRAZIL); ranga@ibilce.unesp.br
SZYSZKOWSKI, MARCIN (GDANSK, POLAND); fox@math.univ.gda.pl
TADEU, PEDRO (BRAGANÇA, PORTUGAL); ptadeu@ipb.pt
TAYLOR, MICHAEL (WINTER PARK, UNITED STATES); mtaylor@pegasus.cc.ucf.edu
TELLECHEA, EDUARDO (HERMOSILLO, MEXICO); etellech@gauss.mat.uson.mx
TENORIO VILLALÓN, ANGEL FRANCISCO (SEVILLA, SPAIN); aftenvil@upo.es
TENORIO VILLALÓN, ANGEL FRANCISCO (SEVILLA, SPAIN); aftenvil@upo.es
TIRADO, PEDRO (VALENCIA, SPAIN); pedtipe@cam.upv.es
TIRONI, GINO (TRIESTE, ITALY); tironi@units.it
TOMI REBECCA, OLUSEYI (IBADAN, NIGERIA); rebtomy@yahoo.com
TONKS, ANDREW (LONDON, UNITED KINGDOM); a.tonks@londonmet.ac.uk
TONOLO, ALBERTO (PADOVA, ITALY); tonolo@math.unipd.it
TORRANO, EMILIO (MADRID, SPAIN); emilio@fi.upm.es
TORRECILLAS, BLAS (ALMERÍA, SPAIN); btorreci@ual.es
TOURÍS, EVA (MADRID, SPAIN); etouris@math.uc3m.es
TRILLO MOYA, JUAN CARLOS (CARTAGENA, SPAIN); jc.trillo@upct.es
TRUJILLO GUILLÉN, MACARENA (VALENCIA, SPAIN); matrugui@doctor.upv.es
ÚBEDA FLORES, MANUEL (ALMERÍA, SPAIN); mubeda@ual.es
UGLANOV, ALEXEY (SAINT-PETERSBURG, RUSSIAN FEDERATION); uglanov@uniyar.ac.ru
VAEZPOUR, SEYED MANSOUR (YAZD, IRAN); vaez@yazduni.ac.ir
VALENT, GALLIANO (MARSEILLE, FRANCE); gvalent@lumimath.univ-mrs.fr
VALERO, OSCAR (PALMA DE MALLORCA, SPAIN); o.valero@uib.es
VAN DORP, JOHAN RENÉ (WASHINGTON, UNITED STATES); dorpjr@gwu.edu
VAN ISEGHEM, JEANNETTE (VILLENEUVE D ASCQ, FRANCE); jvaniseg@math.univ-lille1.fr

VAN OYSTAEYEN, FREDDY (ANTWERP, BELGIUM); Francine.Schoeters@ua.ac.be
VAREA, VICENTE (ZARAGOZA, SPAIN); varea@unizar.es
VARGAS JIMÉNEZ, MARAVILLAS (GRANADA, SPAIN); mvargas@ugr.es
VELASCO, M. VICTORIA (GRANADA, SPAIN); vvelasco@ugr.es
VERCRUYSSE, JOOST (BRUSSELS, BELGIUM); jvercruy@vub.ac.be
VIATCHESLAV A., ARTAMONOV (MOSCOW, RUSSIAN FEDERATION); artamon@mech.math.msu.su
VILCHES ALARCÓN, JOSÉ ANTONIO (SEVILLA, SPAIN); vilches@us.es
VIRCHENKO, NINA (KYIV, UKRAINE); r_lv@mail.ru
VIRUEL, ANTONIO (MÁLAGA, SPAIN); viruel@agt.cie.uma.es
VIVO MOLINA, JUANA MARÍA (MURCIA, SPAIN); jmvivomo@um.es
WHITEHOUSE, SARAH (SHEFFIELD, UNITED KINGDOM); s.whitehouse@sheffield.ac.uk
WIELONSKY, FRANCK (VILLENEUVE D'ASCQ, FRANCE); franck.wielonsky@math.univ-lille1.fr
YÁÑEZ GARCÍA, RAFAEL (GRANADA, SPAIN); ryanez@ugr.es
YARKULOV, BOLI (SAMARKAND, UZBEKISTAN); yarkulov@rambler.ru
YEVDOKIMOV, OLEKSIY (KHARKOV, UKRAINE); yevdokimov@vl.kharkov.ua
YOUSSEF, EL FROM (MARRAKECH, MOROCCO); elfrom@ucam.ac.ma
ZARZO ALTAREJOS, ALEJANDRO (MADRID, SPAIN); azarzo@etsii.upm.es
ZELMANOV, EFIM (SAN DIEGO, UNITED STATES); ezelmanov@math.ucsd.edu

Volunteers: Antonia, David B., Beatriz, Mercedes, Olga, María Laura, Mari Loli, Isabel, José María, Mari Ángeles, Diana, David M., Thomas, Jesús, Rosa María, Yolanda, Mélida, Nazareth, Ángel, Moisés, and ...