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Interdisciplinary
Mathematical
& Statistical
Techniques



New University
of Lisbon



Polytechnic
Institute of Tomar

SCRA PORTUGAL
2006
FIM XIII

Forum for Interdisciplinary Mathematics

September 1 - 4

Interdisciplinary Mathematical & Statistical Techniques

Thirteenth International Conference of Forum for Interdisciplinary Mathematics

New University of Lisbon | Polytechnic Institute of Tomar

CONFERENCE CHAIRS

Sat Gupta, University of North Carolina at Greensboro, USA
Carlos A. Coelho, New University of Lisbon, Portugal

MAIN ORGANIZING COMMITTEE

Satya Mishra (Chair), University of South Alabama, USA
Mark Carpenter, Auburn University, USA
Bal Kishan Dass, University of Delhi, India,
Chandra M. Gulati, University of Wollongong, Australia
Bhu Dev Sharma, Clark University of Atlanta, USA

LOCAL ORGANIZING COMMITTEE

Carlos A. Coelho - Chair, New University of Lisbon Portugal
João T. Mexia - Co-Chair, New University of Lisbon, Portugal
Luís M. Grilo - Site Coordinator, Polytechnic Institute of Tomar, Portugal
Luís Merca - Polytechnic Institute of Tomar, Portugal
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NEW UNIVERSITY OF LISBON

Is the youngest public institution for higher education and scientific research within the Lisbon metropolitan area. Founded in 1973, within a framework of expansion and diversification in Portuguese higher education, NOVA gives pride of place to cooperation between the different areas of knowledge.

The University, which covers an area of approximately 60 hectares, is located on three campuses: Campolide, Caparica and Avenida de Berna, and in different sites in Lisbon (Campo Santana, Lumiar, Junqueira and Oeiras).

At present, NOVA consists of five Faculties, three Institutes and one School, which offers a wide variety of courses in all areas of knowledge. It awards undergraduate degrees in around 40 areas and offers 65 Masters, 20 PhDs and 44 Postgraduate degree programs. It also has 49 research centers financed by the Portuguese Foundation for Science and Technology (Fundação para a Ciência e a Tecnologia), cooperative projects with numerous institutions, businesses and universities at the national and international levels and exchange programs, namely those which fall within the scope of the SOCRATES/ERASMUS programs.

Via its four main strategic pillars - Internationalization, Dimension/Growth, Innovation/Pioneering and Excellence, the New University of Lisbon seeks to: Contribute to the evolution of academic knowledge, in order to solve the challenges presented by the 21st century; contribute to Portugal progress; play a role in world's development; improve higher education in Portugal, through the Bologna process; take a leading role in the cooperation with the Portuguese speaking world (new African Portuguese speaking countries, Brazil, Timor).

Keeping its mission in mind, one of New University of Lisbon strategic's objectives is to participate in the globalization process. It also intends to integrate the new perspectives of knowledge at its highest level by means of an academic activity, wherein teaching and research are inseparable.

POLYTECHNIC INSTITUTE OF TOMAR

The polytechnic Institute of Tomar is located in Tomar in an ample, modern and well-equipped academic campus. Holding about 180 lecturers and 3000 students, it integrates several Resource, Research and Development Centres and it is involved in several Co-operation Agreements with national and international teaching and research institutions.

The Polytechnic of Tomar is a modern higher education institution, with Humanistic and Technological components, namely Culture and Management, Arts, Archaeology and Restoration, Cultural Tourism, Landscape Management, Photography and Design, Civil Engineering, Chemical Engineering, Electrotechnical Engineering, Computer Engineering, Mechanical Engineering, Communication and Management.

The History of the Polytechnic of Tomar has its beginning in 1973, when it was created by ministerial decree. As in the years after the conditions for its installation have not been created, just at the end of 1982 the installation of the Higher School of Technology of Tomar took place. In 1986, the first bachelor degrees were created and classes held in an old building of the historic centre of Tomar using laboratories located in several spots of the city. Finally, in 1992 it changed to a new campus with over 10 hectares.

This institution has obtained, on the 1st January 1997, the permanent statute of independent Polytechnic Institute, with, three schools: the School of Technology in Tomar, the School of Management in Tomar and the School of Technology in Abrantes. It has today a great prestige, both nationally and internationally for its institutional partnerships, the nature of degrees offered, its high-qualified lecturers, its excellent facilities and resources and the growing diversity of Research and Development actions. According to words of the President of the IPT, the prestige of this higher education establishment is largely due to the success and professional prestige its graduates have among their employers.

Welcome Messages

Leopoldo Guimarães



Welcome to the Interdisciplinary Mathematical and Statistical Techniques Conference - SCRA2006/FIM XIII, and a special welcome to those who came from far away to attend this remarkable annual event that brings together top statisticians and mathematicians. This is the right place to exchange information, enhance skills and share opinions.

This year, we have the great pleasure to confer the Honorary Degree to Professor C. R. Rao, a vult on the world scientific panorama.

We are very grateful to those whose creativity, resources and hard work have made this conference possible. It's necessary to remember the level of the plenary presentations and the more than 250 contribute papers to understand the interest that this conference has raised.

Furthermore, this conference has a very nice and historical set up. Founded as head-quarters of the Knights Templar (*Templários*) in Portugal, Tomar had in the 12th century some of the most important Templar monuments in Europe. In the 15th century, the city was the centre of Portuguese overseas expansion under Henry the Navigator (*Infante Dom Henrique*). He was the Grand Master of the Order of Christ (*Ordem de Cristo*), the Portuguese estates of the suppressed Templars. Portuguese sailors had the support of the cartographers which were scholars with a good mathematical and astronomical training.

So, having the conference held in Portugal, is a very nice way for us to contribute to increase the international visibility of statistic and mathematical Portuguese community.

Have a great time!

Leopoldo Guimarães
Rector of *Universidade Nova de Lisboa*

Fernando Santana

The Faculty of Sciences and Technology of the New University of Lisbon is very proud to have integrated the organization of the 13th International Conference of the Forum for Interdisciplinary Mathematics, through its Department of Mathematics and namely Professor Carlos Agra Coelho and Professor Tiago Mexia.

May I welcome the participants and wish you all a sound and interesting conference. For those visiting Portugal I hope you take this opportunity also to enjoy this beautiful country.

To the above mentioned Colleagues of mine a very special word to thank their efforts for the success of this event.

Professor Fernando Santana
The Dean of The Faculty of Science of Technology

António Pires da Silva



Dear Conference participants,

On behalf of the Polytechnic Institute of Tomar, I would like to welcome you to the International Conference on Interdisciplinary Mathematical & Statistical Techniques that occurs for the first time in Portugal.

I really hope that you will enjoy your stay in Tomar, a city intimately related to the Order of the Templar Knights.

The Polytechnic Institute of Tomar will do everything to ensure that the conferences will lead to most productive and helpful results.

I would also like to thank both International and Local Symposia Organizing Committees for this conference schedule, for their efforts to exceed all obstacles that appeared during the preparation of the Conference and for the quality and reputation of all participants.

I would also like to take this opportunity to thank all of our sponsors whose support is crucial for the conferences.

Best wishes to everyone,

A handwritten signature in blue ink, appearing to read 'António Pires da Silva'.

António Pires da Silva
President of Polytechnic Institute of Tomar

Sat Gupta



September 1, 2006

Dear Colleagues:

On behalf of the organizing committee for SCRA 2006 and the Forum for Interdisciplinary Mathematics, I welcome you all to this 13th edition of FIM conferences. Many of you have attended several of our previous conferences and I thank you for your continued support. For those who are attending a FIM conference for the first time, I can promise you that you will take home a wonderful experience. The local hosts Dr Carlos Coelho and Luis Grillo will make every effort to make your stay in Tomar/Lisbon very comfortable. Just to alert you about our upcoming conferences, FIM 14 will be held in Shanghai, China in May 2007, and FIM 15 will be hosted by the Memphis University in May 2008. During this time, we will also be holding or supporting some smaller conferences and symposia at various places.

The Forum was established in 1975 under the able stewardship of Dr Bhu Dev Sharma with the purpose of bringing together researchers from a wide range of disciplines where mathematics is the common thread. All of the FIM conferences have emphasized the significance of interdisciplinary techniques and have been very successful in fulfilling that mission. In addition to the conferences, the Forum publishes two very successful journals – Journal of Combinatorics, Information and System Sciences and Journal of Statistics and Applications. A third journal, in the area of computer science, will also be started shortly. Hopefully you will embrace our journals as enthusiastically as you have embraced our conferences.

I would like to take this opportunity to express my most sincere thanks to Dr. Leopoldo Jose Martinho Guimaraes, Rector New University of Lisbon and Dr. Pires da Silva, President Polytechnic Institute of Tomar for providing whole-hearted support to this conference. I also thank many other principals who have been less visible but have provided significant institutional support to make this conference successful. These include Prof. Joao Tiago Mexia, Director Research Center for Mathematics and Its Applications, Prof. Fernando Jose Pires Santana, Director Faculty of Sciences and Technology of the New University of Lisbon, Prof. Joao Goulao Crespo, President of the Scientific Counsel, the New University of Lisbon and Dr. Luis Miguel Merca Fernandes, Director of the School of Tecnology, Polytechnic Institute of Tomar. The Forum is deeply indebted to Dr. C. R. Rao also for lending his support to Forum's activities. Not only was he our keynote

speaker at the first of the current sequence of FIM conferences held at University of Southern Maine in 1997, as he is here, he also served the Forum as President for two consecutive terms. We are also indebted to all of our plenary speakers and session organizers for their support. I would also like to express my most sincere gratitude to all our sponsors. It is impossible to put together a conference of this magnitude without the generous support of external sponsors. We also express our sincere thanks to all the delegates for choosing to patronize our conferences. Last, but not the least, I must thank Carlos Coelho, Luis Grilo and Satya Mishra who have been working tirelessly for more than a year and have taken care of all of the details regarding this conference.

Hope your deliberations at the conference are productive and your stay at Tomar is a pleasant one. I am looking forward to seeing you again in Shanghai in May 2007.

With best personal regards,
Sat Gupta
Conference Co-Chair, Forum President &
Professor of Statistics, UNCG

Carlos Agra Coelho



As Chair of the Local Organizing Committee and Co-chair of the Statistics, Combinatorics and Related Areas Conference 2006 – 13th International Conference of the Forum for Interdisciplinary Mathematics (SCRA2006/FIM XIII), held this year under the theme ‘Interdisciplinary Mathematical & Statistical Techniques’, I want to welcome all of you to this event.

We truly hope that you will have a very rewarding experience and that your stay in Tomar and in Portugal will be a pleasant and memorable one.

To this end it has certainly contributed the support of the Administrative Board of Faculdade de Ciências e Tecnologia of Universidade Nova de Lisboa, namely its President and the remarkable hard work of the whole team in Tomar. For all the good work done and the dedication, I want to leave here my earnest thanks to the site-coordinator in Tomar, my former Ph.D. student, Adjunct Professor Luís Miguel Grilo.



(Carlos Agra Coelho)

Satya Mishra



I, on behalf of the Conference Organizing Committee and the Governing Council of Forum for Interdisciplinary Mathematics (FIM), extend a very hearty warm welcome to all delegates of the FIM's Thirteenth International Conference on "Interdisciplinary Mathematical and Statistical Techniques" at the Polytechnic Institute of Tomar, Portugal and wish you a successful and fruitful meeting.

With the help of International, Local and Symposia Organizing Committees we are pleased to arrange such an incredible conference schedule. A fantastic slate of prodigious plenary and featured speakers is a testimony to the diligence of many of the members of the organizing committees, for that we thank everyone; without their efforts this gathering would not have been possible. Our special thanks go to Dr. Carlos Coelho, and his colleagues Professor J. T. Mexia and Dr. Luis Grilo who were instrumental in bringing this conference to Portugal. The organizers recognize your admirable efforts towards making this intercontinental assembly of mathematical scientists feasible.

As the name of our society suggests, developing diverse areas of mathematical sciences and their role in cross-disciplinary research has been the rationale behind the inception of it, the FIM continues to propagate and propel this theme through its conferences/workshops, and publications. While the interdisciplinary research has received much attention in the academe in past half-century, it is the prudent applications of mathematical sciences that have led to the newer discoveries of human knowledge; thus the functions of mathematical sciences that promote various scientific investigations leading to breaking new grounds in sciences and technologies are undisputable.

We hope your stay in Tomar-Lisbon and the conference experience will be enjoyable and productive. We at FIM thank you all for your patronage.

With warmest regards,

A handwritten signature in blue ink, appearing to read "Satya Mishra". The signature is written over a light blue horizontal line.

Satya Mishra
Immediate Past President and Chair-Conference Organizing Committee
September 1, 2006

Luís Miguel Grilo



Luís Merca Fernandes



September 1, 2006

Dear Participants,

The local organizing committee, the Mathematics Department and the Technology School of Tomar, welcome you to the SCRA and the Forum for Interdisciplinary Mathematics. For us it is an honor to have a conference of this magnitude on our campus and we congratulate each of you for your personal successes and thank you for visiting us here in Tomar.

Mathematic and Statistic developments have contributed hugely to the advance of all sciences. We are sure that the scientific quality of the invited and plenary sessions, as well as, the featured speakers will bring intellectual interactions and productive ideas across different areas of Science.

SCRA2006\FIM XIII would not exist without the help of many people. Among them we would like to thank our colleagues of the Mathematics Department for their important support. Thanks are also to our sponsors, listed in this booklet, for their contributions.

We will do everything possible to make your visit here a rewarding experience. We hope your stay in Tomar will be a pleasant one and that you may find yourselves attending a very productive conference.

Best wishes to everyone,

A handwritten signature in blue ink, appearing to read 'Luís Miguel Grilo'.

Luís Miguel Grilo
Mathematics Department
Polytechnic Institute of Tomar
Site coordinator – SCRA2006\FIM XIII

A handwritten signature in blue ink, appearing to read 'Luís Merca Fernandes'.

Luís Merca Fernandes
Director of Technology School
Mathematics Department
Polytechnic Institute of Tomar

FORUM FOR INTERDISCIPLINARY MATHEMATICS

A Multidisciplinary Academic Society

Mathematics is undoubtedly the best example of something universal in more than one way. Philosophers believed that the laws of universe are written in the language of mathematics, and it is now permeating in all human activity for over all advancement. In addition to captivating the human mind, Mathematical Sciences form a basis for all quantitative developments and research; be it technology, physical and engineering sciences, life and medical sciences, earth sciences, economics, behavioral and management sciences, and the likes. It also has been proven to be helpful in national defense, peace and devising public and social policies. Thus *Mathematical Sciences* is universal in its application and appeal and hence it has become an indispensable tool to more disciplines than ever before. The society has witnessed an explosive growth in mathematical sciences based technology knowledge in past twenty years, which (information technology) has changed the mode of thinking for all human kind, from classroom to boardroom.

Obviously, these changes also present an unprecedented degree of challenges to consumers, educators, policy makers and scholars working in all areas of human endeavors. The Forum for Interdisciplinary Mathematics (FIM or Forum) is one such international organization of scholars from various areas of mathematical sciences that is trying to ease the societal burden by fast communicating the scientific knowledge to all via conference, seminars and workshops, research publications and promoting exchange of scholars from and to India.

BRIEF HISTORY OF FORUM FOR INTERDISCIPLINARY MATHEMATICS AND ITS ACTIVITIES:

The Forum is a registered, India based international society of scholars working in mathematical sciences and its partner areas (a partner area is defined as one where some knowledge of mathematical sciences is desirable to carry out research and development). The society was incepted in 1975 by a group of University of Delhi intellectuals led by Professor Bhu Dev Sharma.

30th year Celebrations: The year 2005 marked its thirtieth anniversary and was celebrated with

- (i) A large workshop on "Fuzzy Sets" at Stella Maris College, Chennai, India, Workshop leader: Professor P. V. Subrahmanyam-IIT-Chennai (88 participants)
- (ii) A three-week Summer School in Statistical Applications, July 5-25, 2005, at the Allahabad Agricultural Institute-Deemed University-Organizing Secretary-Dr. Jitendra Kumar of AAIDU, 50 participants.
- (iii) FIM's Twelfth International conference SCMA2005-FIM XII at Auburn University, USA, December 2-5, 2005-Local Organizer: Mark Carpenter, Auburn University, USA, over three hundred participants.
- (iv) National Conference on the History of Mathematics and Recent Developments, Patna University, India, March 23-25, 2006.

International Conferences of FIM: FIM in the past has held successful international conferences in USA, India, Europe & Australia. Among its current flurries of conference activities that Forum has organized (its first two conferences were held in India during the decade of eighties):

1. Third International at the University of Southern Maine, USA, June 1997
2. Forth International at Banaras Hindu University, India, December 1997
3. Fifth International at the University of Mysore, India, December 1998
4. Sixth International at the University of South Alabama, USA, December 1999
5. Seventh International at the Indian Institute of Technology, Mumbai, India, December 2000

6. Eighth International at the University of Wollongong, Australia, December 2001
7. Ninth International at the University of Allahabad, December 2002
8. Tenth international at the University of Southern Maine, USA, October 2003.
9. Indian Association Productivity, Quality and Reliability, Kolkata, July 2002.
10. Eleventh International at the Institute of Engineering and Technology, Lucknow, India, December 2004
11. Twelfth International at the Auburn University, USA, December 2005
12. Thirteenth International at the Tomar Polytechnic Institute, Tomar, Portugal, September 2006.
13. Sponsorship to S. N. Roy Birth Centenary “*Multivariate Methods in Statistics International Conference*” at Indian Statistical Institute, Kolkata, India, December 28-20, 2006.
14. Sponsorship to International Indian Statistical Association’s Joint Statistical Meeting and International Conference on “*Statistics, Probability and Related Areas*” Cochin University of Science and Technology, India, January 2-5, 2007.

Some future planned conferences:

15. International conference at the University of Science and Technology of China-Shanghai Institute of Advanced Studies, Shanghai, China, May 20-23, 2007
16. International conference at the University of Memphis, Memphis, USA, May 16-19, 2008.
17. A mini-conference/workshop on Statistics- University of North Carolina-Greensboro, USA

Best Paper Awards to Ph.D. Students: Starting with the Eighth International Conference at the University of Wollongong, Australia, the Forum has started organizing and funding a symposium solely for the purpose of encouraging and awarding young researchers consisting of new Ph.D. awardees and aspirants, also known as Professor R.S. Varma Memorial Student Conference (RSVMSC). These symposia are well structured, critiqued and judged by the leading scholars from various areas of mathematical sciences, and at the conclusion of which a certificate and cash award are provided to the winners. In a very short time, RSVMSC has become popular among young investigators as FIM has appreciably realized their participation at its conferences.

Research Journals of FIM: The Forum, in addition to organizing cerebral confluences, also publishes two international periodical, *Journal of Combinatorics, Information and System Sciences* and a new quarterly, *Journal of Statistics and its Applications* in 2006; and is about to launch a new journal in “*Computer Science and Information Technology*.”

It is evidently visible from the international nature of the FIM’s conferences and its audience that Forum has brought a new energy among the mathematical scientists in the last two decades by providing them with an international bridge to encourage intellectual discourses and exchange of ideas with their counter-parts globally. Advancement of Indian mathematical scientists on the world stage has been one of Forum’s missions which it is achieving on a regular basis by sponsoring partial conference expenses and featuring their presentations abroad at our conferences. It has also featured Indian mathematical scientists as plenary speakers at the conferences in India as well as abroad. In addition to carrying out their scholarly duties, several members of the Governing Council of FIM are associated with the editorial boards of various journals. We trust that a best way to spotlight the academic credential of an intellectual is through publications in quality periodicals which lend visibility and recognition to the researcher’s personal scholastic achievements.

The Governing Council of the Forum for Interdisciplinary Mathematics is eternally grateful for the organizational support of the universities and institutes our conference have been associated with and hopes for comparable provisions for our future meetings.

A partial list of FIM’s past and present leaders is given below:

FIM'S PAST AND PRESENT PRESIDENTS:

Professor M. Dutta (1975-1978), Director S.N. Bose Institute of Physical Science and Professor of Mathematics, Calcutta University, Calcutta

Professor J. Das (1979-1981), Chairman and Professor, Department of Electrical & Communication Engineering, Indian Institute of Technology, Kharagpur.

Professor C. Radhakrishna Rao (1982-1986), Director, Indian Statistical Institute, New Delhi and Pennsylvania State University, College Park, Pennsylvania, USA

Professor Dijen K. Ray-Chaudhuri (1987-1989): Professor and Chairman, Department of Mathematics, Ohio State University, Columbus, OH, USA

Professor BhuDev Sharma (1990-1992) Professor at the University of West Indies, St. Augustine, Trinidad & Tobago.

Professor Jagdish N. Srivastava (1993-1994) Professor of Statistics, Colorado State University, Fort Collins, Colorado, USA.

Professor BhuDev Sharma (1995-1997) Professor of Mathematics and Chair-Department of Mathematics, Xavier University of LA, New Orleans, LA, USA

Professor M. M. Rao (1997-1998) Professor of Mathematics, University of California, Riverside, California, USA

Professor Satya Mishra (1999 - 2004) Professor of Statistics, University of South Alabama, Mobile, Alabama, USA

Professor Sat N. Gupta (2005 -), Professor of Statistics, University of North Carolina at Greensboro, Greensboro, North Carolina, USA

FIM'S PAST AND PRESENT VICE PRESIDENTS:

Professor S. S. Shrikhande, Bombay University, Mumbai, India

Professor D. D. Joshi, Agra University, Agra, India

Professor G. C. Patni, University of Rajasthan, Jaipur, India

Professor J. Das, Indian Institute of Technology, Kharagpur, India

Professor Jagdish N. Srivastava, Colorado State University, Fort Collins, Colorado, USA

Professor M. N. Vartak, Indian Institute of Technology- Bombay, Mumbai, India

Professor M. Dutta, Calcutta University, Calcutta, India

Professor M. C. Gupta, Rajasthan University, Jaipur, India

Professor Laveen N. Kanal, University of Maryland, College Park, Maryland, USA

Professor P. B. Bhattacharya, University of Delhi, Delhi, India

Professor J. K. Ghosh, Director Indian Statistical Institute, Calcutta, India

Professor Keshav Dutta Sharma, Indian Institute of Technology, New Delhi, India

Professor A. M. Mathai, University of Montreal, Montreal, Canada

Professor R. P. Krishaniah, Pennsylvania State University, Pennsylvania, USA

Professor E. Sampathkumar, Mysore University, Mysore, India

Professor D. K. Ray-Chaudhuri, Ohio State University, Columbus, Ohio, USA

Dr. I. J. Kumar, Director, Scientific Analysis Group, Delhi, India

Professor K. B. Misra, Indian Institute of Technology-Roorkee, India

Professor O. P. Sharma, Indian Institute of Technology- Delhi, India

Professor S. M. Sinha, University of Delhi, Delhi, India

Professor Dharam Vir Chopra, Wichita State University, Wichita, Kansas, USA
Professor M. L. Manocha, Indian Statistical Institute, New Delhi, India

Professor N. M. Singhi, Tata Institute of Fundamental Research, Bombay, India
Dr. B. D. Acharya, Director, Department of Science & Technology, New Delhi, India
Professor M. M. Rao, University of California, Riverside, California, USA
Professor Satya Mishra, University of South Alabama, Mobile, Alabama, USA

Professor D. Raghavarao, Temple University, Philadelphia, Pennsylvania, USA

Professor D. S. Hooda, Haryana Agricultural University, Hissar, India

Professor Sat N. Gupta, University of Southern Maine, Portland, Maine, USA
Professor Bikas Sinha, Indian Statistical Institute, Kolkata, India
Professor Kum Kum Dewan, Jamia Millia Islamia, New Delhi, India
Professor Narsingh Deo, Central Florida University, Orlando, Florida, USA
Professor Arun Kumar Sinha, Patna University, Patna, India
Professor Ashis SenGupta, Indian Statistical Institute, Kolkata, India
Professor Yogendra Chaubey, Concordia University, Montreal, Canada
Professor B. K. Dass, University of Delhi, Delhi, India

FIM'S PAST AND PRESENT GENERAL SECRETARIES:

Professor BhuDev Sharma (Delhi University, then UWI, Trinidad, and now in USA),
Professor B. K. Dass (University of Delhi, Delhi, India),
Professor Sat N. Gupta (then at University of Southern Maine, Portland, ME, now in North Carolina, USA),
Professor Ravinder Kumar (Alcorn State University, Mississippi, USA),
Professor Prasanna Sahoo (University of Louisville, Louisville, Kentucky, USA).

FORUM FOR INTERDISCIPLINARY MATHEMATICS'

Collective Vision for

Center of Excellence in Interdisciplinary Mathematics

OBJECTIVES OF THE FIM

The major objectives of the 'Forum for Interdisciplinary Mathematics' (FIM) as per the deed of registration, are the following:

- (a) To encourage and promote the study and research in Mathematics, Science and Technology, applications of Mathematics, and areas interdisciplinary with mathematics.
- (b) To further the cause of education by providing education and carrying on researches in the field of arts, sciences, commerce, management, technology, engineering, pharmaceutical, computers, medicines, surgery, nursing, agriculture both formal and informal, academic and/or practical, and all such other modes of learning and instructions leading to awarding of certificates, diplomas, degrees and non-degree programmes.
- (c) To give financial assistance by way of providing scholarships, books, payment of fees and other expenses to help the deserving students/fellows to continue in pursuance of higher education.
- (e) Printing and/or publishing of journals, brochures, magazines, pictorial features, periodicals, books, pamphlets, posters, souvenirs, films, cassetts connected with education and publicity of education.
- (f) Arranging and/or holding conferences, seminars, symposia, exhibitions, meetings, lectures, discussions, competitions.
- (g) To provide facilities for research in the above fields of studies.
- (h) To serve different organisations in the above fields as consultants.
- (i) To carry out surveys in various branches relating to above activities

NEED FOR THE CENTER OF EXCELLENCE

Mathematics is at the very roots of all quantitative developments and research; be it technology, physical and engineering sciences, life and medical sciences, earth sciences, economics and management sciences, and the likes. It also has been proven to be helpful in national defense, peace and devising public and social policies. *Mathematical studies are* universal in their application and appeal and have hence become an indispensable tool to more disciplines than ever before. The society has witnessed an explosive growth in mathematical sciences based technology knowledge in past thirty years, which (information technology) has changed the mode of thinking for all human kind, from classroom to boardroom. Just as the frontiers of research in mathematics have widened so are fast changing its methods of teaching and instructions.

Obviously, these changes also present an unprecedented degree of challenges to consumers, educators, policy makers and scholars working in all areas of human endeavors. The Forum for Interdisciplinary Mathematics (FIM or Forum) is one such international organization of scholars from various areas of mathematical sciences that is actively pursuing developing interdisciplinary form at the global level, via conferences, seminars and workshops, research publications and promoting exchange of scholars from and to India.

Future scientific advancements will depend on the development of mathematics by interacting with other disciplines. FIM as an academic body serving most of it mission. It was conceived over 30 years ago and has been nurtured by many outstanding scholars.

There is need to institutionalize the work of FIM in the field of interdisciplinary mathematics. It is proposed to establish a Center *par excellence* in mathematical sciences and applications, covering mathematics and disciplines interdisciplinary to mathematics. The Center will be sponsored by the Forum for Interdisciplinary Mathematics and have its physical location in India. The Center will provide a platform for ‘meeting of the minds’ to devise strategies, both long term & short term to foster academic and research environment in mathematics interacting with other disciplines, nationally and internationally. The Center will also conduct research on improving instructions of mathematics at different levels and for different service areas.

SCOPE OF ACTIVITIES OF THE CENTER

The Center will

1. Undertake research in different areas;
2. Organize advanced courses;
3. Publish research journals, research monographs and other instruction material;
4. Periodically hold workshops and seminars on the current emerging topics led by the front runners in the fields that will open new areas of research for the Indian scholars.
5. Establish a regular exchange program for scientists to and from India and arrange for their lectures at different academic institution in India and abroad for fast dissemination of knowledge and thereby bringing “the state of art” information to all.
6. House a decent size technologically well equipped facility to conduct these workshops and seminars.
7. House a decent size technologically well equipped library to accommodate most modern needs.
8. Fund selected annual fellowships in India for advance mathematical scientific activities and reward the academic excellence.
9. Fund select workshops, symposia and conferences in the area of mathematical sciences to promote academic excellence.
10. Increase general awareness in the mathematical sciences and partners areas via sponsoring general lectures at various institutions in India.
11. House a lodging facility for the scholars visiting from other areas of the country or abroad.
12. Institute awards and merit recognitions.
13. Nurture talented & gifted students through scholarships, prizes.
14. Lobby and promote our successful curricula internationally.
15. Identify, adopt & nurture child prodigies who go unnoticed;
16. Network with national & international academic & research institutions for designing ‘co-operative’ experiences, at the student level, at the faculty level, and at the administrative levels.
17. Promote critical scientific research in the context of Indian milieu about ‘concept formation’ in mathematics: how children learn mathematics and how they assimilate it.
18. Provide a set-up for ‘pure’, ‘abstract’ research in mathematical sciences by making available appropriate resources (off-line & on-line).
19. Provide a set-up for research in applications of mathematical sciences by making available appropriate resources (off-line & on-line).
20. Promote a ‘Scholars-in-Residence’ program where national/international scholars of repute can spend sabbatical semester/term/year.

STRUCTURE OF THE CENTER

The center will have the structure of an Institution that will combine several units/divisions for research, advanced studies, publications, conferences, talent search and nurturing. It will have library and other resource centers. Some examples of the divisions are the following:

1. Have divisions in several areas of research, with active research groups; such as Division of Mathematics, Division of Applied Mathematics, Division of Statistics, Division of Information Technology, etc
2. Have a Division of Publications—for publishing journals and research monographs;
3. Have Division of Conferences – hold international conferences and regional symposia and seminars;
4. Division for Colloquia Organization-Colloquia on advanced topics of active research or those that could be introduced as elective new courses at the post-graduate levels;
5. Division of Teachers' Training and Refresher Courses;
6. Division of Talent Search- talented & gifted students at an early stage through testing at various exit points.
7. Division of Student Competition-competitions, Olympiads, national & international competitions/Olympiads;

Steering Committee: The following individuals have agreed to serve on the Steering Committee:

- (i) Professor Satya Mishra, Chair, University of South Alabama, USA
- (ii) Professor K. K. Agrawal-Vice-Chancellor, Indraprastha University
- (iii) Professor Man Mohan Singh Arora, Clark Atlanta University, USA
- (iv) Professor Bal Kishan Dass, University of Delhi, India
- (v) Professor Narsingh Deo, University of Central Florida, USA
- (vi) Professor Sat Gupta, University of North Carolina, USA
- (vii) Professor D. S. Hooda, JP Institute of Engineering and Technology, India
- (viii) Professor Sham Navathe-Georgia Institute of Technology, USA
- (ix) Professor BhuDev Sharma-Clark Atlanta University, USA

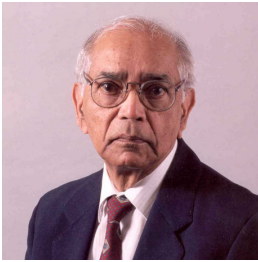
The Forum estimates the Center to be operational by the end of 2007.

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<http://erdos.math.louisville.edu/~pksaho01/fim.html>

INVITED PLENNARY SPEAKERS

C. R. Rao



Professor C. R. Rao, his complete name, Calyampudi Radhakrishna Rao, was born on September 10, 1920, in a small town in south India called Huvvinna Hadagalli. At his father suggestion he went to study Mathematics and he earned his MA degree in Mathematics from Andhra University in 1940, with first class rank and honors. Later on he joined the Indian Statistical Institute in Calcutta, established by Prasanta Chandra Mahalanobis in 1931, where he got another MA degree in Statistics in 1943, which he completed with first class rank, first class honors and a gold medal. In 1946 he sailed for England where he got his Ph. D. from the Cambridge University in 1948 with the Thesis entitled 'Statistical Problems of Biological Classification'. In 1965 the same University awarded him the Sc.D. degree, based on his overall contributions to statistical theory and applications.

C. R. Rao returned to India from Cambridge in August 1948, being offered by Professor Mahalanobis a professorship at the Indian Statistical Institute as well as the headship of the Research and Training School. Under his leadership, the Research and Training School gradually expanded its teaching and research activities, earning quite soon a reputation as a center for advanced study, research, and consultation, attracting brilliant students and statistical practitioners for courses in statistical theory and applications. As its only professor, C. R. Rao had the responsibility of guiding the work of all the research scholars. He quickly earned a reputation as an inspiring teacher, and over the years about 50 students have completed Ph.D. theses under his guidance.

C. R. Rao served as Professor and the Head of the Research and Training School from 1949 to 1963, and then as Director from 1963 to 1972. After the death of P. C. Mahalanobis in 1972, C. R. Rao was appointed Director and Secretary of the Indian Statistical Institute, the position he held from 1972 to 1976.

In 1979 he took leave from the Indian Statistical Institute and went to the United States to accept a University Professorship at the University of Pittsburgh. He moved to The Pennsylvania State University in 1988, where he was offered the Eberly Family Chair in Statistics and chaired as Director the Center for Multivariate Analysis.

C. R. Rao was elected Fellow of the Royal Society, London, in 1967, and Member of the National Academy of Sciences, U.S.A., in 1995. He is also an Honorary Fellow of the Royal Statistical Society (1969), the Calcutta Statistical Association (1985), the Finnish Statistical Society (1990), and the Institute of Combinatorics and Applications (1995), and an Honorary Member of the International Statistical Institute (1983) and the International Biometric Society (1986). He has served as President of the Indian Econometric Society (1971-1976), the International Biometric Society (1973-1975), the Institute of Mathematical Statistics (1976-1977), the International Statistical Institute (1977-1979), and the Forum for Interdisciplinary Mathematics (1982-1984).

Fully recognized as one of the world leaders in Statistical Science over the last six decades, Professor C. R. Rao is considered by many the major statistician of all times. His research and professional activities had and still have a profound influence on the theory and applications of Statistics. Results such as the 'Cramer-Rao lower bound' and the Rao-Blackwell Theorem are only two well-known examples of remarkable results to which his name is attached. Professor C. R. Rao has developed work in almost all areas of Statistics and in many of the Mathematical related areas, such as Linear Algebra and Combinatorics, having received a large number of prizes and awards for his work, among which we may refer the Gold Medal from the Calcutta University, the Samuel S. Wilks Medal from the American Statistical Association in 1989, and National Medal of Science from the United States of America in May 2002 "for his pioneering contributions to the foundations of statistical theory and multivariate statistical methodology and their applications, enriching the physical biological, mathematical, economic and engineering sciences" and in 2003 the International

Mahalanobis Prize from the International Statistical Institute for 'lifetime achievement in statistics and the promotion of best statistical practice'.

Professor C. R. Rao has so far been awarded over 30 Honorary degrees by Universities around the world, among which we may refer The University of Delhi (India) in 1973, the Ohio State University (USA) in 1979, the Tampere University (Finland) in 1985, the University of Neuchatel (Switzerland) in 1989, the Colorado State University (USA) in 1990, the University of Poznan (Poland) in 1991, the University of Barcelona (Spain) in 1995, the University of Munchen (Germany) in 1995, the University of Waterloo (Canada) in 1997, the University of Brasília (Brazil) in 1998, the Kent State University (USA) in 2000 and Calcutta University (India) in 2003. The Honoris Causa degree awarded by Universidade Nova de Lisboa in 2006 is a continuation of many such honors bestowed upon the finest Statistician of our times.

Statistics: Reflections on the past and visions for the future

by

C. R. Rao

Department of Statistics, Penn State University, U.S.A.

By the forties of the last century, the mathematical foundations of statistics were laid by Fisher, Neyman and Wald using stochastic models for observed data, and by Pitman using a model free approach. The probabilistic basis for statistical theory was laid by Kolmogorov. Subsequent research in statistics and the courses taught in the universities were mostly based on the guidelines set by these pioneers. On the applied side, statistics began to be used in all areas of human endeavor from scientific research to decision making in governmental work, business and industry, medical diagnosis and even in courts of law.

With the technological developments in data acquisition on a large scale and computing power, the character of statistics began to change in last quarter of the last century. The use of classical statistics based on stochastic models is thought to be unrealistic and algorithmic (black box approach) to data analysis is advocated. Some of the basic methodologies like tests of significance are found to be inappropriate. Different schools of statisticians such as Bayesians, non Bayesians and advocates of likelihood as containing the whole information in data have come up with the result that different statisticians may come out with different conclusions using the same data. Further, collaboration between statisticians and practical research workers which enabled rapid growth of statistics in the past has been gradually disappearing.

Some methods are being put forward in the name of data mining with a promise of meeting the needs of customers for quick on line processing of data for immediate use. A broad review of the past and the changing trends in statistics will be presented and some possible future developments will be discussed.

Barry C. Arnold



Professor Barry C. Arnold is Distinguished Professor of Statistics at the University of California, Riverside. He received his Ph.D. from Stanford University in 1965 and subsequently was a Professor of Mathematics and Statistics at Iowa State University for 14 years before moving to Riverside. His recent research has focused on multivariate models (especially those involving conditional specification and hidden truncation) and order statistics. He is a Fellow of AAAS, ASA and IMS and an elected member of ISI.

Univariate and bivariate distributions for axial and/or directional data

by

Barry C. Arnold

University of California , Riverside, USA

Coauthors: Ashis SenGupta

Observations on random directions, measured in radians, and thus constrained to take on values in the interval $[0, 2\pi)$, are called directional data. Axial data, encountered when the observed random direction vectors do not have an identified starting point, are recognizable as directional data modulo π . We will survey univariate models (many of which are well known) for such data and will suggest some related (less well known) bivariate models, together with natural multivariate extensions.

Francine Blanchet-Sadri



Francine Blanchet-Sadri is Professor of Computer Science at the University of North Carolina at Greensboro. She has published numerous articles on formal languages, combinatorics on words, and automata theory. Her research has been supported through several grants from the National Science Foundation.

Partial Words

by

Francine Blanchet-Sadri

Department of Mathematical Sciences, University of North Carolina, P.O. Box 26170, Greensboro, NC 27402-6170, USA

Strings of symbols from a finite alphabet, also referred to as *words*, have long been studied in Mathematical Sciences. In this talk, we will investigate *partial words* that are strings that may contain a number of "do not know" symbols. While a word can be described by a total function, a partial word can be described by a partial function. More precisely, a partial word of length n over a finite alphabet A is a partial function from $\{0, \dots, n-1\}$ into A . Elements of $\{0, \dots, n-1\}$ without an image are called holes (a word is just a partial word without holes). We will examine to which extent some properties of words, such as periodicity, remain true for partial words. In particular, we will extend to partial words some fundamental periodicity results on words: (1) the well known and basic result of Fine and Wilf which intuitively determines how far two periodic events have to match in order to guarantee a common period; and (2) the well known and unexpected result of Guibas and Odlyzko which states that the set of all periods of a word is independent of the alphabet size.

Carlos A. Braumann



Born September 4, 1951, in Lisboa (Portugal). In 1973, he has obtained a Licenciatura degree (5 years) in Applied Mathematics at the University of Luanda (best University student prize). He was a teaching assistant (“monitor”) from 1971 to 1973 at the University of Luanda, became an Assistant there and in 1975 moved to the University of Évora, also as an Assistant.

From 1976 to 1979, he stayed at the State University of New York at Stony Brook (SUNY-SB) as a Ph. D. student. Having obtained the Ph. D. degree at SUNY-SB in 1979, he became assistant professor, later associate professor and, since 1989, professor (“professor catedrático”) at the University of Évora (U.E.), where he now heads the Department of Mathematics and the Departmental Area of Exact Sciences. At U.E. he held many other official functions, among which Director of the Research Centre of Mathematics and Applications, President of the Scientific Council, and Vice-Rector. He has been visiting professor/researcher at several Universities in Europe and the USA for short periods.

His research and most publications are concerned with stochastic differential equations and their biological (and occasionally financial) applications. In 1992 he was elected member of the International Statistical Institute (ISI).

He was President of the Organizing Committee and main Editor of the Proceedings of the XV Jornadas Luso-Espanholas de Matemática (Évora, 1990) and of the XII Congresso Anual da Sociedade Portuguesa de Estatística (Évora, 2004). He has also served in organizing and scientific committees and gave invited talks in many national and international scientific meetings. He is now President of the XIV Congresso Anual da Sociedade Portuguesa de Estatística (Covilhã, 2006) and member of the organizing and scientific committees of the 56th Session of the ISI (Lisboa, 2007) (serving also in the scientific committee of one of its satellite conferences) and of the CMDP2 – Computational and Mathematical Population Dynamics (joint meeting DESTOBIO 4 + MPD8, Campinas, Brasil, 2007).

He is currently President of the Portuguese Statistical Society, member of the Board of the European Society for Mathematical and Theoretical Biology, and Portuguese representative at CEIES (the European Union consultative committee for statistical issues).

Population Growth in Random Environments: Some Issues Concerning Stochastic Differential Equation Models

by

Carlos A. Braumann

CIMA-UE (Centro de Investigação em Matemática e Aplicações da Universidade de Évora)

Stochastic differential equation models for population growth in a random environment have been around since the pioneer work of Levins (1969, Proc. Natl. Acad. Sci. USA 62: 1061-1065). However, although little is known about the growth rate functional form, models in the literature assume specific functional forms. Therefore, conclusions may be a property of the model rather than of populations. We have been studying the properties of general models, where the growth rate, instead of assuming a specific functional form, is a general function satisfying reasonable assumptions dictated by biological considerations, so that we can reach conclusions that reflect properties of populations.

Let $N=N(t)$ be the population size at time t . We model the per capita growth rate $(1/N)dN/dt$ as an “average” per capita growth rate $g(N)$ plus fluctuations induced by environmental randomness, which we assume can be

approximated by a white noise. For $N > 0$, the growth rate $g(N)$ is assumed to be a C^1 decreasing function of population size (reflecting intraspecific competition) that is negative for sufficiently high population sizes. We also assume that the limit $G(0+)$ exists and is equal to zero, where $G(N)=Ng(N)$. These are assumptions that are biologically reasonable for every population (without Allee effects). The model takes the form

$$(1/N) dN/dt=g(N)+\sigma\varepsilon(t),$$

where $\sigma > 0$ is an intensity parameter and $\varepsilon(t)$ is a standard white noise.

For these models we determine conditions for extinction and non-extinction, as well as conditions for existence of a stationary density (a kind of stochastic equilibrium with ergodicity).

The conditions depend on the stochastic calculus (Ito or Stratonovich) used. In particular, the qualitative results concerning extinction differ according to the calculus used. That led to a considerable controversy in the literature. We resolve the controversy by showing that the “average” growth rate $g(N)$ indeed means a different type of average according to the calculus used (arithmetic for Ito, geometric for Stratonovich), and that, taking into account the difference between the two averages, the two calculi yield exactly the same result.

Tadeusz Calinski



Professor Emeritus at the Department of Mathematical and Statistical Methods of the Agricultural University of Poznan (Poland), has a Doctorate by the Agronomic University of Poznan is member of several professional associations as: The International Biometric Society (Council Member: 1982-1985), International Statistical Institute (elected in 1974), Bernoulli Society for Mathematical Statistics and Probability, The Institute of Mathematical Statistics (USA), Polish Biometric Society (Scientific Council Member), Polish Mathematical Society, The Poznan Society of Friends of Sciences, Dept. of Agricultural and Sylvicultural Sciences and the Committee for the Mathematical Sciences of the Polish Academy of Sciences. His research area is Mathematical Statistics and Biometry, with applications in Agriculture, Natural Sciences, Biology and Genetics. He is author of the books:

Calinski, T. & Kageyama, S. (2000). Block Designs: A Randomization Approach, Vol. I: Analysis. Lecture Notes in Statistics 150. Springer-Verlag, New York.

Calinski, T. & Kageyama, S. (2003). Block Designs: A Randomization Approach, Vol. II: Design. Lecture Notes in Statistics 170. Springer-Verlag, New York.

and of more than 130 papers in refereed Journals.

On some results of C. Radhakrishna Rao applied to the analysis of multi-environment variety trials

by

Tadeusz Calinski

Department of Mathematical and Statistical Methods, Agricultural University of Poznan, Poland

The analysis of results of a series of experiments repeated at several environments with the same set of plant varieties (genotypes) is usually based on a mixed effects model. Because of possible different responses of the varieties to variable environmental conditions, the standard mixed model for that analysis becomes questionable. Therefore, a more general mixed model is to be considered. However, in its most general form it involves usually a large number of variance and covariance components to be estimated. This causes computational problems, even when using advanced algorithms, unless some simplifying structures are imposed on the general covariance matrix. It appears, that one can avoid these problems when adopting a classic method proposed by Rao (1972, Section 6). This method has been explored recently by Calinski et al. (2005).

The purpose of the present paper is to show the use of that and some other theoretical results of C. Radhakrishna Rao in detail.

Key words: Estimation; More general mixed effects model; Series of experiments.

References:

Calinski, T., Czajka, S., Kaczmarek, Z., Krajewski, P., and Pilarczyk, W. (2005). Analyzing multi-environment variety trials using randomization-derived mixed models *Biometrics* 61, 448-455.

Rao, C. R. (1972). Estimation of variance and covariance components in linear models. *Journal of the American Statistical Association* 67, 112-115.

Richard Davis



Richard Davis is a Professor in the Department of Statistics at Colorado State University. In 1979, he received a PhD degree in Mathematics from the University of California at San Diego, where he studied under the direction of Professor Murray Rosenblatt. He spent two years, 1979-1981, as an Instructor in Applied Mathematics at MIT before joining CSU as an Assistant Professor in Statistics. He has also held visiting appointments at several institutions, including the Center for Stochastic Processes at the University of North Carolina, the University of California at San Diego, the University of New South Wales, and the Melbourne Institute of Technology. Davis is a fellow of the Institute of Mathematical Statistics and the American Statistical Association, and is an elected member of the International Statistical Institute. He is co-author (with Peter Brockwell) of the best selling books, *Time Series: Theory and Methods*, *Introduction to Time Series and Forecasting*, and the time series analysis computer software package, *ITSM 2000*. In 1998, he won (with collaborator W.T.M Dunsmuir) the Koopmans Prize for Econometric Theory. He has been on the editorial boards of *Stochastic Processes and Their Applications*, *Annals of Applied Probability*, and the *Journal of Statistical Planning and Inference*. Currently, he is the Statistics Editor of the *Proceedings of the American Mathematics Society* and serves as the co-organizer (with James Stock of Harvard University) of the annual time series workshops sponsored by the National Bureau of Economic Research and the National Science Foundation. Recently, with colleagues in the statistics department, he was awarded an EPA-STAR grant that is used to support the Department's Space-Time Aquatic Resources Modeling and Analysis Program (STARMAP). In addition, the Departments of Biology, Mathematics and Statistics, along with quantitative ecologists at CSU, were awarded a NSF IGERT entitled "Program for Interdisciplinary Mathematics, Ecology, and Statistics (PRIMES)". Davis is the PI of the grant and with Don Estep, is co-director of PRIMES. He served as Chair of the Department of Statistics 1997-2005.

Break Detection for a Class of Nonlinear Time Series Models

by

Richard A. Davis

Colorado State University

Coauthors: Thomas C.M. Lee (Colorado State University), Gabriel Rodriguez-Yam (Universidad Autónoma Chapingo)

This research considers the problem of detecting break points for a broad class of non-stationary time series models. In this formulation, the number and locations of the break points are assumed unknown. Each segment of the time series is assumed to follow a parametric time series model. The minimum description length is used as a criterion for estimating the number of break points, the location of break points, and the parametric model in each segment. The best segmentation, found by minimizing the MDL, is obtained using a genetic algorithm. The implementation of this approach is illustrated using various nonlinear models for the segments such as GARCH, stochastic volatility, and generalized state-space models. Empirical results show the good performance of the estimates of the number of breaks and their locations for these various models.

Angela Dean



Angela Dean is Professor of Statistics at The Ohio State University. She is a Fellow of the American Statistical Association, the Institute of Mathematical Statistics, and an elected member of the International Statistical Institute. She is an Associate Member of the Southampton Statistical Sciences Research Institute at the University of Southampton, England. Professor Dean has served on the editorial board of the Journal of the Royal Statistical Society and Technometrics and as a guest editor for an issue of Metrika. She served as Program Chair for the Section on Physical and Engineering Sciences of the ASA for the Joint Statistical Meetings 2005. Professor Dean has authored or co-authored 65 research papers, a text book in experimental design and co-edited a book on "Screening". She has graduated 11 PhD students and is currently advising three more.

Optimal experimental design for hyperparameter estimation in hierarchical linear models with application to marketing.

by

Angela Dean

Statistics Department, The Ohio State University, Columbus, Ohio, USA

Coauthors: Qing Liu and Greg Allenby, Statistics and Marketing Departments, The Ohio State University

Marketing, and business in general, requires an understanding of when effect sizes are expected to be large and when they are expected to be small. Gaining an understanding of the contexts in which consumers are sensitive to promotional offers, and to other variables such as price, is an important aspect of merchandising. Hierarchical models are today being used successfully to estimate the importance of product attributes in the presence of subject heterogeneity. In this talk, experimental designs for the efficient estimation of the hyperparameters in a hierarchical linear model will be discussed and illustrated through a study of the "level effect" in conjoint analysis. The level effect is the phenomenon, observed in many psychological and marketing studies, that the importance of a factor as perceived by a respondent increases with the number of levels presented to that respondent.

Malay Ghosh



Malay Ghosh is a Distinguished Professor of Statistics in the University of Florida. He holds Bachelor and Masters degrees from the Calcutta University, and a Ph.D. degree in Statistics from the University of North Carolina at Chapel Hill.

Dr. Ghosh has previously taught at the Indian Statistical Institute and Iowa State University. He held also Eugene Lukacs Distinguished Visiting Professorship at the Bowling Green State University and visiting professorships in the University of Minnesota and Texas A & M University. Dr. Ghosh was a Senior Research Fellow twice at the United States Bureau of the Census and once in the Bureau of Labor Statistics. He is an elected Fellow of the American Statistical Association and of the Institute of Mathematical Statistics, and is an elected member of the International Statistical Institute. Dr. Ghosh is the former editor of *Sequential Analysis*. His current

research interests are Bayesian Statistics, Small Area Estimation, Case-Control Studies, Machine Learning and Theory of Inference.

Estimation for Semiparametric Additive Hazards Regression Models

by

Malay Ghosh

University of Florida

The paper considers empirical Bayesian inference for semiparametric additive hazards regression models of Aalen by using gamma-process priors on the unknown baseline cumulative hazard. The marginal likelihood obtained after integrating the prior process can be maximized using standard statistical softwares, and empirical Bayes estimates of regression parameters, survival curves, and the corresponding standard errors have easy to compute closed form expressions. Asymptotic properties of semiparametric empirical Bayes estimators are found in a special case. The methodology is illustrated via a reanalysis of a survival dataset using existing statistical softwares such as SAS.

Steven G. Gilmour



His research interests are in the statistical theory of designed experiments, methodology for planning and analysis developed from that theory and the application of this methodology. Much of his research has been motivated by applications in research and development for the processing industries (such as pharmaceuticals, foods, agrochemicals and household chemicals) and in the sciences underpinning these industries (such as biochemistry, food science, chemical engineering and iotechnology).

He is a Member of the consultative committee for Revista de Matemática e Estatística and an Associate Editor for Applied Statistics. He is also an elected member of the International Statistical Institute (since 2003) and a member of the Royal Statistical Society, the International Biometric Society and the American Statistical Association.

Classical and Bayesian Analysis of Multi-Stratum Designs

by

Steven Gilmour

Queen Mary, University of London

Many industrial and laboratory based experiments involve studying some factors which are hard, time-consuming or expensive to change and other factors which can be changed more easily. It is now well-recognised that varying some factors more quickly than others leads to split-plot or other multi-stratum structures. The state-of-the-art method for analysing data from such experiments is to estimate the random effects using residual maximum likelihood (REML) and the fixed effects using generalised least squares (GLS). In this talk, I will show some of the dangers in using the REML-GLS methods, especially when there are relatively few main plots. Although these methods have good asymptotic properties, there is no reason why they should perform well in small samples. In fact, it is quite common for REML to estimate the main plot variance component to be zero, simply because there is insufficient data to estimate it. Then GLS produces the same answers as if the experiment were completely randomised. Instead I will explore purely frequentist and purely Bayesian analyses. The frequentist method makes clear that the main plots variance component cannot be estimated, so that no inference on the main plot factors is possible. The Bayesian analysis uses prior information on this variance component and produces inferences on the main plot factors which is sensitive to this prior information. The choice of analysis depends on the objectives, but either of these is preferable to REML-GLS.

M. Ivette Gomes



M. Ivette Gomes obtained her Ph.D. in Statistics in 1978 from the Department of Probability and Statistics, Sheffield University, after studying Mathematics at the Faculty of Science, Lisbon University. She has been a Full Professor at the Department of Statistics and Operations Research (DEIO), Faculty of Science, University of Lisbon, since 1985. Her main research interests are in statistical and probabilistic modelling and inference, particularly in connection with extreme values, statistical quality control, non-parametric and re-sampling methodologies.

She has published around 100 national and international papers and has made approximately 120 presentations at scientific meetings. She has supervised fifteen Ph.D.'s and seventeen M.Sc.'s dissertations. She has been President of the Portuguese Statistical Society (SPE) from 1990 until 1994. President of DEIO from 1995 until 1997 and Director of the Research Centre on Statistics and Applications (CEAUL) from July 1999 until July 2006. She was Associate Editor of "Portugaliae Mathematica" from 1994 until 2001 and has been Chief-Editor of RevStat, since 2003.

Accommodating bias in the excesses over a high intermediate order statistic: reduced bias extreme value index estimation for heavy tails

by

M. Ivette Gomes

University of Lisbon, Faculty of Science (DEIO) and CEAUL

Coauthors: Lúcia Rodrigues (Polytechnic Institute of Tomar and CEAUL, University of Lisbon)

Given a random sample, (X_1, X_2, \dots, X_n) from a heavy-tailed parent with extreme value index $\gamma > 0$, let us consider the associated sample of ascending order statistics, $(X_{1:n} \leq X_{2:n} \leq \dots \leq X_{n:n})$. We shall here work with the excesses over the high random threshold $X_{n-k:n}$, i.e., with $W_{ik} := X_{n-i+1:n} - X_{n-k:n}$, $1 \leq i \leq k$, being $k=k_n$ an intermediate sequence of integers between 1 and n . In a way similar to the one used in Gomes *et al.* (2004) with the log-excesses, we shall now try to accommodate bias in the excesses, assuming that W_{ik} comes from a Generalized Pareto (GP) model, dependent on adequate unknown parameters, α , β , γ and ρ . We then arrive at the maximum likelihood extreme value index estimator, $GP(k)$, obviously dependent on the maximum likelihood estimators of the unknown parameters α , β and ρ . If we do not estimate α through maximum likelihood, but we further think that for heavy tails, a possible estimator of the scale parameter α in the GP model is $\{1/X_{n-k:n}\}$, we come to the *Weighted Hill* estimator, $WH(k)$, introduced in Gomes *et al.* (2004). In this paper we shall first give a motivation for the estimators $GP(k)$ and $WH(k)$, assuming that all the model parameters, but the extreme value index, are known. Next we shall briefly review the estimation of the second order parameters. The ultimate goal of the paper is the comparative behaviour of the estimators $GP(k)$ and $WH(k)$, both asymptotically and for finite samples, through the use of Monte Carlo simulation techniques.

Application to real data in the fields of finance and insurance is also provided.

1. Gomes, M. I., de Haan, L. and Rodrigues, L. (2004). *Tail index estimation through the accommodation of bias in the weighted log-excesses*. Notas e Comunicações CEAUL 14/2004. Submitted.
2. Hill, B. M. (1975). A simple general approach to inference about the tail of a distribution. *Ann. Statist.* **3**, 1163-1174.

Samad Hedayat



S. Hedayat is an alumnus from Cornell University and a distinguished Professor at department of Mathematics, Statistics, and Computer Science at University of Illinois at Chicago. He is a Fellow of both Institute of Mathematical Statistics and the American Statistical Association. He is currently on the editorial board of the Journal of the American Statistical Association and has served on the editorial boards of several other journals including 9 years as an Associate Editor of the Annals of Statistics and many years as a Coordinating Editor of the Journal of Statistical Planning and Inference. For more information on him check his website <http://tigger.uic.edu/~hedayat/>.

An Editorial Road Map to Scientific Publications

by

Samad Hedayat

Department of Mathematics, Statistics, and Computer Science, University of Illinois at Chicago

In this presentation I shall share with the audience and in particular with the young investigators my many years of editorial works with The Annals of Statistics, The Journal of the American Statistical Association, The Journal of Statistical Planning and Inference and several other peer reviewed journals. While submitting your research works for possible publication it is very important to distinguish between societies sponsored journals and those by professional publishers. I will make my recommendation when to submit and when to avoid submitting your research contributions to such journals. It is very important to know with whom you should or should not coauthor your papers. In short, you should know how to market your research product in a best possible way.

Benjamin Kedem



Benjamin Kedem was born in Tel Aviv, Israel, in 1944. He received his PhD degree in statistics from Carnegie-Mellon University, Pittsburgh, PA, in 1973. He is a Professor in the Mathematics Department, and affiliated with the Institute for Systems Research, University of Maryland, College Park, and is currently a visiting professor in the Department of Applied Mathematics and Computer Science, Weizmann Institute of Science, Rehovot, Israel. His research interests include time series analysis, spatial statistics, semi-parametric inference via density ratio modeling, and rainfall measurement from space. He is the recipient of the IEEE 1988 W.R.G. Baker award, and a 1997 NASA/Goddard award. He is a fellow of the American Statistical Association.

Time Series Analysis by Higher Order Crossings

by

Benjamin Kedem

Department of Mathematics and Institute for Systems Research, University of Maryland, College Park

Higher Order Crossings (HOC) analysis of time series is a way to study oscillation of stochastic processes combinatorially by counting. The methodology provides an alternative to commonly used spectral methods. The basic idea behind HOC is to combine zero-crossing counting with parametric filtering. More precisely, once a parametric filter is applied to a signal, the zero-crossing count in the filtered data, denoted by D , is endowed with a parameter. We then refer to the parametrized count D as the (number of) higher order (zero-) crossings or HOC. HOC are best understood against the backdrop of stationary stochastic processes.

Let $\{Z_t\}$, $t = 0, \pm 1, \pm 2, \dots$ be a zero-mean stationary process and let $\{L_\theta(\cdot), \theta \in \Theta\}$ be a parametric family of linear filters (convolutions). Consider the filtered time series $L_\theta(Z)_1, L_\theta(Z)_2, \dots, L_\theta(Z)_N$, and define the clipped binary process

$$X_t(\theta) = \begin{cases} 1, & \text{if } L_\theta(Z)_t \geq 0 \\ 0, & \text{if } L_\theta(Z)_t < 0 \end{cases}$$

The HOC family $\{D_\theta, \theta \in \Theta\}$ is defined from the symbol changes in $X_t(\theta)$:

$$D_\theta = \sum_{t=2}^N [X_t(\theta) - X_{t-1}(\theta)]^2$$

The theory of HOC presents some basic intriguing mathematical questions. For example, does the observed zero-crossing rate of a stationary Gaussian time series converge to a constant? What is the connection between expected HOC sequences and the spectrum? To what value does the expected HOC sequence obtained from repeated differencing converge? Given two stationary time series with the same autocorrelation function, do they have the same expected zero-crossing rate? Intuitively, in a random sinusoid, we expect to see on average as many zero-crossings as peaks and troughs. Does the converse hold? We shall discuss general theoretical properties of HOC and their applications in discrimination and spectral analysis. In the latter case we use a somewhat broader definition of HOC.

John Stufken

(Responsible for the 'Round Table of Editors')



John Stufken received his Ph.D. from the University of Illinois at Chicago in 1986 and his B.S. and M.S. degrees from Katholieke Universiteit Nijmegen, The Netherlands, in 1982 and 1979. Currently he is Professor and Head, Department of Statistics, University of Georgia and in 2001-2004 he served as Program Director for Statistics, Division of Mathematical Sciences, National Science Foundation. Prior to coming to Georgia he was Professor in the Department of Statistics, Iowa State University (1997-2002). He is a Fellow of the American Statistical Association (2001), an elected Member of the International Statistical Institute (2005) and a Fellow of the Institute of Mathematical Statistics (2000). In 2004, Dr. Stufken became the Executive Editor of the Journal of Statistical Planning and Inference, where has previously served as Associate Editor. Since 2003, he served as an Associate Editor of the Journal of the American Statistical Association and, between 1993 and 2001, he served as an Associate Editor of Communications in Statistics. In 2006 he became an Associate Editor for the Journal of Statistical Theory and Practice. He has published a book titled Orthogonal Arrays: Theory and Applications, Springer Series in Statistic, and over 50 refereed publications.

SCHEDULE OF EVENTS

Friday, September 1, 2006: Day 1

- 11:00a.m. – 13:00p.m. **Registration** (will continue throughout Friday and Saturday)
- 12:30p.m. – 14:00p.m. Lunch (available on the campus of Institute Polytechnic of Tomar)
- 14:00p.m. – 14:30p.m. **Parade** (from the Library to the Auditorium)
- 14:30p.m. – 15:30p.m. **Honoris Causa Ceremony Degree** for Professor C. R. Rao
- 15:30p.m. – 16:00p.m. Coffee/Tea break
- 16:00p.m. – 16:30p.m. **Opening ceremony of SCRA2006 – FIM XIII**
- 16:30p.m. – 18:30p.m. **Presidential Invited Keynote Session**
- 19:00p.m. – 20:00p.m. **Welcoming Reception** (Mayor of Tomar)

Saturday, September 2, 2006: Day 2

- 08:30a.m. – 10:00a.m. **Plenary Session 1**
- 10:00a.m. – 10:30a.m. Coffee/Tea break
- 11:30a.m. – 12:30p.m. **Parallel Sessions**
- 12:30p.m. – 14:00p.m. Lunch
- 14:00p.m. – 16:00p.m. **Parallel Sessions**
- 16:00p.m. – 16:30p.m. Coffee/Tea break
- 16:30p.m. – 18:00p.m. **Plenary Session 2**
- 18:00p.m. – 18:15p.m. Break
- 18:15p.m. – 19:45p.m. **Editors Round Table**
- 20:00p.m. **Conference dinner – Templários Hotel** (only those who have paid and registered in advance may attend this event)

Sunday, September 3, 2006: **Day 3**

- 08:30a.m. – 10:00a.m. **Plenary Session 3**
- 10:00a.m. – 10:30a.m. Coffee/Tea break
- 10:30a.m. – 12:30p.m. **Parallel Sessions**
- 12:30p.m. – 14:00p.m. Lunch
- 14:00p.m. – 15:30p.m. **Plenary Session 4**
- 15:30p.m. – 16:00p.m. Coffee/Tea break
- 16:00p.m. – 18:00p.m. **Parallel Sessions**
- 18:30p.m. – 20:30p.m. **Barbeque and Group Photo** (Lawns of Building F). Relax and enjoy after a long day of scholarship.
- 21:30p.m. – 22:30p.m. **Concert** (Library Auditorium)

Monday, September 4, 2006: **Day 4**

- 08:30a.m. – 10:30a.m. **Parallel Sessions**
- 10:30a.m. – 11:00a.m. Coffee/Tea break
- 11:00a.m. – 12:30p.m. **Plenary Session 5**
- 12:30p.m. – 13:00p.m. **Closing ceremony of SCRA2006 – FIM XIII**
- 13:00p.m. – 14:00p.m. Lunch
- 14:00p.m. – 15:30p.m. **Visit to the Convent of Christ in Tomar**
- 15:30p.m. – 17:00p.m. Return to Lisbon

ABSTRACTS

Numerical evaluation of continuous time ruin probabilities for a risk process with credibility based premiums.

by

Lourdes B. Afonso

CMA and Faculty of Science and Technology - New University of Lisbon

Coauthors: Alfredo D. Egídio dos Reis (Technical University of Lisbon) and Howard R. Waters (Heriot-Watt University, UK)

We present a method for the numerical evaluation of ruin probabilities in continuous and finite time for a classical risk process where the premium can change from year to year. Our method is based on the simulation of the annual aggregate claims and then on the calculation of the ruin probability for a given surplus at the start and at the end of each year. We calculate the within-year ruin probability assuming first a Brownian motion approximation and, secondly, a translated gamma distribution approximation for the aggregate claim amount.

We consider this approach in the case where the annual premium is updated according to one of the standard credibility models, such as the Buhlmann-Straub model. We also explore the case where the premium at the start of each year is a function of the surplus level at that time.

On bracketing and matrixing designs in drug shelf life estimation

by

Kasra Afsarinejad

Biostatistics, Clinical Information Science, Astrazeneca R&D Molndal, Sweden

Shelf life of a drug product is defined as the length of time, under the specific storage conditions, the drug product remains within specifications established to ensure its identity, purity, quality, and strength. The drug product may have several different container sizes. To test every batch under all factor combinations at every time point can be expensive and time consuming. A reasonable alternative is to use a reduced design. Bracketing and matrixing designs are the two commonly used reduced designs. In this article, several different reduced designs are compared to the complete factorial designs. These comparisons show that some reduced designs can be recommended, whereas others should not be used.

Box type Near-Exact Distribution for the Generalized Wilks Lambda Criterion

by

Rui P. Alberto & Carlos A. Coelho

Center for Mathematics and its Applications, Faculty of Science and Technology, The New University of Lisbon

Based on a particular factorization of the characteristic function and on the concept of near-exact approximation, by keeping unchanged a good part of the original characteristic function and replacing the remaining part with a Box type asymptotic result, a near-exact distribution for the Generalized Wilks Lambda statistic is proposed for situations where the exact distribution is not known or not manageable. Our near-exact approximation, which also has an asymptotic behaviour, is numerically compared with some of the best known asymptotic distributions.

Detection of Sharp Changes in Hazard Rates: A Review

by

M. Z. Anis

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The theory of change point analysis finds applications in diverse fields such as stock market analysis, industrial quality control and reliability studies. In some real life applications, abrupt changes in the hazard function are observed due to overhauls, major operations or specific maintenance activities. In such situations it is of interest to detect the location where such a change occurs and estimate the size of the change. In this work we consider hazard models with a single sharp change in the hazard rate. We focus on inference problems concerning the change points. The typical models used by the different authors are critically examined. The models under parametric and non-parametric set ups as also complete and censored data are reviewed. The use of different statistical techniques such as Weak Convergence Theory, the theory of L-statistics, TTT transform methods, Bayesian methods etc. have been highlighted. Possible directions of further research are indicated.

Modelling of the series of studies with incidence of the errors in the Escoufier Operators

by

Aníbal Areia

College of Business Sciences, Setúbal Polytechnic Institute

Coauthors: Manuela M. Oliveira (Department of Mathematics, University of Évora), João Tiago Mexia (FCT Nova University of Lisbon, Department of Mathematics)

A study is a trio formed by a matrix of data and two matrices of weights, one for objects and another for variables.

Stochastic models are built for series of studies of first [second] type in which the objects [variables] are the same.

An application is performed on the results of the local elections in Portugal.

Keywords: Statis, models, validation, condensation of information

Selection of Natural Reserves Incorporating Measures of Uncertainty

by

Jorge Argaez-Sosa

Centro de Investigacion Cientifica de Yucatan and Facultad de Matematicas, UADY, Mexico

Coauthors: Mario Martin-Pavon (Facultad de Matematicas, UADY, Mexico)

The conservation of biological species is an issue which has recently been addressed from different perspectives. Each of the proposed methods is designed to identify and circumscribe areas to be proposed for protection, based on environmental information and considering certain practical restrictions. However, none or few of these methods consider ways to assess uncertainty, neither as part of the procedure for identifying a potential area for protection, nor for the evaluation of the quality of the resulting area. In this paper we approach this problem using decision theory, including a measure of uncertainty as part of the decision-making procedure. Moreover, we provide a way to evaluate the precision of the resulting area(s). In order to illustrate the method, we present the results of a simulation study, as well as a case-study for endangered species of the Yucatan Peninsula, Mexico.

Linear Estimators of a Exponential Mean under Balanced Loss Functions.

by

A. Asgharzadeh

Department of Statistics, Faculty of Basic Science, University of Mazandaran, Post code: 47416-1467, Babolsar, Iran

The present paper investigates estimation of a exponential mean using a loss function that reflects both goodness of fit and precision of estimation. The Bayes estimators relative to balanced loss functions (BLFs) are derived and admissibility of a class of linear estimators of the form $cX + d$ are also studied.

Keywords: Admissibility; Balanced loss function; Bayes estimator; Blyth's method; Inadmissibility.

Compound Optimum Designs in Pharmacokinetics

by

A. C. Atkinson

London School of Economics

Optimum designs for features of a model often have very poor properties for estimation of the parameters in the chosen model. A nonlinear example from pharmacokinetics is the three-parameter compartmental model, often used to model the time trace of the concentration of a drug in the blood of an animal, human or not. Possible features of interest include the area under the curve and the time to maximum concentration, for both of which the c -optimum designs have two support points. These designs both therefore have zero efficiency for estimation of the parameters of the model. The talk will describe the use of a weighted product of D -efficiency for parameter estimation and c -efficiency for feature estimation to define a compound design criterion which satisfies the convexity conditions of optimum experimental design. This criterion is called CD -optimality. The adjustable weighting parameter is chosen to give designs with good efficiencies both for parameter estimation and for estimation of the features of interest.

An equivalence theorem for CD -optimality will be presented that can be used in the construction of designs and in checking their optimality. Numerical examples of designs will be given and the properties of simple approximate hybrid designs explored.

Two examples of Bayesian analysis in fisheries: estimating the rate of change in total biomass of a fish stock and the decline of fish abundance by age over time

by

Manuela Azevedo

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There are two main types of models to assess the state of exploitation and determine the productivity of a fish stock, mainly depending on the detail of the basic data available: (i) production models that consider the stock globally and analyse the rate of variation of total biomass and (ii) the age-structured models that take into account the structure of the stock by age and analyse the evolution of the number of survivors of the different cohorts. The underlying mathematical models, basic assumptions and parameter vector are presented for each type of model. It is shown, using two important fisheries resources in Portuguese waters, the application of the Bayesian framework to infer about the values and uncertainty of the parameters of the model. The presentation focus on issues related to the choice of the likelihood function, the adoption of prior probability distributions that summarize the information on the parameters from all knowledge except that contained in the collected data and to the application of MCMC method, given the high dimensional integration required by the selected models, to obtain the posterior distributions for the parameters and derived quantities. The presentation is closed with remarks on sensitivity analysis to the choice of priors.

Improving the efficiency of the interactive Guy Fawkes protocol

by

Vittorio Bagini

Dipartimento INFOCOM, Università di Roma La Sapienza, Gruppo Reti

Coauthors: Andrea Baiocchi, Guglielmo Morgari

In the Guy Fawkes protocol, messages on an insecure channel are authenticated without any shared secret or public key. Each part generates a sequence of secret keys and authenticates its commitment to the first key. Then each message is authenticated by hashing with the current key and the commitment to the next one, both to be disclosed afterwards. This mechanism forces two interacting parts to commit to responses before receiving and authenticating the corresponding requests. By consequence, not all the exchanged messages can be significant, but only 1/3 of them. A modified version of the protocol is presented that improves efficiency (1/2 of the messages can be significant) while retaining security.

Some non-additive generalized measures of 'useful' information and J-divergence

by

R. K. Bajaj

Jaypee University of Information Technology, Waknaghat

Coauthors: Prof. D. S. Hooda, Jaypee Institute of Engineering and Technology, Guna

In the present paper an axiomatic characterization of non-additive measures of 'useful' information associated with a pair of probability distributions of a sample space having utility distribution corresponding to the same number of elements in both probability distributions has been studied. The quantity so obtained under additional suitable postulates leads to the generalized measures of 'useful' relative information, information improvement and J-divergence. Particular cases and important properties of the measures so obtained have also been studied.

Mathematical Criteria for Stability of Online Database Improving Quality of Service

by

Dr. Gaurav Bajpai

Faculty of Computer Sc., The Academy of Medical Sciences and Technology, Sudan

Coauthors: Dr. Raviraja S., Dr. Saif. F. O. Saeed

The paper presents a mathematical model of the problem for stability of online database. The parameters characterizing the state of hits on online database are identified. A sufficient criterion that ensures the damping out of the effects arising out of the perturbations in the variable parameters is obtained. The model assumes prevalence of normal conditions of online database breakdown due to limited resources, quality of service parameters that affect the network.

Congestion based bandwidth-traffic effects on quality of service and routing in communication networks

by

Dr. Gaurav Bajpai

Assistant Professor AMST Khartoum, Sudan

Coauthors: Shekhar Verma, Assistant Prof. (IT Group) I.I.I.T. Gwalior, India

This paper deals with estimation of traffic from all sources of different bandwidths at time of generation. It optimizes the class based traffic over the bandwidth, recalculates existing free space and generates shortest time path reducing real load over the network at real time altogether. In the process, we have utilized few algorithms for finding the shortest time path utilizing various Quality of Service (QoS) parameters, introducing QoS metrics that are either additive multiplicative, concave or in mixed metrics form. The classification is further generalized taking relative weights of QoS parameters and drafting a general equation. Shortest distance time path algorithms such as Dijkstra's, Floyd's and Warshal's algorithms are cross-built to find shortest time path algorithms. Various many numerical techniques are used to optimize the result to find shortest time path that reduces the load over different bandwidth at different intervals providing ultimately a-priori estimate of network stability and a comparative picture is produced which strengthens our work.

Cost benefit analysis of two single_unit reliability modles with inspection for repair and replacment

by

Mahabir Barak

Deptment of Statistics M.D.U.Rohtak, Haryana (India)

Coauthors: Suresh Chander Malik and R. K. Bensal

This paper deals with two reliability modles of single_unit in which unit has partial and direct total failure. There is a single server who plays the dual role of inspection and repair. In model I, the server inspects the unit at its partial failure and in case of model II he inspects the unit at its partial as well as total failure to examine the need of repair and replacement. If repair of the unit at partial and total failure is not beneficial to the system, it is replaced by new one to avoid unnecessary expanses on its repair. The failure, repair and inspection time of the unit are independent and uncorrelated random variables. The distribution of failure time of the unit follows negative exponential while that of repair and inspection times are taken as arbitrary with different probability density functions (pdf). Some reliability measures of system effectiveness are obtained by making use of Semi-Markov process and regenerative point technique. Finally, an expressive for profit is derived for each model. Graphs are plotted to compare MTSF, availability and profit of both the modules for a particular case. Key words: Cost-Benefit, Reliability model, Inspection, Replacement, semi-Markov process and regenerative point.

Comparing Calibration Estimators in Labor Force Survey of Iran

by

Arman Bidarbakhtnia

1414663111, Statistical Center of Iran (SCI), Tehran, Iran

Coauthors: Hamid Reza Navvabpour

Using suitable auxiliary variables in calculating weighted estimators can improve efficiency of estimators. This type of estimations are using for compensating unequal selection probabilities, nonresponse, noncoverage or departures from known population counts. Simplest estimators that are using auxiliary variables are regression and ratio estimators. Devill and Sarndal (1992) shows that regression estimators can be shown as a weighted estimators that their weights have produced with minimizing a distance function such that calibration equations are satisfied. The weights are producing in this manner are known as calibration weights and the resulting estimators are calibration estimators. In this paper we have compare several calibration estimators according to several distance functions in Labor force Survey of Iran and it has seen that D&S method has less impact on the sample distribution and leads to a more precise estimation. All programmes are written in SAS/IML.

Key Words: Calibration Weighting; Model Assisted Estimators; Nonsampling Errors.

Algorithmic Combinatorics on Words (Research Experiences for Undergraduates)

by

Francine Blanchet-Sadri

University of North Carolina, Greensboro, USA

In this talk, I will discuss some research projects related to my Research Experiences for Undergraduates (REU) program entitled *Algorithmic Combinatorics on Words* supported by the National Science Foundation. This program involves students in research at the crossroads between Mathematics and Computer Science. *Words*, or strings over a finite alphabet, are natural objects in several research areas including group theory, number theory, automata theory and formal language theory, coding theory, and theory of algorithms. The University of North Carolina at Greensboro provides unique opportunities for summer research for eight students per year for an eight-week period each year through this program.

Experimental design problem under mixed-effects non-linear models

by

Barbara Bogacka

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London, UK

Coauthors: Maciej Patan

Many experiments are aimed at learning about average behaviour of some model parameters across a population of subjects. For example, in drug development studies, parameters such as drug absorption and drug elimination and their variability within the population are often of interest. Then designing an experiment for one individual in the population will not give the required information and a more general approach is needed. In our work we assume that the model parameters are random variables, and so they represent the population. This leads to the design problem under a mixed effects non-linear model.

In our talk we present a definition of an experimental design as a sampling plan for a population of individuals; we present some theoretical results for an optimum design for estimation of the population parameters and we discuss, via an example, various issues which occur in such design problems.

Directional Tests for Ordered Categorical Data: a New Permutation Solution.

by

Stefano Bonnini

Department of Statistics - University of Padova

Coauthors: Rosa Arboretti Giancristofaro Luigi Salmaso

Frequently in the modern socio-economic systems the aim of a performance analysis or a quality evaluation is to compare different products, different manufacturing plants or service centres, different actions and comparing two of them we need to answer the question “which is better?”. This evaluation is complicated because the aspects to be considered are often several, different and measured through categorical data. From the statistical point of view it is a hypotheses testing problem.

We discuss some directional permutation tests (based on the nonparametric combination of dependent permutation tests) for the problem of two sample comparison in presence of ordinal categorical variables.

In particular we present a new permutation test based on the combination of a finite number of sample moments.

We also show the results of Montecarlo simulations to compare permutation tests with other nonparametric tests.

Residual Analysis of some GLM Models

by

Voicu Boscaiu

Institute of Mathematical Statistics and Applied Mathematics, Bucharest

Why the analysis of residuals of some different general linear models offers similar (practically speaking) conclusions? Why, often, the conclusions can be “reasonable accurate”, doesn’t matter the hypotheses of the considered models can’t be simultaneously true? We try to give some answers to the above questions.

Key words: residuals, linear regression, empirical analysis, models comparison

Generalization of the Dirichlet Distribution

by

Epimaco A. Cabanlit, Jr.

Mindanao State University, General Santos City, Philippines

Coauthors: Roberto N. Padua of the Mindanao Polytechnic State College, Philippines and Khursheed Alam of Clemson University, South Carolina, USA

The Dirichlet distribution is a generalization of the beta distribution. In Bayesian analysis the Dirichlet distribution is used as a conjugate prior distribution for the parameters of a multinomial distribution. However, the Dirichlet family is not sufficiently rich in scope to represent many important distributional assumptions, because the Dirichlet distribution has few number of parameters. We provide a generalization of the Dirichlet distribution with added number of parameters.

On the Mixture of the Displaced Exponential Distributions

by

Epimaco A. Cabanlit, Jr.

Mindanao State University, General Santos City, Philippines

The Displaced Exponential and the Schuhl's Composite Distribution are considered as good models for traffic flow. The Schuhl's Composite Distribution is a mixture of two Displaced Exponential Distributions. In this paper, we extend the Schuhl's Composite distribution for more than two Displaced Exponential Distributions. Important Summaries are then presented. The parameters of the said mixture are also estimated. Lastly, various graphs of the distribution are exhibited.

Semi-parametric second order reduced bias high quantile estimation

by

Frederico Caeiro

Faculty of Science and Technology - New University of Lisbon

Coauthors: M. Ivette Gomes

In the most diversified areas of application, like Insurance and Finance, we often need to estimate a high quantile, or equivalently, the Value at Risk, $\text{VaR}(p)$, a value that is exceeded with a probability p , small. The semi-parametric estimation of this parameter depends not only on the estimation of the extreme value index, the primary parameter in Statistics of Extremes, but also of a first order scale parameter or functional. Recently, new interesting classes of reduced bias extreme value index and first order scale parameters' estimators have appeared in the literature, all dependent on the estimation of second order parameters. The use of one of those new classes of estimators in the estimation of $\text{VaR}(p)$ enables us to introduce new classes of high quantile estimators. These new classes are studied asymptotically and compared among themselves and with previous ones, through the use of Monte Carlo simulation. An application in the area of finance is also provided.

Web Intelligent Information Systems based on Web Mining Search Results

by

Ricardo Campos

Tomar Polytechnic Institute

Coauthors: Gaël Dias, University of Beira Interior

With so many information published on the web, search engines have a very difficult task in selecting the best relevant documents. Typically, they are low precision in response to a query, retrieving lots of useless web snippets, and miss to retrieve some other important. In this paper we study the web page hierarchical clustering problem. We propose the architecture of WISE [1], a meta search-engine software, that automatically builds up groups of related web pages (with the same query sense) into a set of clusters, hierarchically organized and labeled with a phrase (we indistinctively refer to phrases as key or keyword concepts extracted from the web documents), representativeness of its key concept.

The system, which is web-based interface, introduces some interesting ideas, such as the pre-selection of the retrieved web pages and its capability to statistically detect phrases within the documents, which in turn are represented with its most relevant key concepts, by using web content mining techniques to grasp its content, based on pre-trained decision trees. The system final step is supported by a graph based overlapping clustering algorithm, which groups the selected documents into a hierarchy of organized overlap clusters.

We believe that our solution is innovative as the architecture in its all, and not just part of it, is language and topic independent. Moreover, we are the first in the literature to combine hierarchical clustering and phrases with the use of web content mining techniques to semantically represent the documents, overtaking the problem of synonymy and ambiguous, poor and less informative user queries.

References :

1. Campos, R., Dias, G.: Automatic Hierarchical Clustering of Web Pages. In Proceedings of the ELECTRA Workshop associated to the 28th Annual International ACM SIGIR Conference, Salvador, Brazil, August 19, 83-85, (2005).

Dividends and ruin problems in finite time

by

Rui Cardoso

Department of Mathematics and CMA, Faculty of Sciences and Technology, New University of Lisbon

In this work we consider the classical risk model modified by the introduction of a constant dividend barrier, that is, when the surplus exceeds this threshold the insurer pays dividends to shareholders which rate is equal to the rate of premium income. We use a numerical method based on Markov chains to calculate the expected present value of dividend payments and as well the ruin probability, both quantities in finite time. We also considered another risk model where the dividend rate is lower than the premium rate.

About the Kauffman and Vogel's polynomial

by

Rui Pedro Carpentier

Instituto Superior Técnico

In 1990 Kauffman and Vogel constructed a rigid vertex regular isotopy invariant for unoriented four-valent graphs embedded in three dimensional space. It assigns to each embedded graph G a polynomial, denoted $[G]$, in three variables, A , B and a , which coincides, under the change of variables $z=A-B$, with the two-variable Kauffman polynomial when restricted to links. In this talk it would aborded a simplified version of this polynomial (fixing $B=A^{-1}$ and $a=A$) and show that for a planar graph G we have $[G]=2^{c-1}(-A-A^{-1})^v$, where c is the number of connected components of G and v is the number of vertices of G . Thus it gives a good test of the planarity for spatial four-valent graphs.

Diagrammatic Interpretations of Generalized Quandle Co-homology (or what are these bugs that I keep drawing?)

by

J. Scott Carter

University of South Alabama

Quandles are a distillation of conjugation in a group. The main property is an operation that distributes over itself $(a*b)*c=(a*c)*(b*c)$. This property can be interpreted in a variety of contexts. A cohomology theory is presented which encompasses Lie algebra cohomology and other theories. The bugs are the diagrams that describe vector space valued functions.

Modeling computing costs with search trees

by

Alda Carvalho

ISEL and CEMAPRE

Coauthors: Nuno Crato, ISEG and CEMAPRE and Carla Gomes, Cornell University

The runtime distributions of several combinatorial problems have been shown to exhibit heavy-tailed behavior. We show how normalized sums of exponentials and mixtures of stable distributions adequately model such runtime distributions. We also discuss simple tree search models that simulate the behavior of some algorithms and generate heavy tailed behavior, similar to the one found in empirical studies.

F tests in normal models with commutative orthogonal block structures

by

Francisco Carvalho

Polytechnic Institute of Tomar - School of Management, Portugal

Coauthors: João Tiago Mexia, New Univ. Lisbon - Faculty of Science and Technology, Portugal

A model $y = \Delta^T v + C$ has orthogonal block structure if it has variance-covariance matrix $V = \sum_{f=1}^w \gamma_f P_f$, where the P_1, \dots, P_f are mutually orthogonal projection matrices. If the orthogonal projection matrix on the range space of Δ^T commutes with the P_1, \dots, P_w the model will have Commutative Orthogonal Block Structures. F tests are derived for estimable vector in models with COBS.

The Continuous Moran Process

by

Fabio A. C. C. Chalub

Universidade Nova de Lisboa

Coauthors: Max O. Souza

We consider the so called Moran process with frequency dependent fitness given by a certain pay-off matrix. For finite populations, we show that the final state must be homogeneous, and show how to compute the fixation probabilities. Next, we consider the infinite population limit, and discuss the appropriate scalings for the drift-diffusion limit. In this case, a degenerated parabolic PDE is formally obtained that, in the special case of frequency independent fitness, recovers the celebrated Kimura equation in population genetics. We then show that the corresponding initial value problem is well posed and that the discrete model converges to the PDE model as the population size goes to infinity. We also study some game-theoretic aspects of the dynamics and characterize the best strategies, in an appropriate sense.

Small Area Estimation with Skewed Data

by

Hukum Chandra

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Coauthors: Ray Chambers

Small area estimation (SAE) is now common in survey sampling, with several methods proposed in the literature (Rao, 2003). However, research continues on several important practical problems. For example, in business surveys data are typically skewed and the standard approach for SAE based on linear mixed models leads to inefficient estimates. In this paper we discuss SAE techniques for skewed data that are linear following a suitable transformation. In this context, implementation of the empirical best linear unbiased prediction (EBLUP) approach (Prasad and Rao, 1990) under transformation to a linear mixed model is quite complicated. However, this is not the case with the model-based direct (MBD) approach (Chambers and Chandra, 2005), which is based on weighted linear estimators. In this paper we extend the MBD approach to skewed data using sample weights derived via model calibration (Wu and Sitter, 2001) based on a lognormal model with random area effects. Our results show that this estimator is both efficient and robust with respect to the distribution of these random effects. We also examine the robustness of the method under model misspecification. An application to real data demonstrates the satisfactory performance of the method.

Key Words: Small areas, Skewed data, Model Calibration, Expected value model, Calibrated sample weights, MBD approach, EBLUP.

A New Smooth Estimator for Density and Survival Functions

by

Yogendra P. Chaubey

Concordia University

Coauthors: Arusharka Sen and Pranab K. Sen

Commonly used kernel density estimators may not provide admissible values of the density or its functionals at the boundaries for densities with restricted support. For smoothing the empirical distribution a generalization of the Hille's lemma, considered here, alleviates some of the problems of kernel density estimator near the boundaries. For nonnegative random variables which crop up in reliability and survival analysis, the proposed procedure is thoroughly explored; its consistency and asymptotic distributional results are established under appropriate regularity assumptions. Analysis of obtaining smoothing parameters through cross-validation is also provided.

Availability and Maximizing Survivability of cable T.V. transmission system

by

Sanjay Chaudhary

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Coauthors: Raju Singh Gaur

In this short communication, we have computed availability and Maximizing Survivability for cable T.V. transmission system which is one of the example of multi-state acyclic network (MAN). The system is designed to transmit from the cable T.V. operator's satellite link to users' televisions through amplifier units. The user's televisions are connected by cables, which are the system components. The system is operational if user's televisions are connected with amplifier units and the cable T.V. operator's satellite link.

On weighted Poisson mixture of weighted distributions

by

Sanjay Chauhan

7/33, Sector-2, Rajinder Nagar, Sahibabad, Ghaziabad

Coauthors: Mohammad Ali Afzala Momani & R.P. Singh

Mixture distributions in queing theory have played a vital role to characterize Poisson and Exponential probability distributions.

In the present communication, we introduced weighted distribution corresponding to probability distribution and presented a class of weighted poisson mixture of weighted distributions. As different statistical indices characterized the probability distribution, we utilized characteristic functions of weighted Poisson mixture of weighted distributions viz binomial, normal, log-normal and exponential have been derived some particular cases viz. Singh and Momani (1994) and that of Roy-Rehman and Ali (1992) have been studied.

Bayesian Dynamic Models for Survival Data with a Cure Fraction

by

Ming-Hui Chen

University of Connecticut

Coauthors: Sungduk Kim, Dipak K. Dey, University of Connecticut, and Dani Gamerman, Universidade Federal do Rio de Janeiro

We propose a new class of semi-parametric cure rate models. Specifically, we construct dynamic models for piecewise hazard functions over a finite partition of the time axis. Allowing the size of partition and the levels of baseline hazard to be random, our proposed models provide a great flexibility in controlling the degree of parametricity in the right tail of the survival distribution and the amount of correlations among the log-baseline hazard levels. Several properties of the proposed models are derived, and propriety of the implied posteriors with improper noninformative priors based on the proposed models is also investigated. In addition, an efficient reversible jump computational algorithm is developed for carrying out posterior computation. A real data set from a melanoma clinical trial is analyzed in detail to further demonstrate the proposed methodology.

A problem of steady micropolar flow in a sinusoidal channel

by

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The problem of micropolar flows, in wavy channels, has a wide range of applicability in practical problems, such as to observe the characteristics of animal blood, polymeric fluids, liquid crystals, or in many other processes which imply this kind of flow in industry.

In this study, a mathematical model of a steady micropolar flow, in a sinusoidal channel, is presented. In order to simplify the boundary conditions of the problem on the wall, the walls of the channel are transformed into parallel straight lines. The stream function of the flow and the gyration vector are expanded in a series thereby the wall amplitude being the perturbation parameter.

For the case considered, the problem reduces to a system of ordinary differential equations which is solved numerically using the NAG Fortran Routine D02HBF. Representative results for the velocity and microrotation profiles are presented for different Reynolds numbers in the case of weak concentration of particles.

Near-exact approximations for the likelihood ratio test statistic for testing equality of several variance-covariance matrices

by

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While on one hand, the exact distribution of the likelihood ratio test statistic for testing the equality of several variance-covariance matrices, as it also happens with several other likelihood ratio test statistics used in Multivariate Statistics, has a non-manageable form, which does not even allow for the computation of quantiles, on the other hand the asymptotic approximations available do not have the necessary quality for small sample sizes. This way, the development of near-exact approximations to the distribution of this statistic is a good goal. Starting from a factorization of the exact characteristic function for the statistic under study and by adequately replacing some of the factors, we obtain a near-exact characteristic function which determines the near-exact distribution for the statistic. This near-exact distribution takes the form of either a GNIG (Generalized Near-Integer Gamma) distribution or a mixture of GNIG distributions. The comparison between the exact and the near-exact distributions obtained is done through the use of two measures of proximity between distributions, which give close upper bounds on the absolute value of the difference between exact and approximate densities or cumulative distribution functions.

Distribution View: a tool to write and simulate distributions

by

J. Silva Coelho

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Coauthors: Fernando Branco, Teresa Oliveira

In our work we present a tool to write and simulate distributions. This tool allows to write mathematical expressions which can contain not only functions and variables, but also statistical distributions, including mixtures. Each time the expression is evaluated, for all inner distributions, is generated a value according to the distribution and is used for expression value determination. The inversion method can be used in this language, allowing to generate all distributions that have an expression for cdf inverse. The variables in the language allow the generation of several correlated distributions.

To illustrate the advantages of using distribution view we present two applications: One in Project Risk Management, compares the PERT method with Simulation alternative; The other in Statistics, compares the Power of Randomization Test with the power of Student-t Test , using the set of Marron-Wand distributions.

Discretized Formulations for capacitated location models with variable distribution costs

by

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Research Center, Faculty of Science, University of Lisbon

In this paper we consider a discrete capacitated location problem in which there is a maximum amount that can be shipped from each location to each demand point. We consider modular distribution costs depending on the amount shipped.

In 'classical' location models a set of variables x_{ij} is usually considered indicating the amount shipped from location i to demand point j . In this talk we propose and discuss a model using discretized binary variables z_{ij}^q indicating whether or not facility i sends exactly q units to demand point j . We show that in the case of modular costs, the reformulated model may provide better linear programming bounds than the classical model. Using the 'new' allocation variables we propose new valid inequalities for improving the linear programming relaxation bound. We present the computational tests showing that the valid inequalities proposed enhance the linear programming relaxation bound and may be extremely helpful when using a commercial package for solving the problem optimality.

Keywords: Discrete location, Extended formulations

General Equilibrium with Uncertain Delivery

by

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This paper studies general equilibrium with differential information in which trade is made ex ante, under private and incomplete state verification.

Objects of choice are lists of bundles such that the agent has the right to receive one of them. The 'market', interpreted as being composed by competitive brokers, delivers the cheapest of the possible alternatives. Knowledge of the selection mechanism and observation of the prevailing prices, allows agents to correctly predict the bundle that is to be delivered in each state of nature, and thus equate the utility of a 'list' with the utility of the cheapest bundle included in the list.

A small but perfectly informed agent is introduced in the economy in order to guarantee existence of a rational expectations equilibrium.

Multivariate data analysis for the detection of surface defects in the dental enamel during orthodontic treatment

by

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Coauthors: Flores Marcos González, Miguel Javier Caldera, Gloria Patricia Perea González, Galina Javier Vega, Liliana Cortez

In this work, the acquisition and data processing of the rugosity of the surface dental enamel is shown. The purpose of this is the detection of physical defects (de-mineralized zones) in the dental enamel through the comparison of the mean values of the samples generated in orthodontic treatment. The objective of the work is the development of software which allows the comparison of mean values of two samples to synthesize and acquire the covariance matrix from a data matrix of each sample and later obtain an estimation of both matrices. From this matrix its inverse is obtained and finally the Hottelling statistics T^2 and F are calculated for multivariate data, to demonstrate if there are differences in the mean vectors. The experiment carried out with non-invasive technology developed in the Laboratory of "Non-Invasive Methods for Dental Diagnosis" allowed corroboration that the orthodontic treatment generates physical changes in the dental enamel, since it was proven that the null hypothesis in which it is assumed that the mean vectors are equal is rejected, the experiment zone of the dental organ was the middle third, in which the samples without treatment and application of toothpaste, without treatment and application of etching acid, without treatment and application of adhesive, with toothpaste and etching acid, with toothpaste and adhesive, and finally application of etching acid with adhesive were compared, with the objective of proving the hypothesis that if the mean vectors are equal or not. The results obtained allowed the hypothesis that the mean vectors are equal to be rejected, which is made evident in the different stages of the orthodontic treatment. The results obtained are satisfactory and work is continued in this technique for future analysis and different zones of the tooth.

Key Words: rugosity of the dental enamel, multivariate data analysis, covariance, Hottelling and F statistics, inverse matrix, data matrix.

Lattices of Commutative Jordan Algebras

by

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Commutative Jordan Algebras provide a convenient algebraic framework for orthogonal models. We now extend this framework by considering lattices of Commutative Jordan Algebras. This will be useful to study invariance properties.

The study of mortality in age groups

by

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Coauthors: Gheorghe Gabriela Silvia, Faculty of Medicine "Carol Davila" Bucharest, Romania

Researchers in the demographic field are concerned about the different aspects of the human mortality. Death is not a repetitive event. It is attributed to a single cause. By studying mortality, we must take into account the simultaneous action of a number of risk factors upon the life of an individual. For instance, if more deaths are caused by tuberculosis in young people, there can be a lower number of deaths by heart diseases, in a definite interval of time. That is why there have been used some methods in order to establish the causes that produce deaths and also to establish the mortality index for the age groups. Unfortunately, the results of these studies were not always satisfactory for the demography.

It is obvious that, examining closely the implication of death phenomenon, we can notice that there is a similitude with the probabilistic notion of Markovian dependency and also with a more general dependency of Onicescu-Mihoc type.

Onicescu-Mihoc type of the statistical dependency takes into account the whole development of the process and contains the Markov type of dependency as a particular case, so when the phenomenon is studied, the application of a chain with complete links is required.

The first part of this paper deals with a theoretical statistic model which considers that the random variables $\{x_t\}_{t \in \mathbb{N}}$ (where x_t indicate the causes of deaths in the period of time t) are chained according to the probability law of a chain with complete links (an Onicescu-Mihoc chain).

The practical solution for the considered demographic model, the chains with complete links, presents some difficulties due to the fact that the statistic theory of estimation of the parameters that belong to components of the chain is incompletely developed.

That is why, in the second part of our paper, we deal with the same problem using regular Markov chain.

P. Damiani studied and published a mathematical model in the case of the Markov type of dependency, which takes into account the existent relationship between the mortality causes upon the age groups. This model was published in "The Trimestrial Bulletin of Institute of French Actuaries" in March 1973. The author supposes there is a link between the different mortality indexes. Further on, we are going to present the way in which we have completed this model, taking into account the theory of the competitive risks. For this purpose, we are going to individualize the generalized functions in the case of the chains with complete links and suppose that the row of the random variables $\{x_t\}$ forms a regular Markov chain.

Determining life probability and invalidity using the Markov chains theory. The importance of the method in the field of insurance right.

by

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Taking as a starting point the basic principle of insurance: "the medium value of insured person's earnings must equal with the medium value of the insurance institute", is natural to introduce the notion of probability when we study such problem. The population of the study is in a continuous change according to the statistic laws. The transitions from a situation to another are random (the transition of a person from an active to a temporary or definitive invalidity happens at a random). So, it is to introduce the notion of probability when we study such a problem. In a study of mortality we must take into account the simultaneous action of many risks upon the life of a single person. Therefore, the ways used in order to find out the causes of deaths and the mortality index for different age groups give results that are not satisfactory for demographs and actuarial person. It is obvious that, examining closely this implication of death phenomenon, we can notice that there is a similitude with the probabilistic notion of Markovian dependency and also with more general dependency of Onicescu-Mihoc type. We have already proposed a mathematical model which is made with the connection between the death causes and shows more explicit some mortality indexes. We now suggest a new estimation way for the description of the transition probabilities for the considered model. So we obtain estimations for the life and invalidity probabilities.

Parametric multiple correspondence analysis

by

Carles M. Cuadras

University of Barcelona, Spain

We perform an unweighted multidimensional scaling on the Burt matrix, with the diagonal frequencies parametrized to reduce their influence. With this approach the off-diagonal contribution is smaller than the multiple correspondence analysis method, based on correspondence analysis on the Burt matrix. Two real data examples illustrate this parametrization.

Some continuous generalizations of multivariate analysis.

by

Daniel Cuadras

Departament d'Estadística, Universitat de Barcelona

Some techniques of the Discrete Multivariate Analysis can be easily generalized to the continuous case. In the discrete case, the information contained in a discrete data matrix is analysed, summarized and interpreted by using the well known technique of the Principal Component Analysis. Given a continuous random variable, it is possible to associate a stochastic process to it, and a succession of random variables depending on this process, called Principal Directions, that share properties similar to those of the Principal Components in the discrete case. We also study a generalization of the Correspondence Analysis, where a parameter is introduced in order to obtain an alternative way of studying the data contained in a discrete correspondence matrix. This generalization is also extended to the continuous case of a bivariate vector.

A Stochastic Model for HIV/AIDS and its application in Insurance, Health-Care cost Estimation.

by

Palahela Dayananda

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Coauthors: Lynne Billard

This paper considers a four-stage compartment model for HIV/AIDS with an incubation period distribution, which has been shown to conform to data collected on HIV/AIDS infection. The model is developed using sums of random variables and its transition probabilities are derived. The model is used to derive insurance functions for whole life policies. It is also used to establish formulae to estimate the future cost of Health-Care and economic support to dependents of infected. Numerical illustrations are also presented and discussed. From these results we conclude that a HIV infected person has mortality roughly equivalent to a non infected person 18-20 years older for whole life premium evaluation purposes.

Secondary education system in India: a statistical analysis

by

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Coauthors: Haren Choudhury, Gauhati University

In this paper a statistical study on the performance of students in the secondary examinations has been carried out. As different states of India have individual Secondary Boards to conduct Secondary or High School Leaving Certificate (HSLC) examination, and almost all the Boards provide the same compulsory subjects - Modern Indian Language (MIL), General English (GEN), General Science (GSc), General Mathematics (GM), Social Studies (SS) and Elective Subject (EL), which carry specified marks. A state of India - ASSAM has been selected for collecting the necessary data, as the performance of the students of Assam is similar to the performance of students belonging to other states of India.

For this a random sample of 4940 students has been selected out of 39 randomly selected schools for the years - 1996 to 2000. Some very interesting conclusions are derived after analysing the performance of the students in the compulsory subjects. Their statistical models of formation of marks are also obtained.

Robustness and power of few tests for testing main effects in a Three-Way Factorial Experiment

by

Ms Kunja Deka

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For the three-way factorial experiment when interaction effects are not present, we compare three test statistics namely F, rank transform statistic and normal score statistics in terms of power. The simulation results show that normal score statistic is powerful than the other two for testing main effects in case of normal and uniform distribution whereas rank transform test shows more power in case of double exponential and logistic distribution.

Key words: Three-way layout; Robustness; Power, Rank Score

Elementary polycycles

by

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Given $q \in \mathbb{N}$ and $R \subset \mathbb{N}$, a (R, q) -polycycle is a non-empty 2-connected plane, locally finite (i.e. any circle contain only finite number of its vertices) graph G with faces partitioned in two non-empty sets F_1 and F_2 , so that:

- (i) all elements of F_1 (called *proper faces*) are combinatorial i -gons with $i \in R$;
- (ii) all elements of F_2 (called *holes*, the exterior face(s) are amongst them) are pair-wisely disjoint, i.e. have no common vertices;
- (iii) all vertices have degree within $\{2, \dots, q\}$ and all *interior* (i.e. not on the boundary of a hole) vertices are q -valent.

Such polycycle is called *elliptic*, *parabolic* or *hyperbolic* if $[1/q] + [1/r] - [1/2]$ (where $r = \max_i \in R$) is positive, zero or negative, respectively.

A *bridge* of a (R, q) -polycycle is an edge, which is not on a boundary and goes from a hole to a hole (possibly, the same). An (R, q) -polycycle is called *elementary* if it has no bridges. An *open edge* of a (R, q) -polycycle is an edge on a boundary, such that each of its end-vertices have degree less than q . Every (R, q) -polycycle is formed by the agglomeration of elementary (R, q) -polycycles along their open edges.

We classify all elliptic elementary (R, q) -polycycles and present various applications of it.

A near-exact minimum for total expected cost per unit of time in periodically inspected systems

by

J. Rodrigues Dias

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In this paper we present new and simple expressions for obtaining the minimum total expected cost per unit of time in a system, which needs to be inspected to know its operation state, using perfect and periodic inspections. Considering the system expected lifetime, the cost of each inspection and the cost per unit of time of imperfect operation, using recently obtained expressions for the inspection period, some results are presented and analysed. In addition, some numerical results prove that we have nearly optimal solutions.

Developmental impact of very low birth weight status on childhood disability: logit model

by

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Coauthors: Maria Rosário Oliveira Martins

The index of maternal, perinatal and childhood mortality improved during the last decades and brought a significant profit to the Portuguese Public Health. Wich allowed getting rates of fetal and perinatal mortality such as the developed countries. The perinatal care gave an enormous contribution to the increase of the survival rates from 1996 to 2000.

With this study we intend to prove that following up premature babies and very low weight children along their childhood can be extremely important to the behavioural and cognitive development.

This study aims to compare different low birth weight children and to identify variables that most significantly contribute to psychomotor development of premature babies. We want to estimate the effect of very low birth weight in the cognition and in the behaviour of children. To investigate this, we applied a logit model to explain the general developmental outcomes, delays, and impairments of very low birth weight children. To measure the model's ability we estimated the area under the ROC curve.

Besides the weight at birth, the explanatory variables include biomedical factors (mother's age, prenatal care, sex of the baby) living arrangements (mother's education, race, social problems, family structure).

The estimation of the different presented models allows us to verify that the maternal educational and birth weight are the most significantly factors to the child's development.

The finding in this paper is that it is necessary to follow up these children up to adulthood. They have to be followed by qualified medical and educational professionals. These results have great influence in the Public Health.

Key-words: Very low birth weight, risk factors, children development, logit model, ROC curve.

Counting Unbordered Partial Words

by

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Coauthors: Francine Blanchet-Sadri, Margaret Moorefield, Jonathan Britton

An unbordered word is a string over a finite alphabet such that none of its proper prefixes is one of its suffixes. There is a simple formula for the number of unbordered words of a given length. In this talk, we will present some of the work that we have done in an attempt to find a formula for the number of unbordered partial words of a given length. Partial words are strings that may have a number of "do not know" symbols.

Why biologists should/are becoming Bayesians: the case of developmental instability

by

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Living organisms show a remarkable diversity at all levels of organization, from the molecules they are made up by, to the interactions of different species in ecosystems. The study of biological systems is becoming increasingly complex and the use of Bayesian statistical techniques is increasing exponentially. In this paper, we illustrate such complexity and usefulness of Bayesian methods in the area of fluctuating asymmetry as a measure of developmental instability. Not only does a Bayesian approach allow to incorporate all sources of variation and uncertainty, it also illustrates the limitations of what data can contribute to answer biological questions and help in designing better experiments.

Steganographic Schemes based on Error-correcting Codes

by

Michele Elia

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Coauthors: Guglielmo Morgari, Maria Spicciola, Silvia Deantonio

A typical steganographic artifice is to hide information in innocent cover messages by exploiting their high semantic redundancy, as occurs for example in voice messages or pictures. However, information-hiding techniques operating at lower-level layers in a transmission chain have also been proposed. Following this second approach, we describe a steganographic scheme that exploits the redundancy of the error-correcting codes necessarily used over noisy channels, for example in the ubiquitous cell phone or wireless data access communications.

The redundancy of the code is utilized to insert the message to be hidden in the form of artificial channel errors. For the purpose of distinguishing actual from artificial errors at the receiver side, the hidden message is encoded using a second error-correcting code.

A simple yet concrete implementation of this scheme is described, along with an analysis of the relation between channel error rate, hidden communication rate, and the properties of the various error-correcting codes.

Joint risk liquidity/price analysis via Ito line integrals: a simulation study

by

Manuel L. Esquivel

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In previous work we introduced a way of jointly studying the risk evolution of two random quantities, given by diffusion processes, by means of an Ito line integral over the random curve specified by these processes.

An application of the formalism so introduced to real data of Portuguese stocks allowed us to plainly differentiate the joint liquidity/price risk profile of three stocks in a more precise way than using solely liquidity or risk.

In this work, after reviewing the main properties of the model introduced, we present a result on the existence and unicity of solutions for stochastic differential equations using the Ito line calculus developed previously.

We present a simulation study which highlights the properties of differentiation of the risk profiles under the assumption of different models for the evolution of the liquidity, of the price and of the risk process.

A strategic model of club formation; existence and characterization of equilibrium

by

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Coauthors: Myrna Wooders

We introduce a new model of a club economy as a two stage game. Players derive utility from consumption of private good, consumption of public good, and the profile of crowding characteristics - those characteristics of a player that directly affect other players - of members of the same club. In the first stage of the game, players choose amounts to consume of an endowment of private good. The crowding characteristics acquired by a player are determined by his choice of consumption level, as is the amount of private good remaining to contribute to the production of the club good in the second stage of the game. In the second stage of the game, given the profile of crowding characteristics of the total player set, club memberships are endogenously determined as outcomes of subgame perfect equilibrium. We establish conditions for the existence of equilibrium and provide some examples illustrating that characterization results from models of club economies with price-taking equilibrium do not necessarily hold.

Addressing the computational complexity of forest harvest scheduling problems: Heuristics or Integer Programming?

by

André Falcão

Departamento de Informática, Faculdade de Ciências da Universidade de Lisboa

Current forest management research has given a particular focus to the inclusion of spatial constraints in management models. Yet, most of these efforts are based on the Model I formulation that seeks to assign one prescription to each individual stand. For all these models integer solutions are required, in order to provide locational specificity, fundamental to its operational application. Notwithstanding, management modeling for short-rotation species tends to be even more susceptible to the inherent hardness of finding integer solutions, as, even for small forests, the problems generated are often very large. Therefore, in this paper, the complexity of the simple integer forest management problem, as defined by the Model I formulation, is discussed and two possible strategies to reach optimality are addressed. One approach is based on the branch-and-cut mixed integer programming algorithm, the other is a general purpose meta-heuristic. The problem set consisted of twelve increasing complex problems generated from 4 artificially generated eucalyptus (*Eucalyptus globulus*, Labill) forests with 200 to 10 000 stands and areas ranging from 2 000 to 125 000 ha. Results are discussed both in computation resources and produced solution values. It is further defined the problem types more appropriate to solve with each methodology.

Testing for Structural Change in a Mixture of Linear Regressions

by

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Coauthors: Gilda Soromenho, Faculdade de Psicologia e Ciências da Educação, Univ. Lisboa

Over the last years, several structural change tests have been extended to monitoring of linear regression models where new data arrive over time. In this work, we derive a new procedure for the problem testing for structural change in a mixture of linear regressions. In this procedure, the parameters of a mixture of linear regression model are estimated from all available data (initial data plus newly arrived data) and compared to the estimates based only on initial data. The procedure is illustrated through a simulation study on both simulated and real data sets.

How can countries keep developing facing the external-global challenge? Evidence from social and governance learning measurement

by

Sílvia Brito Fernandes

Faculty of Economics - University of Algarve

This paper intends to contribute to an on-going change of perspective in territorial policies, more focused on a place-based integrative development strategy which can be enhanced by social capital. This includes organizational and institutional learning for knowledge and skills' transfer and governance coordination of the layers involved. Several concepts and indicators can be combined to support a conceptual framework for governance redefinition and sustainable growth. A comparison with related quantitative and qualitative indicators across countries highlights an approach for building a common culture that could facilitate governance and growth sustainability. It is less the size or the level of economic development that explain the different performances across countries/regions, than their levels of capital endowment (social, institutional, cultural) and the ability to properly exploit it. The most intangible aspects (entrepreneurship, participation, cohesiveness) are key elements in making the difference through the creation, valorisation and maintenance of distinctive places and communities.

Key-words: governance, social capital, institutional learning, sustainable growth, indicators, cluster analysis, discriminative analysis

Correlation partition coefficient based on a multivariate multilevel model

by

Maria Eugenia Ferrão

Universidade da Beira Interior

School effectiveness research is a major topic in Education. It is broadly accepted that a good criterion for measuring effectiveness is the use of value-added models (VAM). Value-added models or adjusted comparison of schools play an important role in order to produce more accurate estimates of the school effect on student development. The statistical specification of those models is still a matter of discussion. Many authors suggest that VAM should consider more than one outcome variable and argue about the most adequate metric. Model functional form and the set of control variables are not a matter of general agreement, either.

The research project 3EM is a longitudinal study that aims both at estimating the school effect and at identifying the characteristics of the effective schools in Portuguese compulsory education (region of Cova da Beira).

The main purpose of this paper is to show that by the time students get into school (baseline), two potential outcome variables are moderately correlated but all correlation is due to student level. Correlation partition coefficient (CFC) is figured out based on a multivariate multilevel model applied to the 1st year 3EM data, where the response variables are 3EMat score (a measure of math skills) and student intellectual level. The control variables are age, gender, socio-economic level and self-concept.

Keywords: multivariate multilevel model, value added model, variance partition, skills in maths, self-concept.

Bayesian Bertrand model

by

Fernanda A. Ferreira

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Coauthors: Alberto A. Pinto (CMUP and FCUP); Flavio Ferreira (CMUP and ESEIG-IPP); Sofia Barros

Bayesian games are used to model situations in which there are players with privileged information, and where the payoff of each player depends upon this privileged information, besides to depend upon the actions of the payers. We consider an economic model in which two firms, sole producers of differentiated goods, compete on the prices of their products. The firms' aims are to maximize their profits by choosing, simultaneously, the prices for their products. We suppose that each firm has two different technologies, and uses one of them following a probability distribution. The utilization of one or the other technology affects the unitary production costs. In our work we determine the Bayesian Nash equilibrium, as-well the output levels and the expected profits of both firms at equilibrium. Furthermore, we do some simulations to analyze the effect of the probabilities' parameters over the firms' expected profits. We analyze the advantages, for firms and for consumers, of using the technology with highest production cost versus the one with cheapest cost.

Point processes of exceedances by random fields

by

Helena Ferreira

University of Beira Interior

Coauthors: Luisa Pereira

Random fields on \mathbf{Z}_+^d , with long range weak dependence for each coordinate at a time, usually present clustering of high values based on Poisson distributions for positions of the clusters. The asymptotic theory for point processes of exceedances of high levels is developed.

Under smooth oscillation conditions, we compute the clustering measure extremal index and the limiting distribution of the cluster sizes of exceedances.

Memory effects and random walks in reaction-transport systems

by

J. A. Ferreira

CMUC-LMC-University of Coimbra

Coauthors: P. de Oliveira

In tis talk we study continuous and discrete models to describe reaction transport systems with memory and long range interaction. In these models the transport process is described by a non Brownian random walk model and the memory is induced by a waiting time distribution of the gamma type. Numerical results illustrating the behavior of the solution of discrete models are also included.

Cross Additivity in Models with Cross Nesting

by

Sandra Saraiva Ferreira

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Coauthors: Dário Ferreira, João Tiago Mexia

Commutative Jordan Algebras were used to carry out inference for mixed models with balanced cross nesting in which the variance components for interactions between sets of fixed effects and random effects are null.

Multicriteria-decision analysis in land use planning. An application to a forested landscape in Central Portugal.

by

Beatriz Fidalgo

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The new forest management approaches that have evolved share a common recognition of the inherent systemic complexity of environmental management and emphasise stakeholder participation, mutual learning, conflict management, and iterative and adaptive decision-making processes as means to address complexity. The so-called Soft OR approaches provide a candidate group with methodological innovation to deal with this complexity mainly in the problem structuring stage.

This paper describes the approach used to structure a decision problem of land use planning in a forested landscape dominated by small non-industrial forest owners (NIFO), located in central Portugal.

It shows how cognitive mapping techniques may be used to map diversity of points of view among a heterogeneous group of stakeholders concerning to questions such as which issues are relevant to the land use planning process, and how landscape and the decision problem should be represented in order to assist in the decision making process.

It also allowed for the identification of the main features of the decision problem from the structuring point of view: 1) subjectivity in landscape representation; 2) inability of NIFO to prior specification of their preferences about land use; 3) the need for communication and explanation of land use alternatives in public decision making processes.

The result is a hierarchical structure linking a multiple set of objectives and attributes of the landscape throughout a set of decision rules that allow for the integration of the subjectivity. This structure could be used to support all the decision analysis process ranging from the development of land use alternatives to the specification of the structure of preferences of the stakeholders throughout an iterative and self-learning process.

Revisited effects on Psychomotor functions of Clobazam and Diazepam, ANOVA vs. survival analysis study

by

Rita Figueirinha

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Coauthors: Helena Jardim, PhD, Rita Figueirinha, BSc, Emanuel Ponciano, MD, PhD, Alexandre Gomes da Silva, PhD.

This study has the objective to compare traditional statistical methods used in medicine to analyse different treatments with survival analysis methodology.

Data was collected from nine healthy females, who undertook a double-blind study to compare the effects of single doses of 20mg of clobazam, 10mg of diazepam and placebo. The within subjects sequence of the three treatments was balanced according to the Latin-square design. Each subject was tested prior and 1h and 3h after the intake of the capsule. The Critical Flicker Fusion (CFF) level, the Choice Reaction Time (CRT), the Digit Symbol Substitution test (DSST) and Symbol Copying test (SCT) were used to assess psychomotor performance.

The first approach was performing an appropriate ANOVA and Newman-Keuls procedure as needed. The second approach was applying survival analysis techniques.

The results suggests that 3 hours after the intake of dosages similar of those used in clinical grounds diazepam decreases the CNS arousal and clobazam interferes on perceptual skills. Both drugs show an identical profile on the other psychomotor performance measurements when compared to placebo. The analysis of survival curves show the evolution of patients during the study and give more information when compared with traditional approaches.

Efficiency and robustness of some designs for two color microarray experiments

by

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Experiments on gene expression using two-color microarrays can be modeled as a row-column designs taken slides as rows and colors as columns. Thus, any experiment with more than two treatments results incomplete-row (incomplete-slide) designs. Practical experimenters often use the so-called reference designs with one check on each slide. For most cases this is a well known inefficient design and other solutions can be found in literature. The efficiency is critical in such small experiments, specially if one wants to carry on recovery of inter-slides information (Rosa et al. 2005). One of the alternatives to reference designs are Kerr and Churchill (2001) "double reference designs". Kerr (2003) states that "loop" designs are usually efficient alternative, but are also very sensitive to slide loss, on the other hand, double reference designs are usually a bit less efficient but more robust to slide loss. An optimality criterion is proposed that allows to evaluate effects on average efficiency due to slide damage as well as recovery of inter-slides information. Local solutions are conditioned on strong prior beliefs on robustness parameters. Some computational problems are discussed and comparisons on resulting designs are also shown to stress the point. A Bayesian criterion is proposed based on integrating over distributions for the ratio of variance components and the number of damaged slides. This is a general, though computational intensive, solution.

key words: optimal designs, row-column designs, two-color microarrays

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Some E-optimal designs under an interference model

by

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We consider an experiment with fixed number of blocks, in which a response to a treatment is affected by other treatments. It is known that circular neighbor balanced designs (CNBD) are universally optimal in a circular model of such experiment. However, CNBDs cannot exist for each combination of design parameters. In such a situation, only optimality with respect to the specified optimality criteria can be studied. Our aim is to characterize E-optimal allocation of treatments in blocks with respect to the number of blocks under the interference model with left-neighbor effects. For the CNBD extended and abridged by one certain block, the resulting structure is proved E-optimal.

Use of multiple imputation on linear mixed model and generalized estimating equations for longitudinal data analysis: a simulation study

by

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Longitudinal studies are useful in medical and health sciences research to examine effects associated with time. However, longitudinal analysis may be complicated by the presence of missing values. The mixed effects model (MEM) and the generalized estimating equations (GEE) are common methods for analyzing incomplete longitudinal data. Both of them make use of all available data and thus are more appealing to other methods that cater subjects with complete data only. Alternatively, multiple imputation (MI) emerged as a method to facilitate the use of methods that do not accommodate missing values. Nevertheless, it was used together with MEM or GEE as a 3-step process: 1. created multiple datasets with missing values imputed; 2. perform MEM or GEE on each dataset; 3. combine results. There was recently an interest in comparing estimates with and without the use of different imputation methods on MEM and GEE. However, the literature has not examined the use of MI with MEM and GEE in a clinical trial setting when the objective is to determine the treatment effect at specific time epochs. Also, there has been no evaluation of using MI with MEM and GEE when missing values are not occurring at random. Therefore, we performed a simulation study to assess the performance of using MI on MEM and GEE under the three missing value mechanisms: missing completely at random (MCAR), missing at random (MAR) and missing not at random (MNAR). The additional use of MI generally led to overly estimated variances and may yield estimates more biased than the use of last observation carried forward (LOCF). Under MCAR and MAR, MEM or GEE alone yielded unbiased estimates and had good coverage. Under MNAR, there was serious bias in all methods but the use of MEM or GEE alone remained not the worst compared to other methods. Comparisons of the use of MI and LOCF on MEM and GEE were also made in a randomized controlled clinical trial.

Induction of Fuzzy Rules for Character Recognition

by

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The use of fuzzy classifiers for Optical Character Recognition (OCR) is appealing but the main obstacle for its development is the enormous number of rules necessary when we have a considerable number of different objects. This is our case since Portuguese cars licence plates can have combinations of 10 digits divided in two sets of two numbers and 23 characters of the alphabet divided in combinations of 2. In this paper we describe a methodology for automatic generation of fuzzy classification rules using decision trees classifiers. The objective is to produce a fuzzy classifier able to correctly classify isolated numbers and letters extracted from licence plate photographs with varying luminosity and different angles of capturing. Using the proposed methodology only the membership functions must be defined by the user. Based on these membership functions and using a set of examples as training set the system automatically generates the fuzzy classification rules that, according to the tests performed, are able to produce very promising classification results. Besides the explanation of the adopted methodology we also present the results obtained by the resulting fuzzy classifier over 380 examples of characters extracted from licence plate images.

Inference for estimable vectors in models with segregation

by

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Commutative Jordan algebras are used to study the algebraic structure of orthogonal mixed models with segregation. The fixed effects part of these models is then considered. UMVUE for estimable vectors are obtained once normality is assumed. Confidence regions for estimable vectors are obtained using pivot variables and hypothesis tests are derived through duality.

Some extensions of the Markov inequality for polynomials

by

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Let \mathbf{D} denote the unit disc of the complex plane and P_n the class of polynomials of degree at most n with complex coefficients. We prove that

$$\max_{z \in \partial \mathbf{D}} \left| \frac{p_k(z) - p_k(z)}{z - z} \right| \leq n^{1+k} \max_{0 \leq j \leq n} \left| \frac{p(e^{ij\pi/n}) + p(e^{-ij\pi/n})}{2} \right|,$$

where $p_0 : = p$ belongs to P_n and for $k \geq 0$, $p_{k+1}(z) := zp'_k(z)$. We also obtain a new proof of a well-known inequality of Duffin and Schaeffer and sharpenings of some other classical inequalities.

Extreme values for Misiurewicz quadratic maps

by

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We consider the quadratic family of maps given by $f_a(x)=1-ax^2$ with $x \in [-1, 1]$, where a is a Misiurewicz parameter. On this set of parameters, there is an f_a -invariant measure, μ_a , that is absolutely continuous with respect to Lebesgue.

For each of these chaotic dynamical systems we study the extreme value distribution of the stationary stochastic process X_1, X_2, \dots , where $X_{n+1}=f_a(X_n)$, for every positive integer n , and X_1 is a real valued random variable with d.f. given by $G_a(x)=\mu_a((-\infty, x])$. Using the techniques developed by Benedicks and Carleson, we show that the limiting distribution of $M_n=\max\{X_1, \dots, X_n\}$ is the same as that which would apply if the sequence X_1, X_2, \dots was i.i.d. This result allows us to obtain that the asymptotic distribution of M_n is of Type III (Weibull), with parameter $1/2$.

An Application of Balanced Arrays

by

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The balanced array is a generalization of orthogonal array and used in a similar way as an orthogonal experiment.

Kuriki and Fuji-Hara (1994) defined a type of block design, called a balanced nested (r, λ) -design, which is equivalent to a balanced array.

If we have a balanced nested (r, λ) -design with cyclic property, we can construct some sequences from it.

We show that the sequences have good cross correlation property and an application to wireless communication.

Endogenous heterogeneity in strategic models

by

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ISEG

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This paper is an attempt to develop a unified approach to endogenous heterogeneity by constructing general class of two-player symmetric games that always possess only asymmetric pure-strategy Nash equilibria. These classes of games are characterized in some abstract sense by two general properties: payoff non-concavities and some form of strategic substitutability. We provide a detailed discussion of the relationship of this work with Matsuyama's symmetry breaking framework and with business strategy literature. Our framework generalizes a number of models dealing with two-stage games, with long term investment decisions in the first stage and product market competition in the second stage. We present the main examples that motivate this study to illustrate the generality of our approach.

Keywords: inter-firm heterogeneity, submodular games, business strategy, innovation strategies.

Degrees of Invariance in Statistical Models

by

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In this work we examine the situation when a family of probability distributions P_{Θ} is not is not necessarily invariant under the perturbation given by a class G which contains the identity transformation and has some continuity properties to be specified.

For g in G and θ in Θ , we consider the setting in which $g P_{\theta}$ are not in P_{Θ} even for g in the neighborhood of identity and explore the deviation, after a suitable rescaling, of $g P_{\theta}$ from P_{Θ} . The form of rescaling is the focus of our study.

We illustrate the previous ideas by examining the departure of a Normal linear model from an extended model, those which considers an extra factor, and determine a convenient class of estimators for this setting in the context of invariance in degree.

Forward Price models and implied Volatility Term Structures

by

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This paper discusses the relation between forward price models (FPM) and the so-called implied volatility term structure (VTS). We start by considering the case of pure deterministic forward price volatilities and suppose both forward contracts and at-the-money (ATM) options, on a same underlying, are liquidly traded in the market. We, then, derive no arbitrage conditions between the functional form of the ATM implied VTS and the functional form of forward price volatilities. We conclude the first part by characterizing a parametric family of ATM implied VTS that is compatible with a finite dimensional realization (FDR) of forward prices. Finally, we consider the possibility of stochastic forward price volatilities and derive a no arbitrage drift condition that must hold for the dynamics of ATM implied VTS.

Functional Poisson convergence in asymptotics for linear processes

by

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The paper develops an asymptotic theory for a class of linear processes affected by stochastic outliers and breaks. It fits a probabilistic scheme in which Gaussian asymptotics apply to frequent events, and Poisson asymptotics - to rare ones. More precisely, the mathematical background consists of an invariance principle and a theorem for weak convergence to a compound Poisson process. A theorem about convergence of product moment-matrices is proved, and is applied to cointegrated processes with level shifts. The limiting distribution of Johansen's trace test on the cointegration rank is shown, in this context, to involve the compound Poisson process and nuisance parameters.

Marshall-Olkin extended Pareto distribution and its application.

by

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This paper investigates properties of a new parametric distribution generated by Marshall and Olkin (1997) extended family of distributions based on the Pareto type I model. We show that the proposed distribution can be expressed as a compound distribution with mixing exponential model. Simple sufficient conditions for the shape behavior of the density, hazard rate, and likelihood ratio ordering are given. The limiting distributions of the sample extremes are shown to be of the exponential and Fréchet type. Finally, utilizing maximum likelihood estimation, a practical application of the proposed distribution is given.

Bayesian optimal exact design of experiments for enzyme kinetic models

by

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Data from experiments in steady-state enzyme kinetic studies are usually analyzed by fitting nonlinear models developed from biochemical theory. Designing experiments for fitting nonlinear models is complicated by the fact that the variances of parameter estimates depend on the unknown values of these parameters. In this paper, Bayesian optimal exact design for nonlinear least squares analysis is recommended. It has been difficult to implement Bayesian exact design, but we show how it can be done using a computer algebra package to invert the information matrix, sampling from the prior distribution to evaluate the optimality criterion for candidate designs and implementing an exchange algorithm to search for candidate designs. These methods are applied to finding optimal designs for the Michaelis-Menten model and higher order enzyme kinetic models in the context of which some practical problems are discussed.

webmath.zcu.cz - scientific computing to your home

by

Petr Girg

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Computer algebra systems become an indispensable tool in research and education nowadays. Purchase and maintenance of such software together with corresponding hardware is very expensive and not every educational or research institution can afford them. As an alternative, we offer high-performance computing 64-bit cluster with gridMathematica accessible through webpages. These interactive webpages are powered by webMathematica and give access to several computational applications which were programmed under gridMathematica. Our project gives chance to young talented undergraduate students to program their algorithms (of broader interest) and make them accessible to users from universities and academy. Two of students involved in this project: Josef Otta and Pavel Martinek will present some applications in their talks.

Combined Route Capacity and Route Length Models for Unit Demand Vehicle Routing Problems

by

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We consider two types of hop-indexed models for the unit-demand asymmetric Capacitated Vehicle Routing problem:

(a) capacitated models guaranteeing that the number of commodities (paths) traversing any given arc does not exceed a specified capacity; and (b) hop-constrained models guaranteeing that any route length (number of nodes) does not exceed a given value. The later might, in turn, be divided into two classes: (b1) those restricting the length of the path from the depot to any node k , and (b2) those restricting the length of the circuit passing through any node k . Our results indicate that formulations based upon circuit lengths (b2) lead to models with a linear programming relaxation that is tighter than the linear programming relaxation of models based upon path lengths (b1) and that combining features from capacitated models together with those of circuit lengths can lead to formulations for the CVRP with a tight linear programming bound. Computational results on a small number of problem instances with up to 41 nodes and 440 edges show that the combined model with capacities and circuit lengths produce average gaps of less than one percent. We also briefly examine the asymmetric travelling salesman problem, showing the potential use of the ideas developed for the vehicle routing problem to derive models with a linear programming relaxation bound that is tighter than the linear programming relaxation bound of the standard Dantzig, Fulkerson and Johnson (1954) formulation.

Optimal Correlation Attack on the MUX Generator

by

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MUX generator is a well-known keystream generator proposed by Jennings in 1980. It consists of two LFSRs, one of which produces the address sequence for a MUX, while the other produces the data input sequence to the MUX. The output sequence is taken from the MUX output, one bit at a time. It possesses controllable properties such as a long period and a high linear complexity. However, over the years, relatively many cryptanalytic attacks on the MUX generator have been developed. They include correlation attack, fast correlation attack, collision attack, linear consistency test, resynchronization attack, and the autocorrelation weakness.

The basic correlation attack targets the data LFSR and exploits the fact that the output bit is correlated to any of M inputs to the MUX with the correlation coefficient $1/M$. Accordingly, it chooses the data LFSR initial state that minimizes the Hamming distance between the output segment and the segment of any selected input sequence. This work is motivated by the following questions: (1) can we use correlations to all input sequences, (2) can we just accumulate the individual Hamming distances, and (3) what is the statistically optimal correlation attack targeting the data LFSR?

In this talk, the optimal correlation attack on the MUX generator will be introduced and the minimal required output sequence length will be determined. The optimal attack will be compared with the accumulated Hamming distance attack, by using a sort of the list decoding approach, in an appropriate experimental setting. It turns out that both attacks reduce the required output sequence length considerably, in comparison with the basic correlation attack.

The calibration problem in the extremal index estimation

by

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The main objective of statistics of extremes is the estimation of parameters of rare events. Most of statistical procedures deal with the i.i.d. setup, but in practical situations the assumption of independence is not realistic. Under adequate weak dependence conditions, the classical limiting results hold true and we get the same max-stable limit for the suitable linear standardization. It appears now a parameter, the so-called *extremal index* that is a quantity which, in an intuitive way, allows one to characterize the relationship between the dependence structure of the data and the behaviour of the exceedances over a high threshold u_n . That is a key parameter for extending extreme value theory for i.i.d. random variables to stationary processes and it is crucial for any inferential procedure. One of the most popular estimators of the extremal index is the *up-crossing estimator*. This estimator, despite of having good asymptotic properties, presents strong bias and dependence on the high threshold u_n , for finite samples. We now consider a calibration technique as a tool for controlling the bias of the estimation procedure. Some examples will be studied for stationary models where the index θ is less than one and a comparison among the results is done.

Impact of heat waves on mortality: A study based on non-negative integer-valued time series models

by

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Non-negative integer-valued time series models, called generalized DSINAR (Doubly Stochastic INteger AutoRegressive) models, are presented. We will establish existence and weak stationarity conditions for these models. The estimation of the model parameters and the properties of the estimators are studied as also the model validation. These techniques are illustrated by a study of the impact of heat waves on mortality.

Pearson's Idea to test fitting in GLM

by

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In this communication we propose a methodology to suppress the lack of goodness-of-fit test statistics in generalized linear models (GLMs), such as count data models. Goodness-of-fit testing in GLMs has been made using mainly Deviance and Generalized Pearson Qui-Square statistics. However, these statistics have unstable probability distributions under the null hypothesis. Pigeon and Heise (1999) and Goeman and Cessie (2006) have developed alternative test statistics, which are adequate for dichotomous and polytomous data but not for continuous or count data. The Qui-Square test proposed here is a generalization of the former, using an approach to overcome the singularity of the variance-covariance matrix, which increases the efficiency to approximate the Qui-Square distribution. Simulation results reveal the good performance of the proposed method in all cases analysed, when compared to Deviance and Generalized Pearson Qui-Square statistics.

Imperfect Demand Expectations and Endogenous Business Cycles

by

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Optimal growth models aim at explaining long run trends of growth under the strong assumption of full efficiency in the allocation of resources. As a result, the steady state time paths of the main economic aggregates reflect constant, exogenous or endogenous, growth. To introduce business cycles in this optimality structure one has to consider some source of inefficiency. By assuming that firms adopt a simple non optimal rule to predict future demand, we let investment decisions to depart from the ones that would guarantee the total efficiency outcome. The new investment hypothesis is considered under three growth setups (the simple one equation Solow model of capital accumulation, the Ramsey model with consumption utility maximization, and a two sector endogenous growth setup); for each one of the models, we find that endogenous business cycles of various orders (regular and irregular) are observable.

Comparison of methodologies in river flow prediction. The Paiva river case.

by

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The analysis, modelling and prediction of a natural system like a river are of most importance for several reasons. Amongst them we can point out the most relevant ones: prevention of natural disasters, optimization of storage reservoirs for hydroelectric or others purposes.

The river flow is a measurement of a complex system with many relevant variables: precipitation, inflow-runoff transformation, and the hydrogeologic features of the river, etc. Some variables, such as rainfall, may change drastically in short periods of time, less than one day which is usually the minimum period of observation. The effect of this sudden change is usually noticeable in the runoff values in very small intervals of time.

The relevant data for this work is the daily mean runoff of the river Paiva measured in Fragas da Torre from October 1946 to September 1999. Our goal is to predict a future value and it will be approached in a classical way, the point prediction. We will try to predict a future value of the river using the historical series. We will use different techniques coming from different areas, Dynamical Systems, *Temporal Data-Mining* and Stochastic Processes.

A Dynamical Analysis of the Paiva river data is performed using Takens method of Dynamical reconstruction, Takens (1980). Later we use the Nearest Neighbours method of prediction for one-step ahead prediction. The results indicate a gain on quality prediction when one considers only the absence of rainfall regime. The results of the Data-Mining technique Correlation Windows confirm these findings but with inferior quality results in prediction. It is also shown that for this time series the prediction set built with the correlated windows and the point estimator are fundamental to achieve reasonable prediction. The used Robust Methods of regression give results of the same quality as the classical Linear Regression. The fitted linear model also gives better predictions for the absence of rainfall regime but with poorer prediction results when compared with the other methods.

Axiomatic characterization of non-additive weighted average charges for heterogeneous questionnaires

by

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In the present communication, we defined “non-additive weighted average charges for heterogeneous questionnaires” and characterized axiomatically. Some have been obtained. Particular cases of β of type α lower bounds of order 1 and Sharma-Garg and that of Duncan have been discussed.

Near-exact distributions, based on truncations of the exact distribution, for the Wilks Lambda statistic used in test of the independence of several groups of variables

by

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Based on the expression of the Logbeta distribution as an infinite mixture of Exponential distributions we were able, by considering a certain number of terms in the series associated with the characteristic function and making an adequate approximation for the rest, to develop near-exact distributions, for the exact distribution of the product of an odd number of independent Beta random variables, which is expressed as a mixture of Generalized Near Integer Gamma (GNIG) distributions. By direct application of these results and once again based on truncations, we obtain near-exact distributions for the exact distribution of the Wilks Lambda statistic used in testing the independence of several groups of variables, when a maximum of three of these groups have an odd number of variables. These near-exact distributions are finite mixtures of Generalized Integer Gamma (GIG) distributions and GNIG distributions, and are relatively easy to implement computationally, allowing for the computation of near-exact quantiles which may indeed be regarded as virtually exact, given the good convergence properties of the series involved, mainly when the difference between the sample size and the overall number of variables involved is rather small. By construction, the two first moments of these near exact distributions are equal to the exact moments.

Keywords: Near-exact distributions, Beta random variables, Gamma random variables, mixtures, generalized Wilks Lambda statistic, measures of proximity.

Singular Spectrum Analysis (SSA): A Powerful Technique for Analysis of Economic Data

by

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The SSA technique is a novel and powerful technique of time series analysis incorporating the elements of classical time series analysis, multivariate statistics, multivariate geometry, dynamical system and signal processing. Despite the fact that a lot of probabilistic and statistical elements are employed in SSA methods (they relate to stationary, ergodicity, principal components and bootstrap technique), SSA is not a statistical method in terms of classical statistics. In particular, we typically do not make statistical assumptions concerning either signal or noise while performing the analysis and investigating the properties of the algorithm.

In this paper we demonstrate that Singular Spectrum Analysis (SSA) is a powerful model-free method of time series analysis and forecasting especially in economic time series. We start with a brief description of the methodology of SSA and finally demonstrate how SSA works and its capability of finding structure and forecasting in economic time series. As an illustration we use real data, namely the Iranian GDP, taken from the Central Bank of the Islamic Republic of Iran (CBI).

Keywords: Economic time series, Singular Spectrum Analysis (SSA), Decomposition, Reconstruction, Iranian GDP.

Singular Spectrum Analysis: A Comparative Study

by

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In recent years Singular Spectrum Analysis (SSA) as a powerful technique of time series analysis has been developed and applied to many practical problems. Possible application areas of SSA are diverse: from mathematics and physics to economics and financial mathematics, from metrology and oceanology to social science and market research. Any seemingly complex series with potential structure could provide another example of a successful application of SSA.

In this paper, performance of the SSA technique has been considered by applying it to a collection of several well-known time series data sets. As an example study for precision of the SSA technique a detailed analysis of a well-known data set, namely, monthly accidental deaths in the USA, is compared with Box-Jenkins SARIMA models, ARAR algorithm and Holt-Winter algorithm which as described in Brockwell & Davis (2002). The results show that the SSA technique gives a much more accurate forecast than the other methods indicated above.

On distributional properties of quadratic forms occurring in linear models hypothesis testing

by

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Quadratic forms and their functions are common in statistics, particularly in linear models and multivariate analysis. For a quadratic form $Q = \mathbf{x}'\mathbf{A}\mathbf{x}$ based on normal variable \mathbf{x} the distribution of Q depends on properties of the matrix \mathbf{A} . For different matrices \mathbf{A} occurring in linear models hypothesis testing the distribution of Q is analyzed.

Labeled directed Graphs and applications

by

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Graph labelings, where the vertices and edges are assigned real values subject to certain conditions have often been motivated by their utility to various applied fields and their intrinsic mathematical interest (logico – mathematical). Labeled graphs are becoming an increasingly useful family of Mathematical Models for a broad range of applications. While the qualitative labelings of graph elements have inspired research in diverse fields of human enquiry such as Conflict resolution in social psychology electrical circuit theory and energy crisis, etc., quantitative labelings of graphs have led to quite intricate fields of application such as Coding Theory problems, in determining ambiguities in X-Ray Crystallographic analysis, to Design Communication Network addressing Systems, in determining Optimal Circuit Layouts and Radio-Astronomy., etc.

A directed graph D with n vertexes and e arcs, no self-loops and multiple edges is labeled by assigning to each vertex a distinct element from the set $Z_{e+1} = \{0, 1, 2, \dots, e\}$. An arc xy from vertex x to y is labeled with $f(xy) = (f(x) - f(y)) \bmod (e+1)$, where $f(x)$ and $f(y)$ are the values assigned to the vertices x and y . Such a labeling f is a graceful labeling of D if all the $f(xy)$ are distinct. Then D is called a graceful digraph. In this short communication, we present graceful labelings of directed graphs and their applications to sequenciable cyclic groups, complete mappings and neofields, i.e., (i) The unidirectional path is graceful iff Z_n is sequenceable, (ii) A graceful labeling of the Collections of unicycles and paths $(\#61640; C_k)$ $\#61640;$ $(\#61640; P_h)$ $(i=1, 2, \dots, r, j=1, 2, \dots, s)$, where $\#61669; k_i + \#61669; h_j = n = e+s$, occurs if and only if there exists a $(K, 1)$ near complete mapping of $Z_n = Z_{e+s}$, where $K = k_1, k_2, \dots, k_r; h_1, h_2, \dots, h_s$ and (iii) Let H_n be a cyclic group of order n and $N_{n+1} = H_n \rtimes \mathbb{Z}_2$. Then $(N_{n+1}, +, *)$ is a cyclic neofield if and only if the digraph D with specified property is graceful.

AMS Subject Classification: 05C78

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Induced bipartite subgraphs in a random graph

by

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We give bounds on the size of maximum induced bipartite subgraph in a random cubic graph. We show that a vertex-maximum induced bipartite subgraph of a random cubic graph on n vertices has asymptotically almost surely at least $0.817n$ vertices and at most $0.9301n$ vertices. The upper bound is obtained by the first moment method; the lower bound is obtained by probabilistic analysis of a randomized algorithm for finding big induced bipartite subgraphs.

These results are analogous to bounds on the independence number of a random cubic graph. McKay (1987) showed that $\alpha(G) < 0.4554n$ a.a.s. The lower bound $\alpha(G) < 0.4327n$ is due to Frieze and Suen (1994).

We give consequences of the results to the theory of graph homomorphisms.

Portfolio analysis in Finance Mathematics

by

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In the present talk some introductory mathematical models and concepts related to risk in investments are discussed. These models are mainly related to the share market, securities and allied financial activities. Main points of discussion are:

1. Introduction
2. Markowitz Mean-Variance –Efficient Frontier
3. Entropy Mean – Variance Frontier
4. Risk Aversion Index
5. Pareto-Optimal Sharing of Risks
6. Maximum Entropy Principle in Risk Sharing

Optimal designs for model discrimination and estimation in binary response experiments

by

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Coauthors: Shih-Hao Huang and Wei-Shan Hsieh

In this talk, optimal design problems for binary response experiments are discussed. Different kinds of optimal designs have been investigated under an assumed model in the literature, which include some for discrimination between rival models. The main goal of this work is to find an optimal design which concerns about model discrimination and estimation at the same time especially for binary response models. More explicitly, based on the T-optimal design criterion for model discrimination proposed in Atkinson and Fedorov (1975), we look for designs which maximize the ordinary sum of squares of deviations at support points for two binary response models. Later it is shown that under certain conditions for the two models, the optimal designs obtained also possess the model robustness property which minimizes the maximum bias between the true and assumed models. Some numerical results concerning the D-, A- efficiency as well as comparisons with other types of model discrimination optimal designs are presented for the optimal designs obtained here.

Keywords: Mean square error, model robustness, symmetric location and scale family

Combinatorial Design For A conference: Constructing a balanced three-parallel Session Schedule

by

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In this paper we presents some related results in combinatorial design.

We use these results to construct a schedule for a balanced three-parallel for a conference.

In this design we have a set of sessions (each one of them involving three different fields) has to be scheduled within a time period of k days.

The problem consists of finding a schedule that is as balanced as possible for each field.

On the optimal realization of a pair of quadratic Boolean functions

by

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In this work we consider Boolean functions over the basis {XOR, AND} where XOR and AND mean addition and multiplication modulo 2, respectively [3]. Having cryptographic applications in mind, in particular, one-way functions, an important measure of complexity of a Boolean function is the minimum number of AND-gates necessary to realize it. In this scenario, the cost associated to XOR-gates is zero. It is known that a quadratic Boolean function in n variables can be realized by a circuit with no more than $\lfloor n/2 \rfloor$ AND-gates where $\lfloor \cdot \rfloor$ denotes the floor function, see [1]. From [2], it is also known that any pair of quadratic Boolean functions in n variables can be realized by a circuit having no more than $\lfloor 3n/4 \rfloor$ gates. In this work we will address the actual construction of an optimum realization of a pair of quadratic Boolean functions, that is, one with the minimum number of AND-gates. The techniques used are essentially from linear algebra and elementary group theory.

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Forest Management, Environment, and Sustainability Development in Ghana

by

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Bretuoman Institute Network

Coauthors: Philip Afriyie

The involvement of local communities, as well as the private sector and the government, in forest management is now an important principle of tropical forestry policy and practice and a major component of most international forestry aid programmes. This paper present an analysis on the Joint Forest Management Project initiated by two timber companies (Ghana Primewood Products Ltd and Dalhoff Larsen & Horneman) in collaboration with local people in Gwira-Banso of Ghana. Conditions required for enhancing responsibility for and commitment to local forest management, and for an effective local participatory process were also analysed. The study began with the premise that incentives and good communication will enhance participation in joint forest management.

The assumption was valid and the results from the survey showed that five broad issues prioritised by respondents to be essential for co-partnership in forest management are communication, financial support, tree planting, multiple land use and benefit sharing. The Project enjoys a great deal of support from the local community, but a number of factors make the continued support of local people a challenging task, including questions of immediate livelihood sources and tenure arrangements. Although this participatory forest management has been implemented over a relatively short period, there is evidence that government and private sectors can successfully involve local people in sustainable management of the forests.

On Comparison of Two Repairable Systems

by

Kanchan Jain

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Two repairable systems are considered and their performance in terms of orderings viz. likelihood ratio, failure rate, stochastic, mean residual life, expectation and variance ordering of their respective conditional interarrival times is discussed. In particular, the performance of two repairable systems subjected to minimal repair and replacement undertaken under age replacement policy is studied.

Inference for random effects in prime basis factorials using commutative Jordan algebras

by

Vera Jesus

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Commutative Jordan algebras provide a very useful framework for orthogonal models. This framework enables us to treat models with random effects.

In this work, commutative Jordan algebras are used to build the models and to carry out the inference. We obtain complete sufficient statistics and UMVUE. Nextly we obtain confidence intervals and derive, through duality, test of hypothesis.

Key words: prime basis factorial, commutative Jordan algebras, complete sufficient statistics, UMVUE, confidence regions.

Optimal diallel cross experiments for estimating special combining ability effects

by

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Coauthors: Koji Momihara, Kazuhiro Ozawa, Naoki Tsushima

Mating designs are utilized for studying genetic properties of a set of inbred lines (treatments) in plant or animal breeding experiments. The main effect and the interaction effect of each parental line caused by crossing two lines are called general combining ability (g.c.a.) effect and special combining ability (s.c.a.) effect, respectively. In mating experiments, s.c.a. effects play an important role, since one of the main aim of such experiments is to find a new variety with some superior characteristics rather than medium property between two parents. Chai and Mukerjee (1999) studied optimal designs for estimating s.c.a. effects. In usual diallel cross experiments, there are two kinds of lines, test lines and controllines. These two kinds of lines are crossed in a mating experiment. Das, Gupta and Kageyama (2002) and Choi, Gupta and Kageyama (2004) studied an optimal mating design for estimating g.c.a. effects when a single control line exists.

In this talk, we establish an optimal mating design for estimating s.c.a. effects in the case when there are more than one control lines. And we compare optimal designs for estimating s.c.a. effects with ones for estimating g.c.a. effects. Moreover, combinatorial properties of such optimal mating designs are investigated in connection with triangular and rectangular designs.

No affine resolvable triangular design

by

Sanpei Kageyama

Hiroshima University

The existence of affine α -resolvability with some properties has been discussed for block designs in literature since 1942 for $\alpha = 1$ and in particular since 1963 for $\alpha \geq 2$. No example has been found for an affine α -resolvable triangular design (in a class of 2-associate partially balanced incomplete block designs) for any α in literature. In this talk, when $\alpha = 1$, the non-existence of an affine resolvable triangular design will be shown completely, whereas, when $\alpha \geq 2$, partial non-existence results are provided.

A bivariate circular distribution with uniform marginals

by

Shogo Kato

School of Fundamental Science and Technology, Keio University, Japan

In the talk we propose a bivariate circular distribution which is generated by a Brownian motion on the plane. Both marginals have circular uniform distributions, whereas conditionals obey the wrapped Cauchy distributions. In addition, some tractable properties such as additive property and infinite divisibility hold for the proposed model. We discuss parameter estimation using maximum likelihood and method of moments. As a related topic, we construct a bivariate distribution on the plane by applying a bilinear fractional transformation to the proposed model. Its marginals and conditionals are Cauchy distributions on the real line.

On certain D-optimal spring balance weighing designs

by

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Coauthors: Katarzyna Przybyl (Adam Mickiewicz University of Poznan)

The estimation problem of individual weights of objects in spring balance weighing design using the criterium of D-optimality is discussed. It is assumed that variances of errors are not equal and errors are not correlated. The lower bound of the determinant of the variance matrix of estimators is obtained and the conditions for this lower bound to be attained are proved. Some numerical examples of D-optimal spring balance weighing designs are demonstrated.

Mathematical modelling of LNG explosion

by

Nail Khabeev, prof.dr

Plans to exploit oil and gas fields in the Arabian Gulf region usually include options to transport LNG (liquefied natural gas) to markets in Europe and America. The possibility of sinking, ship-ship collision or grounding needs to be considered in the development plans. Such accidents can of course occur near towns and other densely populated areas.

Vapour explosions, also called thermal detonation occur when liquefied gas comes into contact with sea water. During contact of the two liquids with considerably different temperatures intensive boiling of one of them takes place, which is accompanied by an explosive increase in pressure [1]. A similar phenomenon also arises in the cooling systems of nuclear power stations when as a result of some accident the heated particles of nuclear fuel settle in the cold water. This leads to the explosive boiling of the liquid and to a rapid increase of the pressure [2].

If a LNG ship is involved in an accident such that large quantities of liquefied gas escape, a large explosion can occur.

LNG ships are designed and operated to very high standards, because of the dangers involved in handling LNG. Nuclear power stations similarly, are designed and operated to very high standards. Nevertheless, accidents do occur in nuclear power stations. It does not take much imagination to visualize an accident along the Gulf coast involving a LNG ship. The potential consequences of such an accident need to be known.

As the first stage of the problem small scale single drop explosions were modeled analytically and numerically on the basis of models [3,4].

General regularities of the behavior of a bubble containing the drop of liquefied gas have been studied.

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Two phase coxian interdependent queuing model on $L(0, k)$ lattice, a combinatorial approach

by

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Coauthors: Neha M. Wazalwar, Department of statistics P G T D Nagpur University India

Here we present two phase coxian interdependent $C2/M/1$ queuing model with $(0,k)$ control policy on lattice. This Two phase $C2/M/1$ is a model where arrival process follows $C2$ cox distribution which consists of two independent exponential phases with different arrival rates. Here covariable between arrival and service rates is the interdependence parameter. $L(0,k)$ is a lattice where counter is closed or the system becomes idle whenever it is empty and reopens for service or the system becomes active immediately at the arrival of the k th customer in the queue, $k > 1$. An interdependent queuing model is applicable to communication packetized statistical multiplexing. The performance of statistical multiplexing is measured by approximating the arrival and service processes with correlated poisson process. We present a discrete version of such a model on lattice. Transient solutions for the model will be obtained. References 1) Interdependent heterogeneous queuing model with finite source by k srinivasrao et al. Far east j of theo statistics 10(1)2003 43-61. 2) Lattice path approach to transient solution of $M/M/1$ with $(0,K)$ Control policy by kanwar sen ,jain gupta Journal of statistical planning and inference 34 (1993) 259-267.

Design of mixture experiments with uniform restrictions on $m \leq 4$ proportions

by

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Mixture experiments are experiments in which the experimental conditions are the relative proportions of ingredients of a of a whole. Given the a second-degree polynomial regression model, Draper and Pukelsheim (1999) and Draper, Heiligers, and Pukelsheim (2000) have identified classes of designs (so called weighted centroid designs) which are essentially complete with respect to many popular design criteria. These designs are concentrated on extreme points of the design space and might thus be unfeasible in some applications. This raises the question whether an essentially complete class of designs can be found when upper or lower bounds on the proportions of the ingredients are imposed. In order to preserve symmetry we consider bounds which are uniform for all ingredients, and we focus on the case of experiments containing at most four factors. We identify essentially complete classes of designs which are described as convex hulls of finitely many designs. Furthermore we use these results to find D-optimal designs.

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Simultaneous confidence intervals for all contrasts of the means in repeated measures with missing observations

by

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Simultaneous confidence intervals for all contrasts of the mean components in repeated measures with the intraclass correlation model are considered when the observations are missing at random. In the intraclass correlation model the variance σ^2 and the intraclass correlation coefficient ρ are both unknown. A new exact test statistic for the equality of means and Scheffé, Bonferroni and Tukey types of simultaneous confidence intervals for all contrasts are given by an extension of Seo, Kikuchi and Koizumi(2006) when the missing observations are of the non-monotone type as well as the monotone type. Finally, numerical examples by simulation are given to illustrate the method.

Key words: Intra-class correlation model, Missing data, Testing equality of means, Monte Carlo simulation, Simultaneous confidence intervals.

Maximal Error-detecting Capabilities of Formal Languages

by

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A (combinatorial) channel is a set of pairs of words describing all the possible input/output channel situations. We introduce the concepts "maximal error-correcting capability" and "maximal error-detecting capability" of a given formal language, with respect to a certain class of combinatorial channels. We are mainly concerned with obtaining basic general results on these new concepts and discuss possible research directions with an emphasis on the problem of computing maximal error-detecting (or -correcting) capabilities of a given regular language.

The Computational Complexity of Planarity Testing

by

Marek Krčál

Charles University

In this paper we will show that the problem of planarity testing is in SL (symmetric nondeterministic LOGSPACE). The main part of our proof is a reduction of the problem to planarity of graphs with maximal degree three. Note that usual replacing vertices of degree bigger than three by "little circles" can spoil planarity, we need to be smarter. Planarity of graphs with maximal degree three was already solved in paper "Symmetric complementation" by John Reif.

Previously Meena Mahajan and Eric Allender have already proved this in ("Complexity of planarity testing"), but their proof is the pure SL implementation of a parallel algorithm by John Reif and Vijaya Ramachandran ("Planarity testing in parallel"). But it is possibly unnecessarily complex and sophisticated for the purposes of the space complexity.

This result together with recent breakthrough by Omer Reingold that $SL = L$ ("Undirected ST-connectivity in log-space") completely solves the question of complexity of planarity problem, because planarity is hard for L (it is again shown in "Complexity of planarity testing"). We construct logarithmic-space computable function that converts input graph G into G' with maximal degree three such that G is planar if and only if G' is.

Performance modeling and Dynamical behavior of Cardiovascular System in presence of Magnetic Effects

by

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We have previously described a new approach to planning treatments for cardiovascular diseases, Simulation-Based Medical Planning, whereby a physician utilizes computational tools to construct and calculate a combined anatomic/physiologic model to predict the outcome of alternative treatment plans for an individual patient. The cardiovascular system distributes blood with oxygen and many others of vital concernment substances and therefore is the important part of human body beings. Knowing that how cardiovascular system works allows us to treat some heart diseases, but it also helps us to learn about its dysfunctionality. Numerical technique of cardiovascular system has also become useful tool of surgeon who diagnoses cardiovascular diseases and recommends the way of their medical treatment of the doctor. A detailed discussion of these issues forms the basis of this review.

Viscous Flow Coaxial Cylinder in the Presence of Magnetic Field

by

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In this paper, we consider the flow of second order fluid in the annular space between an impervious solid circular cylinders rotating with constant angular velocity and surrounded by the co-axial cylinder in the presence of magnetic medium. The flow in the annular free flow region is taken to be governed by the Navier- Stokes equations and in the porous region by the Brinkman equations. The solutions are obtained by using boundary and matching conditions at the surface of the interface. It has been found that the torque on the surface of the inner cylinder decreases with the increase of the width of the annular region and increases with the decrease of the permeability of the magnetic medium. The features found in this work are in agreement with those of experimental findings.

Analysis for mathematical model of DNA supercoil

by

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Almost every one is familiar with the double helical structure of DNA. The formation of supercoil of DNA in the cell nucleus is a common phenomenon. The molecule grips a three dimensional complex shape which is known as supercoil. In the present model we are highlighting the application of mechanical theory to determining macromolecular shape and the effect of change of half length of supercoil.

Estimation of Regression Coefficients in Mixed Regression Model when Disturbances Follow Multivariate t- Distribution

by

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Employing the small disturbance approximations, the bias vectors mean squared error matrices and risk functions of the mixed regression and improved mixed regression estimators are derived, when disturbances follow multivariate t- distribution. The efficiency of the estimators with respect to criterion of risk is also examined.

Forecasting of economic growth using mathematical models

by

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Economic reforms have affected all sectors of the Indian economy. Before reforms the pace of economic growth was slow and GDP growth rate was imperceptibly above the population growth rate. After reforms Indian economy has transformed relatively from stagnation to a dynamic stage due to growth in primary, secondary and tertiary or service sectors. However, pattern of growth in agriculture, industry and service sectors along with developments in the reforms and liberalization process shows that growth in agriculture sector has not increase substantial though other sectors demonstrate boost particularly service sector. Therefore, the objective of the paper is to examine the nature of growth of different sectors namely agriculture, industry and service sectors in India using growth models. Results indicate that contribution of agriculture sector in GDP is declining whereas the share of service sector is increasing. Further, analysis shows that share of industrial sector in GDP seems approaching towards stagnation.

Reliability Constrained Minimum-Delay Transmission Path-Routing for Data Network

by

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This paper addresses the problem of transmitting a given amount of data along a single path from source end to receiving end node in a directed network so that the performance and reliability of transmission is best. Both the performance and reliability of the transmission along the path is described in terms of an expression has been defined as performance reliability (PR). PR is the function of link reliability, capacity, and delay. A path is said to be best if the numerical value of performance reliability is maximum in comparison to the others available paths between the two specified nodes. The algorithm developed for selecting the best-path uses Dijkstra algorithm for the finding shortest path. Proposed algorithm is more suitable for store-and-forward-first-in-first-out type of transmission delivery system. The best-path selection is an important precomputation in developing the routing protocols with considering reliability, capacity and delay. Proposed method is able to decide the best-path corresponding to the range of data traffic. This method has been extended for the restoration of path in case of link or node failure.

Key Words: Routing, grade-of-service, restoration, fault-tolerance, reliability.

Mathematical modelling of the interaction between tumor cells and tissue cells

by

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Our analysis reveals the local interaction between the tumoral and the tissue cells qualitatively. We present a new formulation of a mathematical model and we study the characteristic sizes and growth rates of spherical tumors, the points of the beginning and end of spherical growth and the further development of complex structures are derived from the assumption that the reproduction rate of a population of cancer cells is a non-monotonic function of their local concentration. We have used the statistical distribution model to predict the characteristic tumor sizes. As tumors grow at different rates through their evolution stages, therefore it is possible to estimate the statistical distribution of their sizes and shapes.

Keywords: cancer cells, tissue cells, local interaction, statistical distribution, sizes and shapes.

Two coding Theorems for weighted information measures of order alpha

by

Satish Kumar

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In the present communication we apply Holder's inequality and obtain two 'weighted' Alpha-average codeword lengths corresponding to 'weighted' information measure of order Alpha; which provide upper bounds for the introduced measures.

Square lattice designs in incomplete split-plot designs

by

Shinji Kuriki

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We construct an incomplete split-plot design by the semi-Kronecker product of two resolvable designs. We use any resolvable design for the treatments of whole-plots and a square lattice design for the treatments of subplots. We give the stratum efficiency factors for such incomplete split-plot designs, which have the general balance property.

GA-optimal Partially Balanced Fractional $2^{m_1+m_2}$ Factorial Designs of Resolutions $R(\{10, 01\} \in \Omega^* | \Omega)$ with $2 \leq m_1, m_2 \leq 4$

by

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Under the assumption that the three-factor and higher-order interactions are negligible, we consider a partially balanced fractional $2^{m_1+m_2}$ factorial design derived from a simple partially balanced array such that the general mean is confounded with some two-factor interactions and all the m_1+m_2 main effects are estimable. Furthermore we present optimal designs with respect to the generalized A-optimality criterion when the number of assemblies is less than the number of non-negligible factorial effects, where $2 \leq m_1, m_2 \leq 4$.

Random Dry Markets and Statistical Arbitrage Bounds for European Derivatives

by

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We derive statistical arbitrage bounds for the buying and selling price of European derivatives under incomplete markets. In this paper, incompleteness is generated due to the fact that the market is dry, i.e., the underlying asset cannot be transacted at certain points in time. In particular, we refine the notion of statistical arbitrage in order to extend the procedure for the case where dryness is random, i.e., at each point in time the asset can be transacted with a given probability. We analytically characterize several properties of the statistical arbitrage-free interval, show that it is narrower than the super-replication interval and dominates somehow alternative intervals provided in the literature. Moreover, we show that, for sufficiently incomplete markets, the statistical arbitrage interval contains the reservation price of the derivative.

A Comparative Study of Fuzzy Logic and Conventional Approach for the Solution of Real World Problems

by

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Fuzzy Logic provides a new way of modeling the uncertainty of natural languages arising in day to day real world problems. All engineering disciplines have already been affected to various degrees by the new methodological possibilities opened by fuzzy logic, fuzzy set theory and fuzzy measure theory. In this paper we characterize the fuzzy approach and establish it as a better alternative design methodology which is simpler and faster and a better alternative solution to non linear systems than usual conventional approach.

Diffusion processes with reflecting boundaries and random initial states

by

Mario Lefebvre

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Kolmogorov's forward equation for one-dimensional time-homogeneous diffusion processes $X(t)$, namely

$$\frac{1}{2} \frac{\partial^2}{\partial x^2} \{v(x) f(x, t)\} - \frac{\partial}{\partial x} \{m(x) f(x, t)\} = - \frac{\partial}{\partial t} f(x, t),$$

is considered. This equation is solved explicitly for the Wiener and the Ornstein-Uhlenbeck processes, in particular, in the case when there is a (time-dependent) reflecting boundary. Moreover, the initial state $X(0)$ is a random variable.

Possibilistic Fuzzy Clustering Using Self Organizing Maps

by

Victor Lobo

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Coauthors: Miguel Loureiro (ISEGI-New University of Lisbon), Fernando Bação (ISEGI-New University of Lisbon)

Fuzzy clustering allows partial memberships of patterns to clusters with non-crisp boundaries. The most well known fuzzy clustering algorithm is the Fuzzy C-Means (FCM), and since its introduction by Dunn, many variants have been proposed. Nevertheless, several clustering problems are not well handled by most of these algorithms. Some examples of these problems are clusters with different data density, clusters with elongated shapes or the chainlink cluster problem. In this paper a new methodology for fuzzy clustering is proposed. It is based on pattern density estimation using a Self Organizing Map (SOM). The new method is a possibilistic method, which allows a pattern to belong to more than one cluster with high membership value, or not to belong to any of them. To highlight the advantages of the new method, a comparison with the FCM is performed using the three clustering problems mentioned above.

Nonparametric and Semiparametric Multivariate GARCH Model

by

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Coauthors: Aman Ullah at University of California, Riverside

The existing parametric multivariate generalized autoregressive conditional heteroskedasticity (MGARCH) model could not capture the nonlinearity and the non-normality, which are widely observed in the financial data. We investigate these issues by suggesting two Nonparametric MGARCH (NMGARCH) models: the Cholesky Factorization and the Nadaraya-Watson estimation. Both can guarantee the positive definite of the conditional covariance matrix estimator and the former degenerates to the later under some circumstances. These methodologies could also be applied to capture the information hidden in the standardized errors and missed by the parametric MGARCH models. Our two-stage Semiparametric MGARCH (SMGARCH) models use the nonparametric skills to model the conditional covariance matrix of the standardized errors from the parametric MGARCH models and incorporate multiplicatively parametric and nonparametric estimators of two stages together for the conditional covariance matrix of the interested variables. For every parametric MGARCH model, we could construct two semiparametric counterparts. Three Monte Carlo simulation experiments motivated by the stylized asymmetric correlations of financial data demonstrate the advantages of NMGARCH and SMGARCH models in terms of statistical loss functions (including mean absolute error, mean squared error, logarithmic loss and heteroskedasticity-adjusted mean squared error of the conditional covariance matrix) and economic loss function, Value-at-Risk check function of the portfolio. Our NMGARCH and SMGARCH models outperform the parametric MGARCH models in the empirical applications on stock indexes and foreign exchange rates. The superiority of semiparametric methodology over nonparametric modeling is also clearly observed.

Hyperfinite Knots

by

Pedro Lopes

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We introduce hyperfinite knots. Loosely speaking, these are limits of certain sequences of knots with increasing crossing number. These limits exist in appropriate closures of quotient spaces of knots. We give examples of hyperfinite knots. These examples stem from an application of the Thermodynamic Limit to the CJKLS invariant of knots.

Identifying asset price booms and busts with quantile regressions

by

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This paper presents a methodology for detecting asset price booms and busts using non-parametric quantile regressions. The method consists in estimating the distribution of real stock prices as a function of fundamental determinants of stock returns, namely real economic activity and real interest rates. It is shown that changes in fundamentals affect not only the location but also the shape of the conditional distribution of stock prices. Asset price booms and busts are identified as realizations on the tails of that distribution. Then we use indicators to analyze the behavior of money and credit around the boom and bust episodes.

Estimating the optimum of a job-shop scheduling problem

by

Pedro Machado & Francisco Saldanha da Gama

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We consider the job-shop scheduling (JSS) problem, which is a NP-Hard combinatorial optimization problem. In this problem a set of jobs must be scheduled in a set of dedicated machines. For each job there is a specific order for 'visiting' the machines. The time required for processing a job in a machine depends on the job and on the machine. No job can be processed simultaneously by two or more machines. No machine can handle more than one job at the same time. Preemption is not allowed. The objective is to minimize the makespan.

Starting with the value of a random feasible solution, a local search based procedure can be used to obtain a sample of, say m , values of feasible solutions. The minimum value in this sample is an upper bound (hopefully good) on the optimal value of the JSS problem. If we repeat the overall procedure, say n , times we obtain a sample of size n of (good) upper bounds to the problem. It is likely that an extreme model can be adjusted to the population from which the final sample is drawn. If that is the case, by estimating the location parameter of the distribution we are estimating the global optimum of the JSS. Simulated annealing is considered as a technique for visiting different regions of the solution space when we start from a random feasible solution. The final sample of upper bounds is analysed in terms of randomness. Adjustment tests are performed to validate a three-parameter Weibull distribution. Different point estimators and interval estimators are analysed for the location parameter of this distribution, which leads to different point and interval estimators for the optimal value of the JSS problem. Computational results are presented based on instances existing in the literature.

Keywords: Job-Shop Scheduling, Extreme Value Theory

Modelling MRP Systems under a Fuzzy Logic Approach

by

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The issue of uncertainty associated with Material Requirements Planning systems (MRP) has attracted considerable attention over the last few years. In fact, MRP is regarded as the most commonly used production planning and control system. Naturally, many inputs are affected by uncertainty. Trying to model and to prevent them is very difficult. Normally it is preferable to consider all inputs affect by uncertainty and make use of one or more techniques to avoid or to decrease the undesirables' effects that are produced. The objective of MRP consists into the minimization of the stock levels, maintaining a flow of materials adapted to the productive process. The application of this technique takes place when a dependent demand system is present.

The aim of this paperwork is handle uncertainty in a MRP model using Fuzzy Logic. Particularly, the model is applied to dependent demand in which a MRP method is used. The materials planning model is a combination of basic sources of uncertainty that affects the MRP system, namely, demand and supply uncertainty, and a Fuzzy Logic Inference system. The model is used to control the principal parameter to buffer against uncertainties, safety stock. The model performance is tested for historic data and compared with real inventories levels and a MRP reference model.

Forecasting in recovery of packaging. An exploratory study

by

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The world of logistics has considerably changed in the last years. There has been a steady evolution due to globalization, modern information technology and especially increasing ecological awareness.

As a result, product recovery turned out a very important issue for companies. On one hand, laws are becoming more demanding every day, with the objective of making companies more conscious about the environment and their responsibility with product preservation. And, on the other hand, companies have discovered the potential profit derived from an efficient product recovery process.

The Packaging and Packaging Waste Directive (PPWD) 94/62/EC, encompassing all packaging placed on the market and all packaging becoming waste within the European Community, established targets to be achieved for the recovery and recycling of packaging. Packaging reuse, in order to prevent the generation of packaging waste, is one of the fundamental principles outlined in the PPWD.

Beverage industry increasingly faces requirements to implement systems to reuse the bottles/containers, at the end of the beverage consume. This is caused by new laws and regulations which assign an extended product responsibility to producer industry. The extension of the producer responsibility, into the after-use phase comes along with the necessity to develop instruments to cope with the arising planning problems. Whereas a traditional supply chain a number of additional aspects have to be considered. The most relevant are:

- i) Uncertainty in reference to volumes, quality and timing of the collected bottles/containers, leads to an increased system complexity;
- ii) An imbalance of bottles/containers supply, on the one hand, and the requirements of the refilling plants as demand, on the other hand, can often be determined;
- iii) The additional market opportunities that can arise from these processes are unexplored until now.

It is important to look for different strategies to improve bottle/container recovery process. One of them is to obtain more accurate forecasting of the return flow. Predicting the return flow characteristics is important for decisions at all levels, strategic, tactical and operational. However, there is little research on identifying factors that significantly influences return flow characteristics. A good understanding of drivers of return flow characteristics would enable better decision making for influence return flows.

The aim of this presentation is to examine all the activities that have to be done in order to get the bottle/container back to the recovery entity (refilling plant), analyse the potential uncertainties on identifying the return flow characteristics and discuss the problems to apply some forecasting methods to predict return flow.

Keywords: Forecasting, Product recovery, Reverse logistics.

Estimation of the Size of Bird Species using Bird-Ringing Data

by

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Ecology is the study of interactions among organisms and their surroundings including other organisms. They grow, multiply, occupy different regions, compete with others for resources, prey upon others, transform into different species etc.

Populations in nature fluctuate; variations in size of population of a particular species, and in relative abundances are frequently in responses to the effect of surroundings. It stands to reason that account of changing numbers over environmental gradients must be kept - there may be a variety of reasons for such changed numbers. Thus, quantification and modeling has become prominent features of ecological studies. If one wishes to monitor the effects of intervention on an eco-ecosystem, estimating abundances of a particular species and bio-diversity of various species living together in a habitat, becomes necessary.

For such populations, traditional finite population sampling technique is not feasible, because the population size is unknown and an exhaustive list of target population units may not be readily available - target population being referred to as a finite labelled population of what we may designate as ultimate units. Such situation arises for a mobile population as in the population of birds. In addition to the population being mobile, a particular method of data collection, namely capture- recapture technique creates the multiplicity problem in the sense that a particular target member or species may be recaptured a number of times. Therefore, the problem of non-availability of a frame for a mobile population gets multiplied with that of over-counting.

Under such situations, an appropriate estimation methodology based on any general sampling design needs to be developed. We review one such method and suggest appropriate modifications and then apply it to the present real life Bird -Ringing data to obtain the estimates of abundances and biodiversity.

Reliability Modeling and Profit Analysis of Single-Unit System with Inspection by a Server who Appears and Disappears Randomly

by

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The aim of this paper is to develop a reliability model for a single-unit system in which unit may fail completely either directly from normal mode or via partial failure. There is a single server who appears and disappears randomly from the system with some probabilities. The server inspects the unit at its partial failure to find out the possibilities of its on-line repair. In the case of complete failure it examines the need of repair or replacement. If on-line repair of the partially failed unit is not possible its repair is done in down-state. Further, if repair of the completely failed unit is not beneficial to the system, it is replaced by new one to avoid unnecessary expenses on its repair. The failure, repair and inspection times of the unit are independent and uncorrelated random variables. The distributions of failure time of the unit, time of appearance and disappearance of the server follow negative exponential while that of repair and inspection times are taken as arbitrary with different probability density functions. Various reliability measures of system effectiveness are obtained by making use of semi-Markov process and regenerative point techniques. Graphical study is also made to show the behavior of MTSF, availability and profit for a particular case.

Exact simulation-based inference for autoregressive coefficients in linear regression:

Approach based on induced tests

by

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In this paper, we consider a regression model with an autoregressive disturbances of order p which may be nonstationary (where $p \geq 1$) and no specific distribution. Exact inference methods are developed for the autoregressive coefficients only. We generalize approaches proposed in Dufour & Neifar (2003) and Dufour & Neifar (2004) for the complete vector of the autoregressive coefficients of an AR(p) model. This is done by first transforming the model in a way that eliminates serial dependence under the null hypothesis, and then testing whether dependence remains present in the transformed model. Proposed approaches are particularly based on p DW type statistics. The distribution of each proposed statistic is independent of nuisance parameters (regression coefficients β), the true θ , and postulated value θ_0 . The test on the complete vector of autoregressive coefficients is accomplished by combining tests against serial correlation at lags 1, ..., p (by induced test). Without using a conservative bound, such as the Bonferroni inequality, tests for dependence at different lags are combined by using methods proposed by Tippett (1931) and Fisher-Tippett (Fisher, 1932), Pearson (1933). In view of the dependence among the different tests, the size of the combined procedures is controlled by using Monte Carlo test techniques. Exact confidence sets for this vector are then built by "inverting" autocorrelation tests. For inference on individual coefficients or more general transformation of the autoregressive coefficients (root of polynomial for example), we propose to use a projection approach.

On admissible linear estimation in linear models

by

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A review of some results inspired by Rao [3] paper is given. In particular, it covers results related to restricted Gauss-Markov model, estimation with respect to the matrix risk, the solution to the problem of "natural restrictions" in singular Gauss-Markov model ([1]), as well as estimation with respect to an arbitrary quadratic risk function ([2]). Some recent results concerning admissibility are also presented.

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Near-exact distributions for a family of generalized sphericity tests

by

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In this paper a new technique is developed to obtain near-exact distributions for the tests of multisample sphericity, block sphericity and multisample block sphericity based on the decomposition of each of the null hypothesis in a number of "partial" hypothesis which are conditionally independent. This way we are able to construct the statistic of each test from the statistics used to test each of the partial hypothesis what allows us to build near-exact distributions for the overall test statistic from the decomposition of the characteristic function of the statistics used to test the partial hypothesis. As partial tests we use the equality of several covariance matrices test, the independence of sets of variates test and the sphericity test. We also develop new asymptotic distributions that are more precise than the existing ones, which are used to show the usefulness of approximations based on moments. Two measures based on the Berry-Esseen inequality are considered to evaluate the quality of the near-exact and asymptotic approximations developed.

Teaching of statistics using webMathematica

by

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We will show how to deploy Mathematica and its web extension webMathematica in teaching statistics for various fields of study - mathematics, natural sciences, and psychology. Tutorial materials, own packages and web interface are currently incorporated into webmath.zcu.cz portal.

A new Mixed Integer Programming Model for Harvest Scheduling subject to Maximum Area Restrictions

by

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Research on exact methods has been done in order to solve forest management problems with constraints on the clearcut size. Each clearcut may have more than one stand if its area does not exceed the maximum clearcut size. Two main basic integer programming models have been discussed, which one with an exponential number of variables or constraints. In this work, we describe a new integer programming model with a polynomial number of variables and constraints. We use branch-and-bound to solve it and we report on computational experience with real life and test instances.

Keywords: Forest management, harvest scheduling, spatial modeling, integer programming

On 2-Dimensional Homotopy Invariants of Complements of Surfaces Embedded in S^4

by

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We prove that if M is a CW-complex and $*$ is a 0-cell of M , then the crossed module $\Pi_2(M, M^1, *)$ does not depend on the cellular decomposition of M up to free products with $\Pi_2(D^2, S^1, *)$. From this it follows that if G is a finite crossed module and M is finite, then the number of crossed module morphisms $\Pi_2(M, M^1, *) \rightarrow G$ can be re-scaled to a homotopy invariant $I_G(M)$. We describe an algorithm to calculate $\Pi_2(M, M^1, *)$, as well as $I_G(M)$, in the case when M is the complement of a knotted surface in S^4 . This, in particular, gives a method to calculate the algebraic 2-type of M . In addition, we prove that the invariant I_G yields a non-trivial invariant of knotted surfaces.

A Kernel-based Specification Test for Binary Discrete Choice Models

by

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In economics, there are many settings in which the phenomenon we seek to model is discrete rather than continuous. Consider, for example, modeling labor force participation, the decision of whether or not to make a major purchase, or the decision of which candidate to vote for in an election. In this paper we will examine a specification test for binary discrete choice models, based on kernel regression (for further details on nonparametric econometrics based on kernels, see for example, Pagan and Ullah, 1999). In most of the situations involving binary dependent variables, a parametric model is specified, based on principles of economic theory such as utility maximization. Usually, the model is estimated by using the method of maximum likelihood (ML). However economic theory provides only partial guidance on how a parametric model should be specified. Consequently, there can be no assurance that the chosen specification is correct. Many studies have investigated the consequences of adopting a wrong parametric model (see Horowitz, 1993, for binary choice models) and concluded that the misspecification of the model causes the ML estimators to be inconsistent, and predictions obtained from a misspecified model can be highly erroneous. Ait-Sahalia, Bickel and Stoker (2001) developed a generally applicable specification test for a regression model based on kernels. This test is able to cover some interesting situations in the literature and focuses on a goodness-of-fit test statistic that is natural and easy to interpret, since it is based on comparing residual sums of squares under the null and the alternative hypotheses. Their test is applicable to virtually any situation where under the null hypothesis the model is of lower dimension than the possible alternative. This paper uses the results proposed by authors for the particular case of testing a parametric single index model, the binary choice model, against a semiparametric alternative, as in Horowitz and Härdle (1994) and Fan and Liu (1997). We show that the test is very simple, works relatively well and overcomes some of the problems existing with the Horowitz and Härdle (1994) test, namely those related to the choice of the bandwidth and the quality of the asymptotic approximation used for the distribution. The empirical size and power of the test are analyzed using the usual Monte Carlo techniques. To illustrate our results, we provide an example related to the female labor force participation in Portugal.

Keywords: specification tests, kernel regression, binary choice models.

Modelling and Optimization of Police Patrol Systems - a case study

by

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The main goal of this work was the development of a procedure to generate patrol schemes. In particular, the procedure could be applied to the management of Police Patrolling Systems in Lisbon. The schemes had to respect several parameters defined a priori by the user.

In the present communication, several alternative mathematical formulations are proposed for the studied problem, which was identified as being a Network Optimization problem.

Secondly, the evolution of criminality in Lisbon, in a specific time frame, is characterized.

It was desired that the Patrol Schemes generated by the procedure not only should have high potential for criminal prevention, but also should be created rapidly and with a high diversity. The reason behind this diversity was to prevent the creation of patrolling patterns that could be easily detected by potential criminals. An algorithmic approach is also proposed.

Finally, the Algorithm was tested on five Lisbon's precincts, and the results are presented and compared.

Spanning trees with degree constraints: proprieties and formulations

by

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This work is on two graph optimization problems. To describe them, let $G=(N,E)$ be an undirected graph, with N the nodes set and E the edge set. We also consider a constant d , taking values in $\{2,\dots,|N|-1\}$. In the first problem, which has long been discussed and designated by d -MST, we want to determine a minimum cost spanning tree of G , with the additional constraint that all nodes have maximum degree d . In the second problem, designated by md -MST and being recently proposed, we also want to determine a minimum cost spanning tree of G , however this time the degree constraint establishes that each node either has minimum degree d or is a leaf-node (degree 1). In practice these problems can occur when one wants to locate means or services that verify certain connectivity propriety (minimum or maximum), being linked together by a tree structure. Both problems belong to the NP-hard class for some values of d . In this presentation we propose proprieties and formulations to both the d -MST and the md -MST. Computational results obtained with these formulations indicate that the second problem (md -MST) appears to be more difficult to characterize than the first, which turns the md -MST a very challenging problem to be tackled.

Nonparametric regression estimation with general parametric error covariance

by

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The asymptotic distribution for the local linear estimator in nonparametric regression models is established under a general parametric error covariance and dependent and heterogeneous regressors. A two-step estimation procedure that incorporates the parametric information in the error covariance matrix is proposed. Sufficient conditions for its asymptotic normality are given and its efficiency relative to the local linear estimator is established. We give some examples of how our results are useful in some recently studied regression models.

A Secure Multiple Path Real-Time Framework for Video Communication over the Internet

by

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Spurred by today's widely-available broadband Internet access, new multimedia streaming applications have experienced explosive growth. Significant examples are audio streaming, video-on-demand, and video conferencing. However, video communication over packet networks such as the Internet suffers from limited bandwidth, packet loss, and delays due to network congestion. Scalable representation techniques of video information, such as Layered Coding (LC) or Multiple Description Coding (MDC), have thus been proposed. In particular, when packet losses are unavoidable, MDC is preferred because loss of one description does not compromise the entire transmission, and its benefits are enhanced when associated with path diversity. Obviously, this gain in robustness is paid for by an acceptable waste of compression efficiency. Path diversity exploits the fact that the probability of having all paths simultaneously congested is relatively low. As a result, MDC can achieve higher throughput and increase tolerance to packet loss. The paper presents a new protocol supporting multi-path transmission of multiple-description encoded multimedia traffic, which features confidentiality and data-transmission security. The method for securing real-time communication exploits the contemporary use of multiple paths. An initial RSA session is used to exchange what are known as call keys, then the video data are encrypted using fast-stream ciphers and sent through different paths. Each bit-stream contains synchronization information of the encryption function of the other bit-stream. This synchronization information is indispensable in the deciphering operations at the receiver. Since the paths may be assumed to be maximally disjointed and not directly associated, this method makes malicious synchronization of the ciphering machines very hard, if not impossible, unless the attacker can gain access to all of the paths, a very difficult endeavor. This last condition means that, even using stream ciphers with relatively weak structures, the proposed algorithm considerably improves overall security.

Improving Access to Statistical Information for the Masses

by

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Naïve users need to access statistical information, but frequently do not have the sophisticated levels of understanding required in order to translate their information needs into the structure and vocabulary of sites which currently provide access to statistical information. However, these users can articulate quite straightforwardly in their own terms what they are looking for. One approach to satisfying the masses of citizens with needs for statistical information is to automatically map their natural language expressions of their information needs into the metadata structure and terminology that defines and describes the content of statistical tables. To accomplish this goal, we undertook an analysis of 1,000 user email queries seeking statistical information. Our goal was to better understand the dimensions of interest in naïve users' typical statistical queries, as well as the linguistic regularities that can be captured in a statistical-query sublanguage grammar. We developed an ontology of query dimensions using this data-up analysis of the queries and extended the ontology where necessary with values from actual tables. We proceeded to develop an NLP statistical-query sublanguage grammar which enables the system to semantically parse users' queries and produce a template-based internal query representation which can then be mapped to the tables' metadata, in order to retrieve relevant tables which are displayed to users with the relevant cell's value highlighted.

Estimation of transition probabilities in multi-state survival data

by

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The experience of a patient in a survival study may be thought of as a process that involves two states, with one possible transition from a 'live' state to a 'dead' state. In some studies, however, the state representing those patients 'alive' may be partitioned into two or more intermediate (transient) states, each of which corresponding to a particular stage in the normal progress of the illness. In such studies where at any time point individuals occupy one of a set of discrete states, multi-state models can be used to model the movement of patients between the various states. Long-term predictions in multi-state data analysis are often based on the estimation of transition probabilities. In this study, we investigated the relevant methodological issues and provide a more systematic evaluation of different approaches for the estimation of these probabilities. An illustration through real data analysis is included.

Resolvable incomplete split-plot x split-block designs

by

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In practice, particularly in agricultural field experiments, situations often appear in which experimental blocks are grouped into some sets called “superblocks”. Such a nested blocking structure makes it possible to control several sources of local variation. In our paper we consider a similar case with reference to a three-factor experiment set up in a split-plot x split-block (SPSB) design. In the ordinary SPSB design, a randomization process according to a stratification of the experimental units leads to seven strata. The number of the strata will increase when we take into account the nested structure of the blocks. Then the resulting design, called the resolvable split-plot x split-block (RSPSB) design, is said to be incomplete with respect to the blocks, but complete with respect to the superblocks. Incompleteness of the RSPSB design can be related to one factor only, two factors only or all the factors.

The aim of the present paper is to show a randomization model, statistical properties and their consequences for an analysis of some three-factor experiments set up in RSPSB designs. A concept of resolvability in nested block designs is adopted for the designs considered.

Key words: general balance, multistratum experiment, nested block designs, resolvable block designs, split-plot x split-block designs, stratum efficiency factors.

Variance free model with special reference to breeding experiments

by

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In breeding programs two facts are very important, namely the crossing system of inbred lines and the breeding experiment. Usually, a statistical analysis deals with observations made on hybrids (crosses) obtained in some two-way crossing systems of lines such as the line x tester system and diallel crossing system. In the selection process certain genetic characteristics such as general combining ability, specific combining ability and reciprocal effect play a crucial role. We assume that in the experiment performed in a complete randomized design on each hybrid we observe two continuous traits (random variables). Moreover, we assume that their joint distribution is normal. An inference concerning genotypes can be based on these traits independently, and this will be correct when the traits are uncorrelated (independently distributed). However, in many cases the traits are correlated, and then it is necessary to take this fact into account when making further inferences from breeding experiments.

In the paper we propose a method which allows us to make inferences on genotypes on the basis of correlation coefficients calculated for each of the crosses. Using Fisher's transformation for correlation coefficient we obtain a model in which observations are normally distributed with known variance. This model is called a variance free model. The paper deals with an application of the variance free model approach to the analysis of breeding experiments with hybrids obtained by some two-way crossing system of lines. Moreover, estimation and testing hypotheses concerning the above-mentioned genetic characteristic effects are discussed.

Bayesian hierarchical models for hake stocks

by

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In Mendes et al (2006) A Bayesian hierarchical model based on zero inflated negative binomial distribution was suggested to model bottom trawl survey data and consequently estimate abundance index on hake stocks. In this talk, we suggest the following alternative model for the same data set:

Let $\mathbf{Z} = \{Z(\mathbf{s}, t), \mathbf{s} \in D \in \mathbf{R}^2, t=0, 1, 2, \dots, 10\}$ be the observed count (hake recruitment) at year t and spatial location $\mathbf{s}_i = (\text{latitude}_i, \text{longitude}_i)$. The data consist of $z(\mathbf{s}_i, t)$, $i = 1, 2, \dots, M_t$ at M_t spatial locations, $t = 1, 2, \dots, 10$, as well as a set of covariates $\mathbf{X}(\mathbf{s}, t) = \{X_k(\mathbf{s}, t), \mathbf{s} \in D \in \mathbf{R}^2, t=0, 1, 2, \dots, 10\}$, $k=1, \dots, K$, with observations $x_k(\mathbf{s}_i, t)$, $i=1, 2, \dots, M_t$ at M_t spatial locations, $t=1, 2, \dots, 10$, $k=1, \dots, K$.

We assume that the counts follow a spatial convoluted Poisson model. Therefore, conditional on $\lambda(\mathbf{s}_i, t)$, $Z(\mathbf{s}_i, t)$ are independent Poisson random variables with mean $\lambda(\mathbf{s}_i, t)$, so that:

$$p(\mathbf{Z}|\lambda) = \prod_{i=1}^{M_t} \prod_{t=1}^T p(Z(\mathbf{s}_i, t)|\lambda(\mathbf{s}_i, t)). \quad (1)$$

However, we do not observe this process. What we observe at locations (\mathbf{s}_i, t) is a thinned version of this process given by

$$p(\mathbf{Z}_{\text{obs}}|\lambda_{\text{obs}}) = \prod_{i=1}^{M_t} \prod_{t=1}^T p(Z_{\text{obs}}(\mathbf{s}_i, t)|\lambda_{\text{obs}}(\mathbf{s}_i, t)), \quad (2)$$

where $\lambda_{\text{obs}}(\mathbf{s}_i, t) = \theta(\mathbf{s}_i)\lambda(\mathbf{s}_i, t)$, $0 \leq \theta(\mathbf{s}_i) \leq 1$ is a thinning factor, $\lambda(\mathbf{s}_i, t)$ is the true mean of the underlying Poisson process that have generated the data. We further assume that $\log(\lambda)$ is given by a spatial convoluted model

$$\log(\lambda(\mathbf{s}_i, t)) = \sum_{j=1}^M k_{ij}\eta(\mathbf{s}_j, t), \quad (3)$$

where \mathbf{k} is a spatial convolution kernel depending on some measure of distance between the (j, t) -th latent location and the (i, t) -th observation location. Typically \mathbf{k} is a $N \times M$ non-stochastic matrix with elements k_{ij} representing the contribution of the latent factor $\eta(\mathbf{s}_j, t)$ to the expected value of $Z(\mathbf{s}_i, t)$. The elements k_{ij} are given by the Gaussian kernel

$$k_{ij} = \frac{1}{2\pi\xi^2} \exp \left\{ -\frac{d_{ij}}{2\xi^2} \right\} \quad (4)$$

where d_{ij} represents the Euclidean distance between the i -th observation location of the study region and the location of the j -th latent factor and $\xi > 0$ is a distance scale governing how rapidly the kernel weights (i.e. the influence of the j -th latent factor on the Poisson mean in the i -th location) decline with increasing distance. The spatial latent factor $\eta \equiv (\eta_1, \dots, \eta_T)'$ represents the influence of a set of gamma distributed latent parameters at each of j locations on the value of Z and is defined as a convolution of gamma variables:

$$\eta(s_j, t) \sim \text{Ga}(\alpha_\eta, \beta_\eta), j=1, \dots, M. \quad (5)$$

After the model has been fitted it is possible to generate simulations of the single spatial process to identify which patterns of the spatial random process correspond to observed patterns represented by the aforementioned covariates. Multivariate analysis can be explored on this issue.

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Non Observable Regressors

by

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When the theoretical framework of a problem points towards linear dependency of an observed variable or non observable variables these will be non-observable regressors.

The algebraic structure of models with non-observables regressors is discussed. Algorithms for the adjustment of such models are presented.

Some Issues in Need of Attention in Statistics Applied to Epidemiology and Medicine

by

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This paper is not about a new technique or a new application of a known technique. Its aim is rather to bring to attention some points often forgotten in the application of statistics to epidemiology and medicine. The points raised are selected based on experiences of the author in the field in the last 25 years as well as on a small survey of an epidemiological journal.

- Despite available literature, there appears to be a general lack of understanding on how to proceed in order to obtain a useful statistical model for a given epidemiological or medical setting
- The availability of very powerful and flexible statistical software allow the fitting of ever more refined models to increasingly complex data sets. However, this appears to be done far too often without proper understanding. One consequence is that checking of models is largely neglected
- In part, the absence in the epidemiological literature of reports on model checking is due to the rarity and lack of prominence of papers on appropriate methods

Facts will be presented to illustrate the above points. As well, some possibilities of statisticians to influence this state of affairs is discussed.

Computational Approach to Cost Analysis of Renewal Model in Clocked Queueing

by

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In conformity with several current network realization (vide [1]), the unit element of the networks the author considered the 2×2 buffered switch, which we can regard as a system of two queues working in parallel, each one with a deterministic servers of unit service time. A message entering either of the two inputs of the switch goes with probability $1/2$ to either of the two output queues of the switch. Any node in this network will see a time series, each element of which is the presence or absence of an information packet to be transmitted to the next node. The author observed the transformation of discrete time series by the basic processes of passage through a queue and of mixing.

Continuous time stationary queueing systems in such as Jackson networks (see[10]) are characterized as Poisson process, only one parameter being necessary to describe which member of the class is under consideration and with the guarantee that elementary transformation processes do not take one out of this class. The situation is very different with discrete clock-regulated networks, even in stationary operation, which will be our principal concern. For example, it has been shown that if independent uncorrelated Bernoulli streams of 0's and 1's (packet absent or present) enter the input of the switch of figure 1, then each output is instead a highly correlated multi-parameter renewal process (see[7]) and subsequent mixing the next input complicates this further. Ultimately, the author worked with the full class of time series encountered and complete defined its network transformations. A more modest approach other quite effect empirical techniques exist in the literature; (see[3]), which the author adopted that of modeling the time series by classes which can be read and upon which any time series encountered can be projected (in the Galerkin sense; see[2])

Medhi[4] discussed the renewal process in continuous time. He has assumed the great importance of renewal model because of its theoretical structure as well as for its application in diverse areas.

Taha[9] discussed the queueing decision models namely a cost model and an aspiration level model. Both models recognizing the higher service levels reduce the waiting time in the system. Under the analysis of cost model, author has discussed the two conflicting costs viz. cost of offering the service and the cost of delay in offering the service (customer waiting time) and established the cost model and computed the expected total cost per unit time for the system. Also, Mishra[5] studied the cost analysis of vacation in $Em/Cm/m$ in queue thereby suggesting an efficient strategy to the vacationing for the models. Moreover, the conditions of the superior model have also been discussed on the basis of revenue functions defined under the models.

Further, Mishra and Pandey[6] have discussed the cost analysis of the bulk queue model $M/M(a,b,c)/2$ for non-identical servers with vacation. Various cost functions have been constructed under the different conditions of the model in order to determine the optimum cost of the system.

The recent developments include Percus and Percus[8] who presented the renewal model for queue length in clocked queueing network. The model considered is a renewal process time series model which is used to find the expected queue length of the second stage of the network. But in this series of works no attempt has been made by the previous authors to analyse the cost of the model as one of the very important performance measures of queueing system.

In this paper, an attempt has been made to discuss the cost analysis of renewal model in clocked queueing network. Here, we have constructed a cost function in order to determine the optimum cost of the system. In this analysis, a fast converging N-R method has been used to solve the non-linear function involving service rate and other parameters of the renewal model. The root value of this non-linear function has been obtained by computer programming in C language, which, in turn, yields the total optimum cost of the model. In this way, an efficient evaluation of performance measure in the form of a cost analysis has been possible to be carried out and consequently a sensitivity analysis of the model has been presented

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Degree of Approximation of a function by a sequence of Linear Operators

by

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In this talk we shall consider the general problem associated with the degree of approximation of functions by a sequence of Linear Operators, their saturation class, and saturation order. We shall then mention results on local and global degree of approximation of functions by a sequence of modified Lupas Operators.

Analysis of SPI drought class transitions using Loglinear models

by

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A total period of 67 years of Standardized Precipitation Index (SPI) data sets was divided into three periods of 22/23 years and a Loglinear modeling approach has been used to investigate differences relative to drought class transitions among these three periods. The study was applied to several locations in Alentejo region, southern Portugal, and four drought severity classes were considered. The drought class transitions were computed for the three periods to form a 3-dimensional contingency table. The application of Loglinear modeling to these data allowed the comparison of the three periods in terms of probabilities of transition between drought classes in order to detect a possible trend in time evolution of droughts which could be related to climate change. Results show that the drought behavior for the first and last periods is similar, both showing worse drought events than the second. If just the second and third periods were compared one could conclude that droughts were aggravating and easily this behavior could be attributed to climate change, supporting the common assumption that a trend for progressive aggravation of drought occurrence exists. Therefore, results are more consistent with the existence of a long-term natural periodicity; however, this hypothesis should be tested using longer time series

Objective Bayesian analysis of multiple change points for linear models

by

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This paper deals with the detection of multiple change points for independent but non identically distributed observations, which are assumed to be modeled by a linear regression with normal errors. The problem has a natural formulation as a model selection problem and the main difficulty is that neither the reference priors nor any form of empirical Bayes factors based on real training samples can be employed.

We propose an analysis based on the intrinsic priors, which do not require real training samples and provide a feasible and sensible solution. For the case of changes in the regression coefficients very simple formulas for the prospective and the retrospective detection of change points are found.

On the other hand, when the sample size grows the number of possible changes also does and consequently the number of models involved. A stochastic search for finding only those models having large posterior probability is provided. Illustrative examples based on simulated and real samples are given.

Key words: Bayes factors, change points, intrinsic priors, model selection, posterior model probabilities, stochastic search.

Regime switching in financial data conditioned by the existence of thresholds

by

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Some financial data e.g. price of international investment funds such as PF-European Sustainable Equities-R from the Pictet Funds or the Converging Europe Bond from the Schroder company, display a behavior that suggests a diffusion regime switching model conditioned by the existence of thresholds.

In such a model the evolution of the process is driven by a diffusion with certain parameters, let us say a positive drift, until the trajectory hits an upper threshold. At that time the drift changes, let us say to a negative value and the process continues driven by that diffusion until the trajectory hits a lower threshold at which time the drift changes again to the preceding positive value, and so on.

Supposing that a particular diffusion model holds for such data sets, for instance Brownian with drift, Ornstein Uhlenbeck and geometric Brownian motion, we apply an estimation procedure for the parameters of the diffusion and the values of the thresholds. This estimation procedure was developed in previous work.

The agreement of the model with the data set by means of the estimation procedure used is quite convincing.

Shift Permutation Invariance in Linear Mixed Models

by

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The objective of this paper is to consider shift invariance of random factors in linear mixed models. Marginally shift invariant interaction factors are treated. The random factors are described via their covariance matrices and it is shown that shift invariance implies Toeplitz covariance matrices and marginally shift invariance implies block Toeplitz covariance matrices. In order to get interpretable linear models reparameterization is taken place and it is shown that by putting restrictions on the spectrum of the Toeplitz matrices natural reparameterization conditions are obtained.

Promoting Local Community Participation in Forest Management through the Application of a Geographic Information System

by

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Bretuoman Institute Network

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The expansion of Geographic Information System's (GIS) applications into communities outside Western industrialized nations and to cover issues of interest to underprivileged groups in society present a number of challenges to GIS practitioners. There are issues regarding adaptations that need to be made in current GIS software to suit peculiar needs of the people, safeguards to ensure the attainment of goals demanded by Public Participation GIS (PPGIS) practice, and of ways to attract and sustain the interest of the communities. These challenges and other obstacles to PPGIS practice imposed by the culture and traditions of the people are explored in a GIS project implemented in three rural communities in Southern Ghana to support the creation of institutions for collaborative forest management.

Empirical method for estimating turning counts from link flows

by

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Traffic data collected at a series of 3-legged and 4-legged intersections are used to examine the possibility of avoiding the necessity of collecting either historical data or the manual count data to establish the turning probability matrix at an intersection. The turning probability (or propensity as described in the paper) is estimated empirically from the inflow and the outflow data only and a generalized solution is provided. The comparison of the estimated and the observed flow values indicate a high degree of agreement. However, the estimated flows are in better agreement with the observed flows at 3-legged intersections than those at 4-legged intersections. The accuracy at 4-arm intersections can be further improved by taking more data and refining the propensity equations.

Conservative simultaneous confidence intervals for multiple comparisons among mean vectors

by

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Conservative simultaneous confidence intervals for multiple comparisons among mean vectors in multivariate normal distributions are considered. Some properties of the multivariate Tukey-Kramer type procedures for pairwise comparisons are presented. The affirmative proof of the multivariate generalized Tukey conjecture in the case of four mean vectors is presented. Further, the upper bound for the conservativeness of the multivariate Tukey-Kramer procedure is also given in the case of four mean vectors. Finally, numerical results by Monte Carlo simulations are given.

A statistical approach to building a human figure drawing score system measuring visual constructive ability in elderly

by

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Intelligence consists of a large collection of narrowly defined abilities.

In this study we define a new Human Figure Drawing (HFD) scoring system and prove its validity and reliability as a visual constructive task in elderly. This scoring system is based on 27 items sensitive for constructive impairment in dementia. These items are classified into five criteria. Significant correlations are proved between the HFD total score as well as two HFD criteria and the corresponding ones from Benton Visual Retention test (BVRT). The results from the factor analysis on data from HFD criteria, BVRT criteria, Mini-Mental State Examination (MMSE), Raven Standard Progressive Matrices (RSPM) and level on lowering of the social and occupational functioning (SOFAS) confirms the existence of the visual spatial and the executive components of constructive ability.

Key words: probability of success, Mann-Whitney test, Spearman's rank correlation test, promax factor rotation

A heuristic method for the sectoring-arc-routing problem

by

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The Sectoring Arc-Routing Problem (SARP) belongs to a wide family, usually called sectoring or districting problems, and seeks to split a large area into smaller sub-regions (sectors or districts), to simplify the organization of the activities that must be executed within each sub-region. These problems are addressed over a long-term horizon and are typically classified in the strategic level. Political districting, sales territory design, salt spreading, waste collection or meter reading are examples of real-world applications of districting problems. The SARP is defined here in the context of the household waste collection. Defined over a mixed graph, with demand arcs and edges representing the streets that must be collected, its aim is to identify sectors (sub-graphs) such as the total cost of collecting trips is minimized. Each sector is collected by only one vehicle with maximum working time and trip load. Trying to get balanced sectors that do not overlap, we present a heuristic method that builds all the sectors simultaneously, based on the identification of minimum demand circuits in a balanced graph. The final vehicle tours, within each sector, are computed from an extended mixed capacitated arc routing algorithm. Some computational results are presented and analysed.

Selective F tests for associated models with balanced cross-nesting

by

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Balanced models with cross-nesting enable us to study the action of a large number of factors. Whenever possible, F tests are lightly recommended due to its robustness and power. In what follows such tests are derived for fixed effects part of the models. Besides the usual F tests we will consider selective F tests which have high power for chosen alternatives. Moreover, we consider the effects of perturbations on the numerator and denominator of the statistics. These perturbations arise when additional terms are added to the models, thus originating associated models.

Use of Fuzzy Logics on Human-Centered Systems: a Review

by

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The analysis of human-centered systems, i.e. of the relationship between human, machine and the environment is a complex problem, involving vagueness, uncertainty and ill-defined data. Decision support systems are tools that try to replicate human decision-making processes. Thus, most times such decision-making processes are complex and therefore based on qualitative classifications and subjective judgments.

Fuzzy set theory, formulated by Lotfi Zadeh, in 1965, provides a mathematical framework for the systematic treatment of vagueness and imprecision. The subjective nature of human classification processes renders classical logics (dichotomous) approaches almost useless to deal with human-centered systems.

Fuzzy set theory facilitates the elicitation and encoding of uncertainty related knowledge. It provides a representation mechanism that improves the flexibility for dealing with vague data. Besides this, there is a broad variety of fuzzy logic operators, parametric and non-parametric, whose behaviors cover the continuum from the union operators to the intersection operators, including average operators.

This paper will provide an introduction to fuzzy set theory followed by the discussion of the use of fuzzy methodologies applied to support decision-making processes on human-centered systems.

Multivariate multiple comparison procedures in elliptical populations

by

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Simultaneous confidence intervals for pairwise multiple comparisons and comparisons with a control among mean vectors are considered under elliptical populations. In order to construct them, it is necessary to obtain the upper percentiles of T^2_{\max} which is Hotelling's T^2 -type statistic. However, it is difficult to obtain upper percentiles exactly even when populations have the multivariate normal distribution. In order to obtain conservative approximate simultaneous confidence intervals, Bonferroni's inequality is applied to T^2 -type statistic. The first order Bonferroni approximation, which uses the first term of Bonferroni's inequality, becomes conservative too much when the number of populations or the kurtosis parameter is large. Then, the modified second order Bonferroni approximation, which uses the first and the second terms of Bonferroni's inequality, is discussed in order to improve approximate accuracy.

Bonferroni approximations can be expressed with the F-distribution precisely when each population has the multivariate normal distribution. The effect of nonnormality on approximations is theoretically investigated in elliptical populations. Finally, accuracy and conservativeness of the first and the modified second order Bonferroni approximations are evaluated via a Monte Carlo simulation.

Analysis of Residuals and Validation of the Adjustment in Joint Regression Analysis

by

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Joint Regression Analysis is based on linear regression of yields, one per cultivar, on non observed regressor. This regressor, the environmental index, measures the productivity of the blocks in the field trials.

Usually a Zig-zag algorithm is used in the adjustment. In this algorithm the minimizations for the regression coefficients alternate with those for the environmental indexes. The algorithm has performed very nicely but a general proof of convergence is still to be found.

To validate the adjustments a linear model for the residuals is presented...

Edgeworthian Economies

by

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We present a modified model of an Edgeworthian exchange economy where two goods are traded in a market place. The novelty of our model is that we associate a greediness factor to each participant which brings up a game alike the prisoner's dilemma into the usual Edgeworth exchange economy. We also consider two distinct evolution rules of the greediness of the participants along the trades: they become either more or less greedy if they trade more. We analyse the effect of the evolution rules in the individual greediness factors and in the values of the utilities.

Limit of the Zakharov-Rubenchik equation

by

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The Zakharov-Rubenchik Equation $iB_t + \omega B_{xx} - k(u - [v/2]\rho + q|B|^2)B = 0$, $\theta\rho_t + (u - v\rho)_x = -k|B|^2_x$, $\theta u_t + (\beta\rho - vu)_x = [k/2]v|B|^2_x$ appears in the context of Magneto-Hydro-Dynamics and describes the propagation of Alfvén waves in a magnetized plasma. Here θ is a small parameter. We will show in this talk that in a certain sense this model tends to the Nonlinear Schrodinger Equation.

Binary operations and prime basis factorials

by

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Binary operations and commutative Jordan algebras may be used to define: product models in which the treatments are the combination of those in the initial models; nested models in which each treatment of a model nests all the treatments of another model. This technique is now applied to prime basis factorials.

Key words: prime basis factorial, product models, nested models, binary operation, commutative Jordan algebras.

The effect of some specific genetic and anthropometric factors on the activity of Acid Phosphatase ACP1.

by

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The Acid phosphatase, C-LMW-PTP (cytosolic low molecular weight protein tyrosine phosphatase), or ACP1, is an intracellular enzyme that possesses phosphotyrosine phosphatase and flavin-mononucleotide (FMN) phosphotransferase protein activity. Tyrosine phosphorylation in receptors is implied in growth and cellular proliferation of normal and neoplastic cells, and in signal transduction by the insulin and other growth factors. Haptoglobin (Hp) is a protein of the immunitary system. Hp exists in two allelic forms in the human population, so called Hp1 and Hp2; the latter one having arisen due to the partial duplication of Hp1 gene. Three phenotypes of Hp, therefore are found in humans: Hp1-1, Hp2-1, and Hp2-2. Hp of different phenotypes has been shown to bind hemoglobin with different affinities, with Hp2-2 being the weakest binder.

This protein is associated to the susceptibility for common pathological situations, such as diabetes, cardiovascular diseases and obesity.

The aim of the present work is to assess whether there are significant statistical differences between the ACP1 phenotypes in respect to the activity of ACP1 (Observations in mmol/g (Hb/H)), with regard to the effect of Body Mass Index, age and haptoglobin phenotype.

Within the general purpose of disease prevention and given that work on this subject is scarce, the present work is therefore justified.

After a preliminary exploratory data analysis using recent statistical techniques, an application in the context of Design of Experiments is considered.

Estimation of Adoption and Diffusion Models of Internet in Portugal

by

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Nowadays it is consensual that Information and Communication Technologies (ICT) have a significant effect on firms productivity. However, this contribution can only be accomplished if, and when, the new ICT are widely spread and used. The understanding of the determinants of adoption and diffusion is a fundamental question, not only for economists, but also for society in general.

To find the determinants of adoption and diffusion of Internet, we have estimated two ordered probit models:

- Time period of adoption of Internet.
- Intensity of use of the Internet in 2002.

The explanatory variables include: obstacles to the adoption of ICT, human capital, experience, spillovers effects, firm size and sectors of activity.

The results from the ordered probit estimation of the different models suggest that the spillovers effects (diffusion of ICT inside each sector) are the most important conductors to the adoption and diffusion of Internet. The workers skills and research and development are the most important factors that explain the time period of Internet adoption. We have concluded that it is not enough to encourage the adoption of ICT in firms. There must be qualified workers that can take advantage of its use.

Finally, we have verified that, as it would be expected, the experience of previous use of internet and firm size work as a lever and lead to an opportune adoption of Internet.

Keywords: Internet, Information and communication technologies (ICT); adoption and diffusion of Internet; ordered probit.

Varying-Coefficient Regression Models for Non-linear Time Series: Estimation and Testing

by

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In this work, we propose a modified smoothing method based on polynomial splines for the estimation of varying-coefficient regression models for non-linear time series. The implementation of the method using splines with equally spaced knots and free-knots are discussed. The consistency and rate of convergence results are presented to support the proposed estimation method. Methods for model selection of the threshold variable and its lags are discussed. The estimated model which requires homoscedastic error is used to produce multi-step-ahead forecasts. The estimated varying-coefficients of the time series model were tested. The method is further illustrated by simulations and application to daily mean of temperature from 1987 to 1996 for six cities in Nigeria.

Numerical study of the pseudo-p-Laplace operator

by

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We study the pseudo-p-Laplace operator $[(\Delta)\tilde{]}_p u := \sum_i [(\partial)/(\partial x_i)] (|[(\partial u)/(\partial x_i)]|^{p-2} [(\partial u)/(\partial x_i)])$, an anisotropic version of the p-Laplace operator for $p \neq 2$. The numerical approximation of the eigenpair associated with nonlinear eigenvalue problem $[(\Delta)\tilde{]}_p u + \lambda_p |u|^{p-2} u = 0$ for $p \rightarrow 1$ and $p \rightarrow \infty$ is computed.

Linear combination of two U-statistics for testing new better than used

by

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Testing exponentiality against positive aging is an active research area in the past three decades. A particular type of positive aging, namely the new better than used distributions is useful in the study of replacement policies. Two classes of test statistics for testing exponentiality against new better than used alternative is proposed which are the linear combinations of U-statistics. The asymptotic distributions of the proposed class of tests are studied. The performance of the members of the classes of tests is studied in terms of Pitman asymptotic relative efficiency in comparison with the tests due to Hollander and Proschan(1972), Ahmed (1975,1994). It is observed that the newly proposed tests are better for some value of the sub sample size and mixing coefficient.

Key words and Phrases: New better than used, U-statistic, linear combination, asymptotic relative efficiency.

Fitting Nonlinear Gompertz Curve to Banana Growth Data

by

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This study is to discuss the application of nonlinear Gompertz curve to measure the growth data. Data used are the growth of production of banana of different states. By using specific starting values, it is found that the nonlinear Gompertz curve is suitable to match the growth of banana production. It is found that both samples have the sum squares error, which is low and the variance analysis conducted showing that this model is statistically significant. Furthermore, it is supported by the asymptotic correlation matrix value among the parameter estimated much lower.

The analysis of growth data becomes more important in many fields of study. In agriculture there are obvious economic and management advantages in knowing how large things grow, how fast they grow and how does these factors respond to environmental conditions or treatment over time. The Gompertz model, based upon a model given by Gompertz in 1825 for the hazard in life table, and then used as growth model by Wright (1926). Its initial formulation was largely empirical, but later Medawar (1940) derived it as a growth model for the heart of a chicken. The Gompertz model is very popular and used in various fields such as population studies and animal growth in situations where growth is not symmetrical about the point of inflection.

Nonlinear models are more difficult to specify and estimate than linear models. Instead of simply listing exploratory variable, we must write the regression expression, declare parameter names, and guess starting values (developed in SAS for all the non-linear models) for them and possibly specific derivatives of the model respects to the parameters. Some models are difficult to fit and there is no guarantee that the procedure will be able to fit the model successfully. On the other hand, we have to try and error process, but experience may be useful. By using SAS package, Proc nlin (developed) fits nonlinear regression models by Gauss Newton methods.

Determining Recommended Levels of Harvest on Pacific Halibut

by

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Using data for catch and effort of Pacific halibut (*Hippoglossus stenolepis*) provided by the International Pacific Halibut Commission, we created a logistic growth based surplus production model representative of six regions off the coast of Alaska. We explored the effect of changes in fishing gear, density-dependent catchability, migration patterns, and changing carrying capacity on a model of fish biomass. Parameters estimates were determined using maximum likelihood techniques and Akaike's Information Criteria was used to compare models. After choosing the model that best fit the observed data, recommendations on harvest levels can be suggested by examining the maximum sustainable yield predicted by the model. In order to account for uncertainty in the parameter estimates, bootstrapping techniques were used to determine harvest levels that maximize amount of halibut harvest without overfishing the population.

Double minimization for complete series of experiments in Joint Regression Analysis.

by

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Joint Regression Analysis is a widely used technique for cultivar comparison.

For each cultivar a linear regression is adjusted on a non observable regressor: the environmental index. This index measures, for each block, the corresponding productivity.

When all cultivars are presented in all the blocks in the field trials the series of experiments is complete. A double minimization is presented for such series of experiments. In this technique we start by obtaining for each vector of environmental indexes the minimum of the sum of sums of squares of residuals. This minimum is then minimized thus giving the adjusted vector of environmental indexes which is then used to obtain the adjusted coefficients for the regressions.

Multiple regression models for lactation curves

by

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Several methods were developed in order to study lactation curves. However, the lactation curves aren't often well adjusted since several factors affect milk production.

The usual model used to describe lactation curve is Wood's Model, which generally uses a logarithmic transformation of an incomplete gamma curve to obtain least squares estimates of three constants: a - a scaling factor associated with average daily yield; b - associated to prepeak curvature; and c associated to postpeak curvature (Wood, 1976). Some disadvantages of Wood's model have strong relation with the overestimating milk production at the beginning of lactation, with underestimating the lactation peak, the self correlated residuals and highly correlated parameter estimates (Scott et al,1996).

Fleischmann's Method is usually used to estimate total milk production. This method generally overestimates actual yields until peak lactation as well as yield during the period following the last measurement but underestimates yields for other periods (Norman et al, 1999). The total milk yield estimate according to this method, considers a constant daily milk production between two records and equal to this two records mean, which doesn't describe the real variation of milk secretion during lactation.

Recent applications use test day models (TDM) based in mixed models (Stanton et al, 1992; Jamrozik et al, 1997) and repeated measures (Ptak and Schaeffe, 1999). In TDM, specific effects for each individual record and variable amounts of information from different lactations may be accounted. These models also allow the estimation of fixed effects to vary across flocks and stages of lactation, and can be adjust for differing effects of sampling date. Most importantly, TDM records may be adjusted for the curvilinear shape of the lactation curve (Swalve, 1995).

In the models where daily records are treated as repeated measures and factors to model the lactation curve, are included the main issue is to count for the covariance structure of the repeated records.

Recently, random regression models have been widely studied and evaluated for genetic evaluation at national level in many countries. Random regression models have the advantage of flexibility to account for the environmental and genetic components of the shape of lactation curve. However, random regression models require the estimation of large number of parameters and may not be adequate at early or late stages of the lactation (Sawalha et al, 2005).

The mentioned disadvantages led us to consider the milk curve concept as a graphical representation of milk production described by mathematical models.

In our work we considered a new approach using polynomial regression one for each group. Polynomial curves were adjusted to daily milk records for each group and the respective hypograph area was calculated. After determining mean squares, an exact F-test was constructed.

This approach increases a lot the power of the test allowing working with smaller experiences. The importance of these results is the replacement of classical repeatability by time repeatability. A great increase of freedom degrees is achieved. Another advantage of this method is to use a continue process instead of an obligatory discrete process conversion. Differences between protein supplements and stocking rate were found using an adaptation of Scheffé's method. We concluded that a lower stocking rate and high protein content in supplement allow a higher mil production.

Keywords: multiple regression; lactation curve

Statistical analysis of a survey of non-industrial forest landowners associations

by

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Knowledge management is addressed in the framework of disciplines such as economics and sociology. Theories and models to explain knowledge management (e.g. diffusion of innovations theory, knowledge utilization model, communication-based model of technology transfer) tackle strategic, managerial, behavioral and operational issues. Portuguese and Spanish forest sector research in knowledge management has focused on extension methods and programmes based on the knowledge-consulting paradigm (one way transfer). Yet, the knowledge-based economy and the advances in communication and information technologies suggest a shift to the knowledge-sharing paradigm (two way transfer). This paper discusses a knowledge management strategy for forest science transfer. It focuses on Non-Industrial Private Forest (NIPF) owners, as they represent, respectively, 85 and 63 percent of the Portuguese and Spanish forestland. 106 personal surveys to NIPF organizations in Portugal and Spain were conducted to study current interactions between researchers and forest practitioners, identify processes and mechanisms of knowledge transfer in the forest sector and explain how knowledge is transferred from university to the landowner and what is the role of the NIPF Organizations as intermediaries in the process. Preliminary results show that knowledge transfer and adoption in small-scaled private property depend on the frequency, transfer methods and communication skills between the NIPF Associations and the knowledge sources such as universities and governmental institutions. Survey analysis also suggests that the government's role as a sponsor or knowledge diffuser in the forest sector is incipient and ineffective due to the absence of a nation-wide strategy for forest knowledge management. It further shows that the processes, mechanisms and methods used in forest knowledge transfer and management may be updated to better address current NIPF needs and facilitate the science adoption process.

Methodology for inventorying and characterizing communal forest lands (mvmc) in the Northwest of Spain

by

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The communal forest lands in Galicia are one type of collective private property, according to specific characteristics in terms of land use tenure, and were traditionally managed in a communal way.

2 887 communal forest lands existed in the region in the beginning of the XXI century, widely distributed through 1 712 parish councils, occupying a surface of 661 183 ha, which represents a third of the woodland and 15 % of the forestland in Galicia.

The total population living in parish councils within communal forest lands is around 760 732 inhabitants, 27% of the total Galician population.

A methodology was developed, comprising both uni and multivariate statistic techniques, allowing the classification of communal forest lands and properties, according to physiographic, territorial, economic and social variables, which were defined by census and surveys.

These techniques were employed in two different areas, where this type of property is highly important. Finally, the cost structure of the methodology is analysed, considering its implementation in larger areas.

Statistical modeling in the problems of complex machines studying

by

Elena Pervukhina

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Coauthors: Victoria Golikova

When complex machines are studied the main modeling problem is devoted to estimation and forecast of their technical state. At assumption of stability of assembling process when machines' parameters are grouped around etalon values it is not necessary to use complicated deterministic models with a big number of equations and variables. Simple models permit to estimate characteristics needed for the goals of industrial tests.

Usually at statistical process modeling independent and identically distributed random variables are considered. But in practice autocorrelations and other systematic effects are often substantial. Under such conditions standard control-chart procedures can be seriously misleading.

A known approach to the solution is extended. Autoregressive and moving average models are proposed to study complex machines at the stage of their industrial bench tests. New automatic algorithm to estimate the model parameters in real time regime of tests is added to standard Box-Jenkins methodology.

Parallel transport for gerbes and 2-knots

by

Roger Picken

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We describe parallel transport for abelian gerbes with connection along arbitrary surfaces with boundary using an approach based on local functions and forms [1], extending [2]. Gerbes with connection on a given manifold are shown to be in one-to-one correspondence with a class of embedded 2-dimensional TQFT's. The parallel transport for a gerbe with connection along a surface, which is divided into regions by a trivalent graph, is given in terms of a three-level integral involving the gerbe transition functions at the vertices of the graph, integrals of the connection 1-forms along the edges of the graph, and integrals of the connection 2-forms on the regions.

The aforementioned TQFT's satisfy rules for the partial gluing of two discs, i.e. not along their whole boundary. It is argued that a careful analysis of the partial gluing of surfaces with boundary, combined with constructions like crossed modules of groupoids, is the right way to approach non-abelian gerbes with connection.

If time allows I will speculate on applications of gerbe parallel transport to finding invariants of 2-knots.

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Optimal investments in the reduction of production costs

by

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We present deterministic and stochastic dynamics on the production costs of Cournot competitions, based on R&D investment strategies with and without uncertainty. We study the sensitivity of the Nash investment equilibrium to the variation of the initial production costs and also to the differentiation of the goods. We also analyse the loss in the profits of one firm when this firm decides not to invest in R&D projects and the other firm uses the best investment strategy. The uncertainty deviates the mean of the stochastic trajectories from the deterministic trajectories.

Joint Regression Analysis - a technique for management of plant breeding programs

by

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Joint Regression Analysis with L2 environmental indexes is a well known technique for cultivar comparison and selection. Usually, a small number of years and a given list of cultivars are considered, when applying the technique.

The aim of this paper is to perform an extension of the technique to plant breeding programs. In a first part, the required statistical techniques are presented. Namely, it is shown, how to adjust the linear regressions and how to classify and select cultivars. Next, the application of JRA to plant breeding programs is performed. This application is carried out with emphasis on the Portuguese Wheat Breeding Program (1986 - 2000). The results obtained in the studied case clearly indicate the validity of JRA on managing plant breeding programs. Namely, the technique is useful in deciding yearly which of the cultivars used should be kept for the next year.

Keywords: Joint Regression Analysis, L2 Environmental Indexes, Adjustment, Cultivars Selection.

Hilbert Basis of Orthogonal Arrays

by

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Coauthors: Enrico Carlini, DIMAT - Politecnico di Torino - Italy

In this presentation, we relate the problem of generating all orthogonal arrays of given dimension and force, i.e. all elements of $OA(n,m)$, to the solution of an Integer Programming problem. In turn, this problem can be solved by finding a finite generating set called Hilbert Basis, cfr. Schrijver (1986) "Theory of Linear and Integer Programming".

We discuss a few examples using softwares performing Hilbert Basis computations such as 4ti2 and CoCoA. Some benchmarking of both softwares is provided.

A Comparison of Fundamental Mathematics Achievement between Tutoring Program and Non-Tutoring Program of Bangkok University Students

by

Krisawan Prasertsith

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The purpose of this research is to compare the fundamental mathematics study achievements between the groups of students who undertook the tutorial supporting course and those who did not. The aim of the study is also to cover the investigations on students' opinions, suggestions and various problems occurring in the fundamental mathematics instruction. In the research, a sample of 128 first-year students of Bangkok University, 2004 academic year, was selected by statistical matching basis. The research instruments used in this research were well-designed questionnaires, mathematics-background test papers and the papers from midterm/final exams for fundamental mathematics courses. The data and information from the study were analyzed in terms of percentage, mean, standard deviation and the paired-sample t-test was conducted using SPSS for Windows.

The results of this research show the following:

- 1) the average score of the students who entered the Tutoring program was higher than that of the students who did not enter the program. However, the difference of the scores was not statistically significant at 0.05 level;
- 2) Students' opinions about mathematics instruction from both groups (tutored students and non-tutored students) were not different. The opinions indicated that they can apply the mathematics knowledge in their daily lives. The research also reveals that students who lacked the background in mathematics and those who finished vocational schools had to spend relatively long time to follow the lessons. Moreover, most students spent insufficient time to review the lessons or do their homework which led to incomprehensiveness for the complicated topics.

On The Behaviour Of Conjugate Derived Fourier Sequence By Taylor-Cesaro Product Summability Method

by

Ajay Pratap

Eritrea - Institute of Technology, Asmara, Eritrea

In this paper, a new theorem on Taylor-Cesàro product summability of a conjugate derived Fourier sequence has been established.

Decomposing the Watson efficiency in a linear model

by

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Coauthors: Jarkko Isotalo, George P. H. Styan, Ka Lok Chu

We consider the estimation of regression coefficients in a partitioned weakly singular linear model and focus on questions concerning the Watson efficiency of the ordinary least squares estimator of a subset of the parameters with respect to the best linear unbiased estimator. Certain submodels are also considered. The conditions under which the Watson efficiency in the full model splits into a function of some other Watson efficiencies is given special attention. In particular, a new decomposition of the Watson efficiency into a product of three particular factors appears to be very useful. Moreover, we prove an interesting connection between a particular split of the Watson efficiency and the concept of linear sufficiency. We shortly review the relation between the efficiency and specific canonical correlations.

An L^p inequality for 'self-reciprocal' polynomials

by

M. A. Qazi

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A polynomial f of degree at most n is said to be 'self-reciprocal' if $f(z) \equiv z^n f(1/z)$. Such polynomials have been studied since about thirty years, and have some very intriguing properties. In my talk I intend to discuss the growth of the integral means of such polynomials on $|z| = R$, as $R \rightarrow \infty$.

Extensions of a result of Erdős about the arc-length of a trigonometric polynomial

by

Q. I. Rahman

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It was shown by P. Erdős that if t is a *real* trigonometric polynomial of degree n such that $|t(x)| \leq 1$ for all real x , then the arc-length of its graph on any interval of length 2π cannot exceed that of $\cos nx$. This result was generalized by A.P. Calderon and G. Klein. They proved that $\int_{-\pi}^{\pi} \varphi(|t'(x)|) dx \leq \int_{-\pi}^{\pi} \varphi(|-n \sin nx|) dx$ if φ is real-valued on $[0, \infty)$ and $(\varphi(u) - \varphi(0))/u$ is a non-decreasing function of u on $(0, \infty)$. In particular, for any a , the integral $\int_a^{a+2\pi} |t'(x)|^p dx$ cannot be larger than the corresponding integral for $t(x) := \cos nx$, if $p \geq 1$. We note that the restriction on p in this result can be relaxed. In addition, we formulate and prove an extension of the theorem of Calderon and Klein to non-periodic entire functions of exponential type.

Binary models with misclassification in the variable of interest and nonignorable nonresponse

by

Esmeralda A. Ramalho

Evora University

In this paper we propose a general framework to deal with datasets where a binary outcome is subject to misclassification and, for some sampling units, neither the error-prone variable of interest nor the covariates are recorded. A model to describe the observed data is formalized and efficient likelihood-based generalized method of moments (GMM) estimators are suggested. These estimators merely require the formulation of the conditional distribution of the latent outcome given the covariates. The conditional probabilities which describe the error and the nonresponse mechanisms are estimated simultaneously with the parameters of interest. In a small Monte Carlo simulation study our GMM estimators revealed a very promising performance.

Success in Outsourcing Financial Services through Optimization of Staffing Needs

by

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Coauthors: Chin Keat Chuah & Chooi Leng Ang

One of the phenomenal revolutions in financial services recently is the outsourcing of financial services or in other words, the centralization of many global operations. This involves banking back-office activities. The problem arose when there was much increase in activities or processes during the implementation of centralization at a particular outsource point. At the same time, available manpower was seemed to be insufficient. However, a staggered staffing model was developed to overcome this problem instead of hiring more staff there. The model has taken into consideration the intra-day transactions or processes together with the fluctuated volume of these incoming transactions. This efficient model employed the technique of integer programming to provide optimal solution. The solution resulted in different quantity of skilled staff required to report duty at different time intervals of a day thus, reducing certain incurred costs. Comparison of the solution has been made with that of the existing staffing method.

Keywords: integer programming, staff planning, financial services outsourcing, banking transactions volume fluctuation.

Polynomial almost normality, application to Statis and dual Statis

by

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CMA and Faculty of Science and Technology - New University of Lisbon

Many of the most important statistics are low degree polynomials. Even if we accept that the observations are normal and independent the exact distribution are generally unknown or untractable. Now we explore a technique for obtaining approximate distributions showing that, if the observations are normal, independent and have low variation coefficients, the linear term in low degree polynomials is dominant. Now this linear term will be normal and in this way we obtain a normal approximation to the distribution of low degree polynomial statistics. We then apply this approximation to the modelling of the series of studies in Statis and dual Statis methodologies.

"Variance components estimation in generalized orthogonal models"

by

Paulo Ramos

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Coauthors: Célia Fernandes (Área Científica de Matemática - Instituto Superior de Engenharia de Lisboa), João Tiago Mexia (Departamento de Matemática - Faculdade de Ciências e Tecnologia - Universidade Nova de Lisboa)

The model $\underline{y} = \sum_{j=1}^w X_j \beta_j + \underline{\epsilon}$ is generalized orthogonal if the orthogonal projection matrices on the range spaces of matrices X_j , $j = 1, \dots, w$, commute. Unbiased estimators are obtained for the variance components of such models with cross-nesting.

Bounds for the zeros of polynomials satisfying a three term recurrence relation

by

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Coauthors: Andrea P. da Silva

Bounds for the zeros of polynomials which can be generated by a certain three term recurrence relation are looked at. These polynomials include Szegő polynomials, para-orthogonal polynomials and, specifically, any polynomials with all their coefficients different from zero. The treatment is based on an eigenvalue representation for the zeros of these polynomials.

Modelling for HIV spread in homosexual population

by

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The HIV causing disease AIDS is now 25 years old and is fast spreading to all sections of the societies around the globe. India soon will top the list of affected countries in terms of number of infections. Statistical modelling of HIV spread is useful in understanding the spread mechanism and for predicting HIV/AIDS counts and for forecasting healthcare needs. This paper:

- (1) stresses the need for modelling of HIV and AIDS
- (2) discusses the appropriateness of a Stochastic model for HIV transmission and
- (3) examines the applicability of Diffusion of News and rumours model of Taga Isii(1967) and presents the adopted version of this model to suit HIV spread in homosexual populations. Three different cases are considered under this model.

Keywords: AIDS, Incubation time, HIV infection, Homosexual population, Mixing, Modelling.

The Challenges underlying the Assessment and Comparison of Tonality of Violins using Statistical Analysis of Vibration Modes of Violin Plates

by

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The tonal quality (tonal colors) of the sound from different violins made by famous violin makers such as Stradivarius, Amati and others during the 17th and 18th centuries is of research interest in physics for the last 150 years. Even today many researchers and universities are conducting experiments for explaining the tonal quality of violin's 'voice'. Such research has a direct impact on making (and not the production) of high quality violins of the future. The violin making is an art. Further, each violin has its own sound (tonal quality). The expert violinists can recognize the differences in tonality by listening to these instruments.

During the past twenty-five years the scientists have developed new methods of collecting the data that are useful in the study of violin acoustics. The sound of violin depends on number of components (parts) of the violin. The major non-replaceable components of the violin that contribute to the tonal quality of the violin are the front and back violin plates. The acoustic qualities of these plates are of interest to violin makers. Therefore, the effect of different musical notes (frequencies induced) on these plates is studied in as many details as possible. In particular, the response from the violin plates at different frequencies is studied through the analysis of vibration modes of these plates. The data related to the location and formation of such modes is collected using different techniques such as holography interferometry.

In this presentation, in view the above-mentioned source of data, we will be discussing the following research problems:

- The relationship between the tonality of the violin sound and the patterns among the vibration modes.
- The quantification of such relationship in view of comparison of the tonal quality of violins.
- The statistical methods that could be useful for such comparison.

On maximum and minimum of a bivariate exponential random vector

by

Sreenivasan Ravi

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Coauthors: A. S. Praveena

In this article we study the maximum and minimum of components of a bivariate exponential random vector (X, Y) as a function of means, variances and covariances of X and Y when (i) (X, Y) has Marshall-Olkin bivariate exponential distribution and (ii) the components are independent.

The evolution of kleptoparasitic behavior

by

Statistical Approach in Analysis of Malarial Parasite Infected Blood Image Detection and Identification of its Stability.

by

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Coauthors: Dr.Gaurav Bajpai

This work introduces blood image processing technique for detecting and classifying malarial parasites in images of Giemsa stained blood slides, in order to evaluate parasitaemia in blood cells. Generally, blood images are made up of three different kinds of cells red, white and other blood platelets. Their dimension, shape and color distinguish them. In malarial blood, the red corpuscles of vertebrates are infected by malarial parasites. The aim is to detect the blood cells, which are infected by malarial parasites, by evaluation of size of the nuclei of the red blood cell, its structure, and shape. The image of the contaminated blood cells is compared with original blood cells by image processing and malaria is detected. In order to achieve higher success rate in lower time an algorithmic technique is proposed that also identifies the stability of the image processing reducing the time of diagnosis.

Multiplicity of solutions of Dirichlet problems associated to second order equations in \mathbf{R}^2

by

Carlota Rebelo

Universidade de Lisboa Portugal

Coauthors: Francesca Dalbono

We are interested on the existence of multiple solutions to the Dirichlet problem

$$\begin{cases} x''+A(t, x)x=0, & x \in \mathbf{R}^2, t \in [0, \pi] \\ x(0)=x(\pi)=0, \end{cases} \tag{1}$$

where $A:[0, \pi] \times \mathbf{R}^2 \rightarrow GL_s(\mathbf{R}^2)$,

$$A(t, x) = \begin{bmatrix} a_{11}(t, x) & a_{12}(t, x) \\ a_{12}(t, x) & a_{22}(t, x) \end{bmatrix},$$

is a continuous function such that uniqueness of solutions of Cauchy problems associated to system (1) is guaranteed. We assume that

$$\lim_{|x| \rightarrow 0} A(t, x) = A_0(t) \text{ uniformly in } t \in [0, \pi] \text{ and } \lim_{|x| \rightarrow \infty} A(t, x) = A_\infty(t) \text{ uniformly in } t \in [0, \pi],$$

and prove that if $a_{11}(t, x) < 0$, $a_{22}(t, x) < 0$ and $a_{12}(t, x) \neq 0 \in (t, x) \in [0, \pi] \times \mathbf{R}^2$ then (1) admits at least $2i(A_0) - i(A_\infty)$ nontrivial solutions where we denote by $i(A)$ the index of a symmetric matrix A .

Comparison of two polynomial representations of experimental designs

by

Eva Riccomagno

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Coauthors: Maria Piera Rogantin, Department of Mathematics, Università degli Studi di Genova

In the context of algebraic statistics a design of experiment is described by a set of polynomials called the design ideal. This in turn is generated by finite subsets of polynomials. Two types of generating subsets are present in the literature: Grobner bases and indicator functions. We describe them both, how they are used in the analysis and planning of a design and how to switch between them. Examples include fractions of full factorial designs and designs for mixture experiments.

Empirical Distribution of the Macedonian Stock Market Index

by

Slave Risteski

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Coauthors: Dragan Tevdovski

The assumption that stock returns are normally distributed has been, implicitly or explicitly, widely used in theoretical finance. However, the normality of stock returns is questionable. Empirical evidence has shown that the normality assumption of asset returns does not hold as stated in Mandelbrot (1963) and confirmed by Fama (1965).

Peters (1991) found that the distribution of the S&P500 stock returns exhibits negative skewness, fat tails, and a high peak. More recently, Aparicio and Estrada (2001) tested and rejected the normality assumption of the daily stock returns for four Scandinavian securities markets. They found that distributions of the daily stock returns from these markets are clearly leptokurtic.

Praetz (1972), Blattberg and Gonedes (1974) and Peiró (1994) have reported that the Student's t fits stock returns better than any other distribution if the variance follows an inverted gamma distribution. Gray and French (1990) fitted the scaled t, logistic and exponential power distributions to the S&P500 Index returns. The exponential power distribution appeared to provide a superior fit of the distributions considered. Harris and Kucukozmen (2001) tested exponential generalized beta and skewed generalized t distribution on the daily returns of a large emerging European stock market – Turkey. They reported that skewed generalized t distribution provides better fit to the data.

In this paper we investigate the distribution of Macedonian Stock Index daily returns. MSI is a price-weighted index and consists of the most liquid ten stocks on Macedonian Stock Exchange. We found that the daily returns of the index are not normally distributed. In addition, the daily returns are not identically nor independently distributed. The daily returns of the index are found to be better explained by a student t rather than a normal, logistic or exponential power distribution.

The findings have important implications for the calculations of optimal portfolio. In the last section of this paper is presented construction of the VaR optimal portfolio consisted with the stocks from Macedonian Stock Index.

Key words: normal distribution, Student t distribution, heteroskedastic variance, autocorrelation, Chi-squared test, value at risk.

Comparison of different definitions of regular fraction

by

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Coauthors: Giovanni Pistone - Dipartimento di Matematica - Politecnico di Torino - Italy

The Authors in "Indicator function and complex coding for mixed fractional factorial design" (under revision) present a new definition of regular fraction and discuss its properties. This definition applies to the mixed-level case with no restriction on the number of levels. Such fractions have the no-partial-confounding property.

After a brief review of such a definition, we will discuss, on a number of simple examples, the relation of our definition with both the classical Galois Field construction and the use of pseudo-factors with a prime number of levels.

Building air quality indices using a Generalized Dynamic Factor Model

by

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In this paper we build a set of air pollution indexes and indicators, exploiting the information from a large panel data of air pollutant concentrations series measured at different monitoring sites.

For the construction of such indices, we used, as a first step, the Generalized Dynamic Factor Model (GDFM) developed by Forni et al. (2000,2001,2002). This method is useful to "clean" our data from measurement errors and from local or regional effects (such as those due to small scale meteorological phenomena), retaining only those features that are common to a large number of monitoring sites. These common features are obtained after the "alignment" of series that, although exhibiting a similar behaviour pattern may not be synchronized. Before implementing this model, we previously transform our series, in order to obtain stationarity, and we divide them by a reference value, in order to obtain comparable air pollutants measures.

Using the common component obtained via the GDFM, we construct our indexes and indicators as an adaptation of Bruno and Cocchi (2002) work.

The proposed methodology is applied to UE15's concentrations of five air pollutants, CO, NO₂, O₃, PM₁₀ and SO₂, measured weekly from January 1st, 1999, to December 31st, 2002.

Keywords: air pollution indices; spectral analysis, dynamic principal components; generalized principal components; generalized dynamic factor model

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Multivariate Linear Models with Kronecker Product Structure

by

Dietrich von Rosen & Tatjana Nahtman

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The objective of this paper is to consider multivariate linear models where the independent experimental units consists of matrices. There are many practical situations where these type of data can appear. For example data which are both spatially and temporally related. The models extend the classical Growth Curve model. An algorithm for obtaining MLEs will be presented. The covariance structure is specified via the Kronecker product and special attention will be given to the parametrization of the models.

Black box queries for finite groups

by

Joachim Rosenthal

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Coauthors: Gerard Maze and Jens Zumbraegel

Motivated by problems in cryptanalysis, people have been studying the following problem: Given a finite set S with a hidden (black box) binary operation $*$: $S \times S \rightarrow S$ which might come from a group law, and suppose you have access to an oracle that you can ask for the operation $x*y$ of single pairs (x, y) in S^2 you choose. What is the minimal number of queries to the oracle until the whole binary operation is recovered, i.e. you know $x*y$ for all x, y in S ?

This problem can be trivially be solved by using n^2 queries to the oracle, so the question arises under which circumstances you can succeed with a significantly smaller number of queries.

In this presentation we give a lower bound on the number of queries needed in general. On the other hand, we introduce algorithms solving this problem by using $[S]-1$ queries, provided that $*$ is an Abelian group operation. We also discuss the more general situation where $(S, *)$ is a non-Abelian group or even just a semigroup.

Successes and Obstacles From a Research Experience for Undergraduates in Mathematical Biology

by

Michael A. Rutter

Penn State Erie, The Behrend College

Penn State Erie, The Behrend College, has conducted a research experience for undergraduates (REU) in mathematical biology for the past nine years. Funded by the National Science Foundation, this six week program brings six undergraduate students from around the United States to conduct mathematical research on a wide range of topics including population dynamics, human physiology, and population estimation. I will discuss the evolution of the REU from its inception to its current format. Project creation, selection, and outcomes will also be presented. A number of our students have entered graduate school in fields related to mathematics or mathematical biology. The students often exceed our expectations, with several projects resulting in peer reviewed journal articles. However, it is still important for faculty mentors to recognize that the students have varying backgrounds and that the REU should be a dynamic environment.

Jan Rychtar

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Coauthors: Christian Sykes (undergraduate student, UNCG) and Dr. Mark Broom (University of Sussex, England)

Kleptoparasitism, the stealing of food items, is a common biological phenomenon. It has been observed in many species, but it is especially common amongst seabirds.

When searching for items of food, foragers can find themselves in contact with a conspecific that has discovered such an item. If this item cannot be immediately consumed, then the individual may have the opportunity to steal it. It may or may not be advantageous to make such a stealing attempt, depending on a variety of factors such as the value of the food item, the chance of success and possible costs in entering a contest (e.g. possibility of injury, time or energy used). Hence, food-stealing (kleptoparasitism) falls within the cost-benefit economic framework central to much of behavioral ecology and game theory can be used in modeling kleptoparasitic systems.

The mathematics needed to approach and answer questions on evolution of kleptoparasitic systems is accessible to undergraduate students. In this talk we show some results done in cooperation with undergraduate students; we also show potential projects for perspective undergraduate students.

Pseudo-Differential Operator with Watson transform

by

Sadhana

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Coauthors: R. S. Pathak

A class of pseudo-differential operators associated with general Fourier kernel associated with Hardy and Titchmarsh is defined. An integral representation of p.o.d's is obtained and its continuity property from the space $T(\lambda, \mu)$ to itself is investigated. Some special forms of the symbol are considered. It is also shown that these p.o.d's and their products are bounded in certain Sobolev type spaces.

Eigenvalues of Symmetric Matrices whose Graph is a Tree

by

Carlos M. Saiago

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Given an n -by- n real symmetric matrix $A=(a_{ij})$, the (undirected) graph of A has vertices $1, 2, \dots, n$ and an edge between vertices i and j , $i \neq j$, if and only if $a_{ij} \neq 0$.

Let T be a tree and let $S(T)$ denote the set of all n -by- n real symmetric matrices whose graph is T . What are the possible multiplicities for the eigenvalues among matrices in $S(T)$?

We will discuss recent results related with this general question.

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Recent results on the Bayesian analysis of response surfaces

by

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Response surface methodology typically employs a second order polynomial model to locate the stationary point of the true response function and to make inferences on it. The standard confidence regions for the true stationary point are due to Box and Hunter (1954). An alternative and equivalent parameterization of the model, in which the stationary point appears as the parameter of interest, lets easily perform a Bayesian analysis. The marginal reference prior distribution of the parameter of interest can be obtained in its general form. The features of this non-informative prior distribution are showed using particular experimental designs and exhibiting the Bayesian role of rotatability. The use of informative prior distributions is also proposed. Through MCMC techniques, it is possible to get HPD regions for the true stationary point. Moreover an empirical method to obtain HPD regions for the true maximum point (which is obviously a special case of the stationary point) is described and the results of a simulation study performed to check the coverage probabilities of these Bayesian regions are showed.

Inverse transversals of naturally ordered regular semigroups

by

Maria Helena Santos

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An inverse transversal of a regular semigroup S is an inverse subsemigroup that contains a unique inverse of every element of S . An ordered regular semigroup $(S; \leq)$ is said to be naturally ordered if the imposed order \leq extends the natural order on the idempotents. Here we consider inverse transversals of naturally ordered regular semigroups. We investigate various general properties that relate the imposed order to the natural order, and highlight the situation in which the inverse transversal is a monoid. In this situation we determine the structure of such a semigroup.

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Chi-square tests in the analysis of structural equation models: structural and distribution misspecification

by

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Coauthors: Heinz Neudecker

We study the asymptotic distribution of chi-square type test statistics for the analysis of structural equation models, under general conditions on the model and on the distribution of the data. The test of submodel M_0 under the maintained model M is investigated when (a) M_0 and M are possibly misspecified, (b) the chi-square test is possibly misspecified given the distribution of the sample moments, (c) the models M_0 and M both are possibly overparameterized, and (d) the asymptotic variance matrix of the sample moments is possibly singular. Diagnostics are developed to distinguish between model and distribution misspecification. The general results are specialized to the analysis of augmented moment structures. An illustration using simulated data is presented.

Graph-theoretic formulation of a probability problem

by

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What are all the (necessarily finite) sets of numbers which arise as probabilities of events in some finite repetition of Bernoulli trials? We give a partial answer to the problem of characterizing all such sets. It is seen that a certain special case; namely, when all the numbers or their pairwise ratios, are rational and their maximum is at most the reciprocal of ϵ , conforms to this situation. For the full description, a method is indicated that requires obtaining the cardinality of a certain set, the result being given in terms of this number. Though an exact formula remains elusive, it is shown that the desired cardinality can be expressed in several equivalent forms, perhaps the most elegant one using the graph-theoretical concept of clique numbers, applied to a certain regular graph.

Mathematical Modelling in Blood Rheology

by

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Blood is a multi-component mixture with complex rheologic characteristics which interacts both mechanically and chemically with vessel walls, giving rise to complex fluid-structure interaction models whose mathematical analysis is still incomplete and which are difficult to simulate numerically in an efficient manner. Experimental investigations over many years show that blood flow exhibits non-Newtonian behaviour such as shear-thinning, viscoelasticity, thixotropy and yield stress and its rheology is influenced by numerous factors including plasma viscosity, rate of shear, hematocrit, level of erythrocytes aggregation and deformability. Hemodynamic analysis of blood flow in vascular beds and prosthetic devices requires the rheological behaviour of blood to be characterized through appropriate constitutive equations relating the stress to deformation and rate of deformation.

In this talk we present a short overview of some macroscopic constitutive models that can mathematically characterize the rheology of blood and describe its known phenomenological properties. Some numerical simulations obtained in geometrically reconstructed real vessels will be also presented to illustrate the hemodynamic behaviour using Newtonian and non - Newtonian inelastic models under a given set of physiological flow conditions.

Double minimization for logit models with an additive two factors structure

by

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Logit models may be used to express the incidence rate of diseases when the impact depends on two, or more, additive factors.

A double minimization algorithm is presented for the adjustment of such models for the case of two additive factors.

An application to the incidence of AIDS, Tuberculosis and Hepatitis B is presented.

On estimation of population mean under missing observations

by

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We propose several estimators of finite population mean in the presence of missing observations using auxiliary characteristics. The estimators are studied under both simple random sampling and stratified sampling. The proposed estimators are more efficient as compared to usual mean estimator, regression estimator and Toutenburg and Srivastava (2003) estimator. A simulation study is also conducted to compare the relative performances of various estimators.

Combined Control Chart to Detect Change in the Process Parameter

by

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A control chart obtained by combining two control charts can have better performance over the standard Shewhart's chart. A synthetic control chart introduced by Wu and Spedding (2000) is one such chart. Here an unified approach to construct a combined control chart useful to detect shift in the process parameter of an arbitrary process distribution is provided. Applications to improve the existing standard control chart are discussed alongwith the numerical results related to Average Run Length.

Stochastic model for knockout switch in computer networks

by

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In computer networks, switching is used as a juncture to provide a path to a message to pass on. The knockout switch is a specially designed architecture having equal number of input and output lines. An input cell, in this switch, passes through several stages like filters, concentrators and shifters (or queue). The cell may be under unicasting or multicasting depending upon the number of tokens of output lines allotted. This paper considers the random movement of a cell, inside the design of knockout switch, up to the output line. A Markov chain model is proposed to explain the transitions on various states of filter, concentrator and shifter. The outgoing probability is computed using the number of transitions performed by the cell. Several theorems and corollaries are derived for explaining the behavior of the cell movement. The expected number of transitions are computed keeping various situational constraints. A simulation study is performed to support the derived theorems under the model.

Problem Structuring Methods: incorporating multiple perceptions & conflict in decision modeling

by

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Making and taking managerial decisions, solving business problems, designing and re-designing optimal operational systems now a day have to take place in conditions of unprecedented complexity and uncertainty. Ambiguous risks, combining irreducible uncertainties and diverse assessments, hamper decision-making processes in many public and private corporate arenas. To be adequate to such situations, analytical approaches to decision support must take account of differences of perception and conflict between multiple actors, encourage creativity and generate decisions with flexible capacities.

In the previous generation, the emphasis was on analytic modeling (represented normally in quantitative analytic form), the factors/alternatives & relationship among them in a decision situation are represented mathematically & then using computer/software packages to solve them. Mostly these tools & techniques aim at finding the 'best' solution, though considering a number of assumptions. Classical approaches to both planning and decision-making have proved inadequate in practice for the managing such ambiguous risks, which may fall apart in the real life situations. So, the time has come for alternative techniques and methodologies known as Problem Structuring Methods (PSMs).

PSMs use models to help group decision making. The aim of PSMs is both more modest & more ambitions than precious generation of optimizing methods because they are meant for more general situations considering much less assumptions so more useful in the real business life. The principal PSMs are Strategic Options Development & Analysis (SODA), Soft System Methodology (SSM), Strategic Choice Approach (SCA), Drama Theory etc to assist strategic decision-making. This field is now generally referred to as 'Soft OR' as they are distinguished by the different assumptions the approaches make regarding problem definition, the nature of organizations, the use of models and the emphasis placed on organizational and individual learning. All of these PSMs take a process-orientated approach to model messy and wicked problems and have been actually developed through action research. These methods are predicated on the need to address uncertainty and plurality, powerful means to promote integration of knowledge, to build trust and understanding between culturally distinct groups, therefore, enhancing the quality of decision-making.

A symmetric Laplace distribution on the unit sphere

by

Hai-Yen Siew

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A distribution on the unit sphere is generated by conditioning scale mixture of normal distribution when the reciprocal of the weight follows a gamma distribution. It can be regarded as the Laplace distribution on the unit sphere. The density involves the modified Bessel function of the third kind. This new distribution includes uniform and von-Mises Fisher distributions as the special cases. It will be suggested to use EM algorithm to find the maximum likelihood estimates of the parameters.

Generalized Additive Models in Survival Analysis

by

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When using Generalized Linear Models (GLMs), misspecification of the link is very likely to occur due to the fact that the information, necessary to correctly choose this distribution function, is usually unavailable. To overcome this problem, new developments emerged which, simultaneously, gave rise to more flexible models. As a result, survival analysis also derived benefit from this new line of research, due to the correspondence between models in binary regression analysis and in survival analysis. In fact, with survival data, the Gamma-logit model may be viewed as a GLM with binary response and unknown link function belonging to the Aranda-Ordaz one-parameter family of transformations. However, the imposition of a linear relation between the outcome and the covariates is still present in these kind of models. Believing in a greater flexibility by also allowing non linear covariate effects, we propose the use of flexible parametric link families, in Generalized Additive Models (GAMs) with binary response. If we now consider the referred Aranda-Ordaz transformations family, a generalization of the Gamma-logit model will be obtained, which we will denote by Additive Gamma-logit model. Based on the local scoring algorithm, the estimation process minimizes the deviance through the use of a deviance profile plot. The evaluation of the the link parameter estimates and the comparison of the performance of the proposed GAM with that of the logistic GAM, were carried out for simulated data. Due to the inexistence of asymptotic theory for the new model, inference was accomplished by using bootstrap techniques. The proposed methodology was applied to a real current status data set, with the purpose of studying the distribution of the elapsed time from first potential HIV exposure by injecting drugs until HIV infection.

Keywords: Generalized Additive Model; unknown link function; survival analysis; Gamma-logit model; current status data.

Fixed points in the dual space of an Ockham algebra

by

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An Ockham algebra $(L;f)$ consists of a bounded distributive lattice L together with a dual endomorphism $f:L \rightarrow L$ [1]. Concerning these algebras we highlight the following basic facts.

A Priestley space [2] is a compact totally order-disconnected space. An Ockham space $(X;g)$ consists of a Priestley space X together with a continuous antitone mapping $g:X \rightarrow X$. By a fundamental dual equivalence of Urquhart [4], if $(X;g)$ is an Ockham space then the set of clopen down-sets of X becomes an Ockham algebra $O(X)$ (the dual algebra of $(X;g)$ under the definition $f(A)=X \setminus g^{-1}(A)$); and if $(L;f)$ is an Ockham algebra then the set of prime ideals of L becomes an Ockham space $I_p(L)$ (the dual space of $(L;f)$ under the definition $g(J)=\{x \in L: f(x) \notin J\}$). If $(L;f)$ is an Ockham algebra with dual space $(X;g)$ then $O(X) \cong (L;f)$.

Let $(L;f)$ be an Ockham algebra with dual space $(X;g)$. A subset Q of X is said to be a g -subset if $g(Q) \subseteq Q$. For each closed g -subset Q of X the relation ϑ_Q defined on $O(X) \cong (L;f)$ by

$$(A, B) \in \vartheta_Q \Leftrightarrow A \cap Q = B \cap Q$$

is an Ockham congruence and, if we denote by $C_g(X)$ the set of closed g -subsets of X , the mapping $\vartheta:C_g(X) \rightarrow \text{Con } O(X)$ given by $\vartheta(Q)=\vartheta_Q$ is a dual lattice isomorphism [2].

Given any Ockham algebra, we describe the congruences such that the quotient algebras are boolean. This description is obtained using certain ideals that we call pro-boolean ideals. We prove that every proper pro-boolean ideal is the intersection of a family of falsity ideals. We also determine when every proper pro-boolean ideal is a unique intersection of such ideals. Finally, we show that if an Ockham algebra in the Urquhart class $\mathbf{P}_{n+2, n}$ is fixed point free then the corresponding dual space has a fixed point [3, Theorem 9]. This result is a natural generalisation of a well known theorem [1, Theorem 6.3].

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Approximations to the ruin probability of the perturbed risk process

by

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Let R be the perturbed risk process, defined by $R(t)=u+ct-X(t)+\sigma W(t)$ where u , c and σ are positive constants, u denoting the initial capital, c the rate of premium per time unit, $X(t)$ the aggregate claim process and $W(t)$ a Wiener process. It is assumed that $X(t)$ is a compound Poisson process independent of $W(t)$. Here, we are concerned with the derivation of numerical approximations to the ruin probability caused by oscillation or by a claim. The new approximations are illustrated through some particular examples.

Selecting Discriminant Features for Language Identification in Hard Context Documents

by

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Automatic determination of the language in which a document is written is not yet a completely solved problem. Generically it is solved as a classification problem and, for most common situations, namely for documents written in just one language, results obtained are very good. However, there are texts that are hard to classify for which there is currently no reliable solution. Among the hard texts are: small touristic advertisements on the web, addressing foreigners but written in such a way that most part of the words used to name local entities are from the local language; texts written both in a national language and in English, addressing two linguistic communities; and texts written in European and in Brazilian Portuguese or other pair of variants of the same language. We will present a statistics based Language Identification (LID) approach which is based on a covariance similarity measure. To build this similarity, we use n-grams of characters, with length ranging from 2 to 8 characters. These sequences are weighted by its Discriminant Ability, a measure we have developed. In this presentation we will show how the setting up of different thresholds for this measure influences the precision of classification in any context.

This approach has two phases: learning and classification. In the learning phase, statistical techniques and the above mentioned Discriminant Ability are used in order to strongly reducing the number of initial discriminant attributes. Document clusters are built for each language in a space of uncorrelated k dimensions. In the classification phase we use the Quadratic Discriminant Score to decide which cluster (language) must be assigned to the documents we want to classify.

This methodology is shown to be 100 % correct for classifying normal texts written in 19 languages and maintains its robustness when classifying both short normal texts and hard context documents.

Bimachines: an algebraic approach to Turing machine computation

by

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Bimachines are structures defined essentially as a combination of two automata (where semigroups act on the left and on the right, respectively) linked by a single output function, and are a natural tool to work with length-preserving mappings on free monoids. Bimachines can be used to develop a new algebraic approach to the theory of Turing machines: given a Turing machine T , the one-move bimachine B encodes the behaviour of T during a single move. To deal with the general situation of an arbitrary number of moves, we must introduce a binary operation on bimachines adequate to deal with composition of mappings: the block product. Iteration of the block product and profinite limits lead us to a profinite bimachine that encodes the full computational behaviour of T . The space and time complexity functions of T can be translated naturally to the bimachine level, and the authors expect that this new approach based on iteration of operations involving finite automata and semigroups can open new perspectives to the theory of complexity and the famous P vs NP problem.

Mathematics - the crystal tower?

by

Noémia Simões

ISEL

Is Mathematics a crystal tower?

A science more or less esoteric, for the amusement of a few 'iluminated brains'?

Or is it rather capable to develop 'crystal balls' - which make us able to foresight diferent scenarios and possibilities for the individual and colective future?

A science which is able to connect poetry and technological development; to develop symbolic, social and technological imagination, to create bridges - by showing the homeomorphisms - between different cultures and civilizations:

Through interdisciplinary perspectives, and several examples, we'll show the importance of this discipline as a science and a language fundamental along the history of human thought, and also a tool for dealing with the global challenges the world faces.

Saigo operator on fractional integration involving the Gauss hypergeometric functions

by

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In this paper we observed some new hypergeometric functions whose based upon operators of fractional integration by Saigo [2]. The several attempts have been made by the author's to drive a number of theorems. The main results of the paper are given in section (2-5) [Theorem (1-7)].

Steady Flow of Conducting Fluid in a Channel of Infinite Length in Presence of Inclined Magnetic Field

by

Chandra Bali Singh

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In this paper the steady flow of conducting liquid in parallel channel under the influence of inclined magnetic field has been considered. Analytical expression is obtained and effects of the strength of magnetic field is shown graphically.

Multiple comparison procedures for location parameters: logistic population case

by

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Consider independent populations p_1, \dots, p_k such that the population p_i is characterized by the logistic distribution function with unknown location parameter and common known scale parameter σ , $i = 1, \dots, k$. In this article, we propose test procedures for testing H_0 , based on sample medians. If there is prior information that populations under comparison are ordered in a certain way, for example, they may be a sequence of increasing dose levels of a drugs in dose response experiment. For such situations, experimenter may be interested in successive comparisons of population means. We propose test procedures for testing null hypotheses (one-sided problem) and (two-sided problem) which control the family wise type-I error rate at level α . We also propose a test procedure for testing the null hypothesis against umbrella ordered alternative with at least one strict inequality. When H_0 is true, the proposed test procedure is a test procedure to test the null hypothesis of equality against simple ordered alternative. The test procedures are inverted to obtain the associated simultaneous confidence intervals. The critical constants required for the implementation of the proposed procedures computed numerically are presented.

Nonparametric empirical Bayes tests in a positive Exponential Family

by

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This paper provides nonparametric Bayes and empirical Bayes test procedures for one and two tail tests in a positive exponential family when the prior distribution of the parameter is completely unknown and unspecified. Various types of asymptotic optimalities are established. Special emphasis is given on the speed of convergence.

On generalized Jensen's inequality

by

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Shannon's inequality has played a vital role to characterize Shannon's entropy in Information Theory. Several measures of information have been characterized by many coding theorems accordingly for the probability distributions complete and incomplete and weighted or unweighted. Same is the case of Jensen's inequality which has also played a vital role to characterize some information indices.

Therefore, in the present communication, we attempted to generalize the Jensen's inequality

$$f [E (z)] < E [f (z)] \dots\dots\dots(1)$$

i.e (functional expectation of the variant is always less than or equal to expectation of the functional variant in the form viz.

$$E [V (z)] < V [E (z)] \dots\dots\dots(2)$$

i.e. expectation of the variance is always less than or equal to variance of the expectation of the variant. To prove (2), we have utilized some lemmas.

From application point of view in Information theory, the problem of data reduction has been presented through the inequality

$$IH [\theta, T (x)] < IH (\theta, X) \dots\dots\dots(3)$$

Where H is an uncertainty function and θ is a state.

On measure of fuzzy information improvement through generating function and their inequalities

by

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Measures of Fuzzy information are playing a very important role in Fuzzy control for decision making. On the other hand information improvement has its unique role in decision making science. Generating functions simplify the complex decision to characterize and analyse the given distribution probabilistic or non probabilistic. Motivated by these, we introduce in this communication, the concept of measures of fuzzy information improvement through generating functions in different ways.

Information improvement has been introduced by Theil in information theory as

$$I (P, Q, R) = \dots\dots\dots(1)$$

for the probability distributions P, Q and R directly. Recently Singh et al (2005) introduced information improvement in three ways through generating functions.

- i) Directly
- ii) As a difference of Directed Divergences
- iii) As a Difference of inaccuracies.

Hence, in the present communication, we introduce measure of fuzzy information improvement through generating functions in three different ways i.e., directly as a difference of generating functions of fuzzy directed divergence and as a difference of fuzzy inaccuracies. Last section provides some classical inequalities in measures of fuzzy information improvement.

Some fundamental properties of measure of fuzzy information improvement have been tested for weighted on unweighted distributions.

An Analysis of Gender Differences in Vehicles Miles Traveled (VMT) Using Nonparametric Methods

by

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In the United States as in many nations, there are often differences between the travel patterns of men and women with regards to the differences in travel. Traditionally, women make shorter work trips, make greater use of public transit, make more trips for the purpose of serving another person's travel needs, and drive far fewer miles per year than men. These differences in travel are delineated by the separate social responsibilities of men and women. However, in the past few decades, women have been participating more in the labor force. In addition, women still retain their family obligations as nurturers, shoppers, and homemakers. Given the changes in the transit patterns of women in recent decades, women's travel patterns still differed substantially from those of men. In fact, these emerging trends from transit patterns of women, their actual vehicle miles traveled (VMT) are starting to increase and may surpass the VMT of men. Additionally, it is speculated by transportation planners and policy-makers that the VMT of women will surpass the VMT of men in the future.

In the past, transportation studies have not been particularly oriented to women's travel issues despite the presence of the data and statistical methodologies. On the other hand, surveys such as the National Household Transportation Survey (NHTS) can be used to understand trends in women's travel patterns, which are often attributed to changes in labor force participation, household structure, and attitudes. This paper will analyze the differences in the vehicle miles traveled (VMT) between men and women using nonparametric methods using the data from the NHTS data as prepared by the Bureau of Transportation Statistics (BTS) in the U.S. Department of Transportation. Moreover, the examination of the relationship of VMT and other household variables would be estimated in a flexible way which cannot be assessed using parametric modeling methods.

Factorization by invariant embedding of elliptic problems

by

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This work concerns the factorization of elliptic operators, namely the decomposition of a second order boundary value problem, defined in an open bounded regular domain, in an uncoupled system of two first order initial value problems. The method presented here is inspired on the theory of Optimal Control. It is a return, in a new spatial approach, to the technique of the invariant temporal embedding, defined originally in the context of Dynamic Programming, used in Control Theory for the computation of the optimal feedback. This technique consists in embedding the initial problem in a family of similar problems depending on a parameter, which are solved recursively. In our case, each problem is defined over a sub-domain limited by a mobile boundary depending on the parameter.

Without loss of generality, we particularize the study to a Poisson's equation with a Dirichlet's boundary condition. Also, we consider the case where the family of curves which limits the subdomains defined by the invariant embedding are homothetic to one another and homothetic to a point. This fact induces the appearing of a singularity.

Statistical analysis of large-intestine and lung cancer of the Kharkiv population

by

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Introduction: The percentage of developing of large-intestine cancer before 80 years of age is 0.92% and 0.49% of the male and female populations of Kharkiv, respectively. But the percentage of developing of lung cancer for the same age is about 1.8 times higher for the male population (1.67 percents) and 2.7 times less for the female population (0.18%).

Methods: Information on the age of manifestation of cancer in 2220 patients from Kharkiv in 2000 was also obtained. The age and sex structure of the Kharkiv population was estimated from data on 2,949,599 people. Information on 2904 first-degree subjects of 545 probands (the basic group) was analysed. Two hundred and ninety-five probands (220 men and 75 women) had lung cancer, and 250 probands (113 men and 137 women) had stomach and intestine cancers.

Results: The correlation coefficient of the age of manifestation of cancer in parent-off spring pairs is 0.47. These correlation coefficients for the father-son, mother-daughter, mother-son, and father-daughter pairs are 0.64, 0.49, 0.44, and 0.37, respectively. If the parent has lung cancer, the correlation is stronger (0.71). On average, cancer is manifested in offspring earlier than in parents (57 and 63 years, respectively); the differences in the father-daughter and mother-son pairs are 8.2 and 2.8 years, respectively.

Conclusions: We have found that the best prognostic parameter is the age of manifestation of cancer in the father with respect to the age of manifestation in the son. Our results supported by null hypothesis tests of the coefficients of correlation using F and Chi-squared tests.

keywords: Public health, correlation analysis, cancer research

Modeling Idiopathic Intracranial Hypertension

by

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In an attempt to better understand Idiopathic Intracranial Hypertension (IIH), mathematical models display the behavior of the brain's sinuses when introduced to changes in transmural pressure-the pressure difference between interior and exterior pressures ($P_{int} - P_{ext}$). The definite causes and proper treatment of IIH escape doctors and scientists. Disturbances of the brain's blood flow system, such as sudden pressure changes, may be the origin of this disorder. We analyze a piecewise system of non-linear differential equations derived from conservation equations. The dynamics of the system can result in a partial collapse of the sinus, thus causing increased resistance to natural blood flow. We compare measures of Cerebrospinal Fluid (CSF) pressures from IIH patients to numeric solutions to our model and conclude that our model can sufficiently match all known behavior we have attempted thus far.

Maximum Log Likelihood Estimation using EM Algorithm and Partition Maximum Log Likelihood Estimation for Mixtures of Generalized Lambda Distributions

by

Steve Su

The George Institute for International Health

An essential problem in fitting mixture distributions to data is to choose the appropriate distributions. This paper presents two effective mixture distribution fitting methods based on maximizing the likelihood using the generalized lambda distributions. Due to the flexibility of generalized lambda distributions, these distributions by themselves can fit a wide range of data flexibly and relieve the burden of having to choose between distributions in mixture distribution modeling. This paper demonstrates its fitting algorithms on a wide range of empirical data using the Nelder-Mead simplex algorithm and discusses the strengths and weakness of each method which can influence their use under different mixture modeling situations.

Factors Affecting the Decision of Students at high Vocational Certificate on Continuing their Undergraduate Studies at Private University : Case Study of Bangkok Metropolis

by

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The study examined decision-making of the students at high vocational certificate level on continuing their studies at private university and investigated factors affecting their decision. Six hundred students selected by multi-stage sampling from high vocational certificate level in both private and government vocational schools in Bangkok Metropolis were asked to fill out a questionnaire. The data were analyzed through SPSS program to find out percentage of frequency, arithmetic mean, standard deviation, and discriminant analysis. The results of the research showed that factors affecting the decision making on continuing their studies were cumulative grade point average, parents' occupation, parents' educational level, parents' income, opportunity, honors, curriculum or branch, faculty staff, buildings and facilities, as well as personal reasons. Some factors that did not affect their decision were sex, number of brothers and sisters, and external drive. Fisher's categorical equations were used to divide three groups of high vocational certificate students namely deciding to study, deciding not to study, and being unsure of continuing their studies at private university.

Two-sample comparisons for serially correlated data

by

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The purpose of the study is to develop new tests for the equality of trends in two stationary independent or dependent time series, i.e. when the usual i.i.d. and other distribution-related assumptions usually associated with two-sample comparison tests, are relaxed. Analysis of data obtained from the mining industry of South Africa motivated these tests. In order to conduct sensible comparisons of two independent time series, adapted two-sample tests are proposed and for the comparison of two dependent time series, adapted pair-wise statistical methods are pursued, developed and evaluated. The new methods consider the correlation-structures in the data, and involve the bootstrap method. The estimated power of the new tests are discussed.

Bootstrap goodness-of-fit tests with estimated parameters based on empirical transforms

by

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Several test statistics have been proposed recently which employ a weighted distance that depends on an empirical transform, as well as on estimated parameters. The empirical characteristic function is a typical example, but alternative empirical transforms have also been employed, such as the empirical Laplace transform when dealing with non-negative random variables or the empirical probability generating function corresponding to discrete observations. A general formulation is provided under which the consistency of the proposed test is established. The limiting null distribution of the test statistic is obtained, and it is shown to depend not only on the null hypothesis, but also on the true values of shape parameters, whenever present. Two effective bootstrap versions of the test procedure are proposed, which can be used to approximate the critical values and to compute the power under contiguous alternatives. The validity of these bootstrap procedures is shown analytically and numerically.

Interpolation of linear subspaces by P-matrices

by

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A P-matrix is a real square matrix with positive principal minors. P-matrices are important in numerous applications, e.g. the quadratic assignment problem in operations research.

Given real n by k matrices X and Y of rank k , we consider the necessary and sufficient conditions for the existence of a P-matrix which maps X to Y . A simple necessary condition based on the Hadamard (or entry-wise) product is known to be sufficient for $k = 1$ and $k = n$. We discuss whether this condition is sufficient for all $k < n$.

Optimal allocation of time points under quadratic growth curve model with correlated observations

by

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Optimal designs under growth curve models with correlated observations is determined.

In our considerations by a design we mean an allocation of time points in the experimental domain $[\alpha, \beta]$. For symmetric experimental domain we determine a correlation structure for which a design optimal over the time interval $[-1, 1]$ is still optimal over $[-\alpha, \alpha]$ for $\alpha > 0$. Moreover, we determine asymmetric experimental domain and a correlation structure such that optimal design has the form $d = \{\alpha, (\alpha+\beta)/2, \beta\}$. We study the efficiency factors of designs optimal in a model with uncorrelated errors relative to the values of correlation coefficients and the type of dependence.

Teaching Statistics in Management Courses

by

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The authors have been teaching statistics, strategic and quality management in Portugal and Asia. This paper is the starting point of an intended international survey on statistical teaching and registers the result of a reflection on how to teach statistics in university business courses taking into account a widely recognized unsatisfactory mathematical literacy of the students coming from high school.

The conclusion is that the emphasis must be on statistical thinking through methods more conceptual than mathematical, without taking into account the mathematical base in order to avoid a theoretical drift comparable to the outcome of the rule five for the funnel experiment presented by Deming in his book *Out of the Crisis*.

Bayesian Model Selection - A Comparative Study Through an Application

by

Júlia Teles

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Model selection is an important statistical problem. In the particular case of variable selection in regression problems, the number of models to compare may be large, even if the number of independent variables is moderate. There are several Bayesian strategies to address this problem. Basically they may be divided into two groups (Dellaportas et al., 2000): (1) variable selection strategies, where all the models are considered simultaneously (e.g. Gibbs variable selection) and (2) methods for variable selection, where the models are separately adapted and compared based on discrepancy measures (Carlin and Louis, 2000). In Teles (2005) were suggested two Bayesian methods of variable selection which fall on the second category, namely a forward variable selection and a backward variable elimination scheme. In this work, the performance of these methods is studied, by comparing them with existing ones through an application concerning the anthropometric evaluation of primary school children of the Lisbon public schools (Vieira and Fragoso, in press).

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A Rational Prince and New Perspectives

by

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Confirmation Theory is a sub-field in Philosophy of Science.

Bayesianism is a popular subjective probabilistic approach to confirmation theory.

In this paper, though I am not a Bayesian, I will cut of a general criticism often leveled at Bayesian confirmation theory.

It is my contention that the 'problem of no new evidence' and the 'problem of old evidence' are only problems if there is in fact no new evidence.

I argue that properly understanding what evidence is dissolves both problems.

My solution to the problems serves to remind confirmation theorists what exactly evidence is and what exactly we should, even if we are not Bayesians, take evidence to be.

A Systematic Approach for Unequal Allocations for Ranked Set Sampling with Skew Distributions

by

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Ranked Set Sampling (RSS) is a useful technique for improving the estimates of mean and variance when the sampling units in a study can be more easily ranked than quantified. Under equal allocation, RSS is found to be more precise than simple random sampling (SRS). Further gain in precision of the estimate may be obtained with appropriate use of unequal allocation. For skewed distributions, the optimum gain in precision is obtained through unequal allocation based on Neyman's approach, in which the sample size corresponding to each rank order is proportional to its standard deviation. However, the unavailability of the standard deviations of the rank orders makes the Neyman's approach impractical. The two models, viz., 't-model' and '(s, t)-model' suggested by Kaur, Patil, and Taillie (1997, *Biometrics* 53, 123- 130) are also impractical due to their dependence on population parameters of rank orders and complexities in finding the optimum values of 't' and '(s, t)'. In this article, we propose a simple and systematic approach for unequal allocation for RSS with skew distributions. The proposed approach performs better than SRS and RSS with equal allocation. It also appears to perform better than the RSS with unequal allocation using 't-model' and quite close to the '(s, t)-model' in most of the situations we have considered. The performance of the proposed procedure relative to existing models has been numerically evaluated for some skewed distributions.

Keywords: Ranked set sampling; Relative precision; Neyman's allocation; Positively skewed distributions; Order statistics.

Improved version of Generalized Least Squares Estimators in Linear Regression models under exact restrictions

by

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The use of ordinary least squares method on the ground that error structure has same variance was criticized by some researchers and they prefer the Atiken's Generalized Least Squares Estimators which can be shown to be BLUE. When some or all parameters satisfy a few exact linear restrictions then the restricted Generalized Least Squares Estimators are used instead of Generalized Least Squares Estimators. In this paper we develop improved method of estimation for the regression coefficients. The two families of estimators are also presented and their properties are studied.

Asymptotic joint distribution of extremes of continuous time processes and their discrete versions

by

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In many applications, the primary interest is the supremum of some continuous time process over a specified period. However, data are usually available over a discrete set of times and the inference can only be made for the maximum of the discrete version of the process over this discrete set of times. The true continuous time maximum will be larger than the maximum of the discrete skeleton and if we want to estimate the extremes of the continuous time process based on the discrete time data, we need to make an adjustment to allow for the effect of discrete sampling and provide a measure of how much smaller it tends to be. Thus, we need to look at asymptotic distribution of the maxima of continuous processes and their discrete versions.

The most complete characterization of the relation between discrete and continuous time extremes is given by Piterbarg (2004) for Gaussian processes, where he looks at the asymptotic joint distribution of

$$P\left(\max_{0 \leq t \leq T} X(t) \leq a_T x + b_T, \max_{0 \leq \delta i \leq T} X(\delta i) \leq a_{T, \delta} y + b_{\delta, T}\right),$$

as $T \rightarrow \infty$, for different sampling frequencies δ , and suitably chosen pairs of normalizing constants (a_T, b_T) and $(a_{T, \delta}, b_{\delta, T})$.

In this work, we generalize Piterbarg results to P-continuous, stationary processes.

Piterbarg, V. (2004) Discrete and continuous Time extremes of Gaussian Processes. Extremes 7, 161-177.

Triangular and Trapezoidal Distributions: Applications in the Genome Analysis

by

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Coauthors: Luzia Gonçalves

In recent years, many works present some applications of classical triangular and trapezoidal distributions and, particularly, of some new extensions of these distributions. van Drop and Kotz (2002, 2003) investigate an extension of the three-parameter triangular distribution called two-sided power (TSP) distribution and a generalized trapezoidal family. In this context, applications have been emerging, for example, in computers and industrial engineering, geotechnical engineering, financial engineering, spatio-temporal information processing, screening, detection and progression of cancer. This work adds some new applications of triangular and trapezoidal distributions in the genome analysis, particularly, in the construction of physical mapping of linear and circular chromosomes.

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Model comparison: A Bayesian viewpoint using some of the recent toolkits

by

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The present talk focuses on the use of some of the recent Bayesian toolkits of model validation and comparison and describes the exact computational and other difficulties associated with each one of these. The discussion is done absolutely in a general framework but illustrated in context of some commonly used reliability models. Finally, numerical results are provided using both complete and censored data sets.

Calculation of Mean Square Error variations for Discrete Data with Different Sample Rate

by

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In this paper, we have followed the smoothing technique for calculating Mean Square Error and make some changes to expand it for estimation of deterministic discrete data which were corrupted with additive-multiplicative noise. We have shown that time duration of estimation filter and its shape are important parameters in estimation error and could be set on optimum value to reach minimum error. For the sake of simplicity we limited the problem to specific case of deterministic functions and our simulations showed that the estimation error will be increased with increase of sampling frequency. Also we consider how to control the variation of mean square error with respect to sampling frequency. The simulation results had been compared with [1], [2] and show considerable improvements.

Keywords: Smoothing technique, Sampling, Estimation, Mean Square Error

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Hierarchical Linear Models: an application on education sciences

by

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Coauthors: Teresa Oliveira, Universidade Aberta e CEAUL

The importance of hierarchical structured data analysis, based in appropriate statistical models, is very well known in several research areas. In our work we present an application to Education Sciences: we have students which are grouped in classes belonging to schools which in turn are scattered throughout the country. This grouped organization is labelled as a hierarchical or multilevel structure and the usual adopted models for statistical analysis of this kind of data are the hierarchical linear or multilevel models. These models development takes in account the data variability, inside and among each hierarchical level.

We apply the hierarchical linear model (HLM) with two levels, students and schools, in order to identify relevant differences on students' performance, (10th grade high school in 2004/2005) considering three subjects of the scientific areas and comparing two different regions in Portugal: Coast and Inland regions.

Keywords: Hierarchical linear models, Multilevel models, Multilevel analysis.

Reduced bias estimation of high quantiles and small exceedance probabilities for heavy tailed models

by

Björn Vandewalle

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Coauthors: M. Ivette Gomes and Fernanda Figueiredo

We deal with bias reduction techniques for heavy tailed models, trying to improve mainly upon the performance of classical estimators for high quantiles and small exceedance probabilities, by estimating the second order parameters in the bias at a level larger than the level at which the tail index is estimated. Doing this, it is proved that the asymptotic variance of the new estimators can be kept equal to the one of the popular Hill estimator. An illustration of the finite sample behavior of the estimators is also provided through a simulation study and the application to sets of real data in the fields of finance and insurance.

European Options with Discrete Dividends - An Hedging Approach

by

Carlos Antunes Veiga

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European options on underlyings with discrete dividends are frequently mistreated in the literature. The widely known approximation where the underlying's diffusion is subtracted by the present value of the dividends is flawed and gives rise to significant pricing errors. Several alternatives to the valuation procedure have been proposed ranging from changing the volatility of the underlying's diffusion to ad hoc correction techniques. We propose a valuation approach that is found on a dynamic hedging argument and results in a closed formula series.

Weather influence on TV audience

by

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The essay is focused on a practical problem of TV audience and its dependence on weather conditions. It is based on real data which cover TV audience and weather conditions in 14 regions of the Czech Republic during 3 years (2003-2005). Several primary analyses were worked out and mixed-effects model was used to model the situation.

An actuarial model for heart disease and stroke

by

Howard Waters

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Coauthors: Tushar Chatterjee and Angus Macdonald

Actuaries need to be able to predict mortality rates over relatively long terms. For this reason, the effects of recently developed treatments for conditions which can lead to serious illness or death are of interest to actuaries.

In this talk we describe a continuous time/age (semi-)Markov model for the pathways to ischaemic heart disease and stroke. These pathways include the development of the major risk factors: smoking, body mass index, high blood pressure, high cholesterol and diabetes. The model has been designed to allow the long term effects of different treatments for some of these risk factors, in particular statins for high cholesterol, to be determined.

Partial Words and the Critical Factorization Theorem

by

Nathan D. Wetzler

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Coauthors: Francine Blanchet-Sadri

In this paper, we consider one of the most fundamental results on periodicity of words, namely the critical factorization theorem. Given a word w and nonempty words u, v satisfying $w = uv$, the minimal local period associated to the factorization (u, v) is the length of the shortest square at position $|u| - 1$. The critical factorization theorem shows that for any word, there is always a factorization whose minimal local period is equal to the minimal period (or global period) of the word.

Crochemore and Perrin presented a linear time algorithm (in the length of the word) that finds a critical factorization from the computation of the maximal suffixes of the word with respect to two total orderings on words: the lexicographic ordering related to a fixed total ordering on the alphabet, and the lexicographic ordering obtained by reversing the order of letters in the alphabet. Here, by refining Crochemore and Perrin's algorithm, we give a version of the critical factorization theorem for partial words (such sequences may contain "do not know" symbols or "holes"). Our proof provides an efficient algorithm which computes a critical factorization when one exists. Our results extend those of Blanchet-Sadri and Duncan for partial words with one hole. A World Wide Web server interface at <http://www.uncg.edu/mat/research/cft2/> has been established for automated use of the program.

Design selection criteria for discrimination between nested models for binomial data

by

Dave Woods

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Coauthors: Tim Waterhouse (Eli Lilly & Co.), John Eccleston (University of Queensland) and Sue Lewis (University of Southampton)

The aim of an experiment is often to enable discrimination between competing forms for a response model. We investigate the selection of a continuous design for a non-sequential strategy when there are two competing generalized linear models for a binomial response, with a common link function and the linear predictor of one model nested within that of the other. A new criterion, TE-optimality, is defined, based on the difference in the deviances from the two models, and comparisons are made with T-, DS- and D-optimality. Issues are raised through the study of two examples in which designs are assessed using simulation studies of the power to reject the null hypothesis of the smaller model being correct, when the data are generated from the larger model.

A note on criterion-robust optimal designs for model discrimination and parameter estimation in polynomial regression models

by

Mei-Mei Zen

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Consider the problem of discriminating between the polynomial regression models on $[-1, 1]$ and estimating parameters in the models. Zen and Tsai (2002) proposed a multiple-objective optimality criterion, M_γ -criterion, which uses weight γ ($0 \leq \gamma \leq 1$) for model discrimination and $\alpha = \beta = (1 - \gamma) / 2$ for parameter estimation in each model. In this paper, we generalize to a wider setup with different value of $\alpha = m\beta$, $m > 0$. For instance, $\alpha = 2\beta$ suggests that the "smaller" model is more likely to be the true model. Using similar techniques, the corresponding criterion-robust optimal M_{γ^*m} is investigated. The study of M_{m, γ^*m} -efficiency of any M_{γ^*1} -optimal shows that the criterion-robust optimal design in Zen and Tsai (2002), which use equal weights for parameter estimation, is good enough for any wider setup.

Kernel estimation when density may not exist

by

Victoria Zinde-Walsh

McGill University

Nonparametric kernel estimation of density and conditional mean is widely used, but many of the pointwise and global asymptotic results for the estimators are not available unless the density is continuous and appropriately smooth; in kernel estimation for discrete-continuous cases smoothness is required for the continuous variables. Non-smooth density and mass points in distributions arise in various situations that are examined in empirical studies; some examples and explanations are discussed in the paper. Generally, any distribution function consists of absolutely continuous, discrete and singular components but only a few special cases of nonparametric estimation involving singularity have been examined in the literature and asymptotic theory under the general set-up has not been developed. In this paper the asymptotic process for the kernel estimator is examined by means of the generalized functions and generalized random processes approach; it provides a unified theory since density and its derivatives can be defined as generalized functions for any distribution, including cases with singular components. The limit process for the kernel estimator of density is fully characterized in terms of a generalized Gaussian process. Asymptotic results for the Nadaraya-Watson conditional mean estimator are also provided.

Nonlinear Control Chart

by

Mohammad Zokaei

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Many of the techniques developed by mathematical statisticians for the analysis of data may be used in the control of product quality. The expression statistical quality control may be used to cover all uses of statistical techniques for this purpose. One important tool in statistical quality control is the Shewhart control chart. One of the applications of the Shewhart control chart is in the investigation of the physical growth of human beings (like height and weight). Consideration of physical parameters especially in the early ages is and has been of utmost concern to parents and biology researchers and nobody denies that.

In this paper we introduce a nonlinear control chart. For drawing UCL and LCL, we used many conditions such as non-stability of Variance, Nonlinear estimation and Curve estimation. To demonstrate how this chart works we use real data, height and weight of children, which were taken from some clinics in Tehran.

Keywords: Nonlinear Control Chart, Statistical Quality Control, Height and Weight

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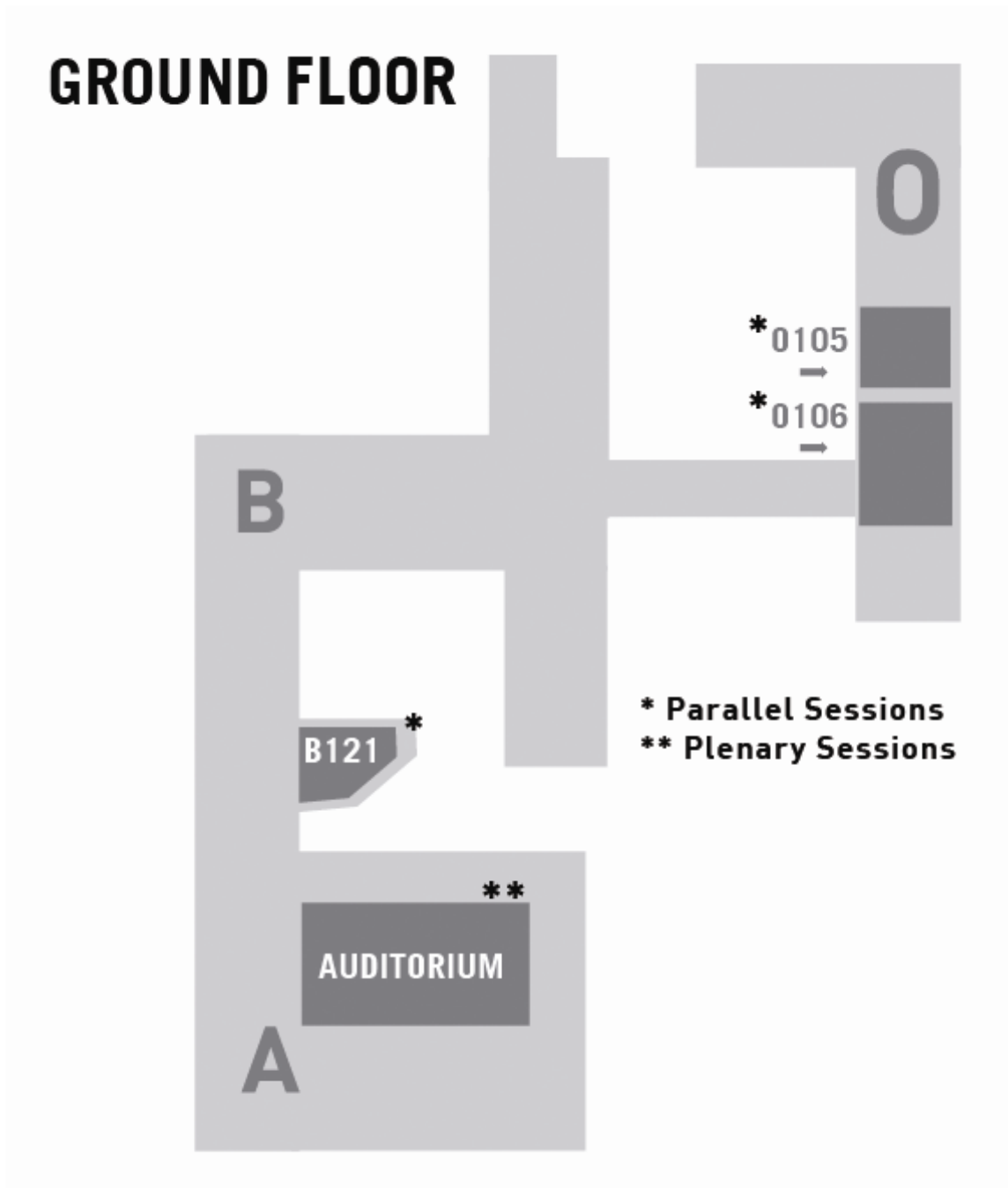
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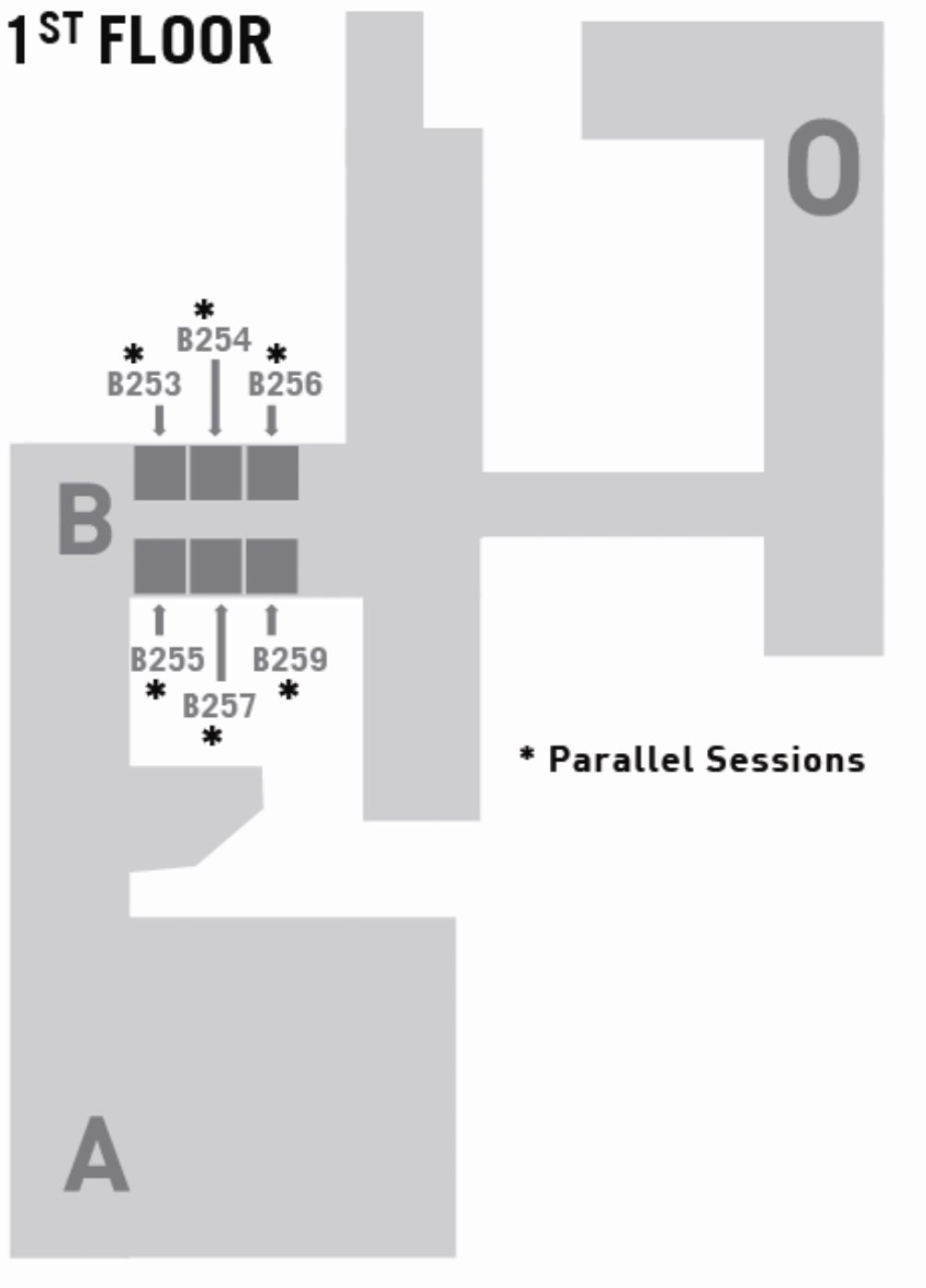


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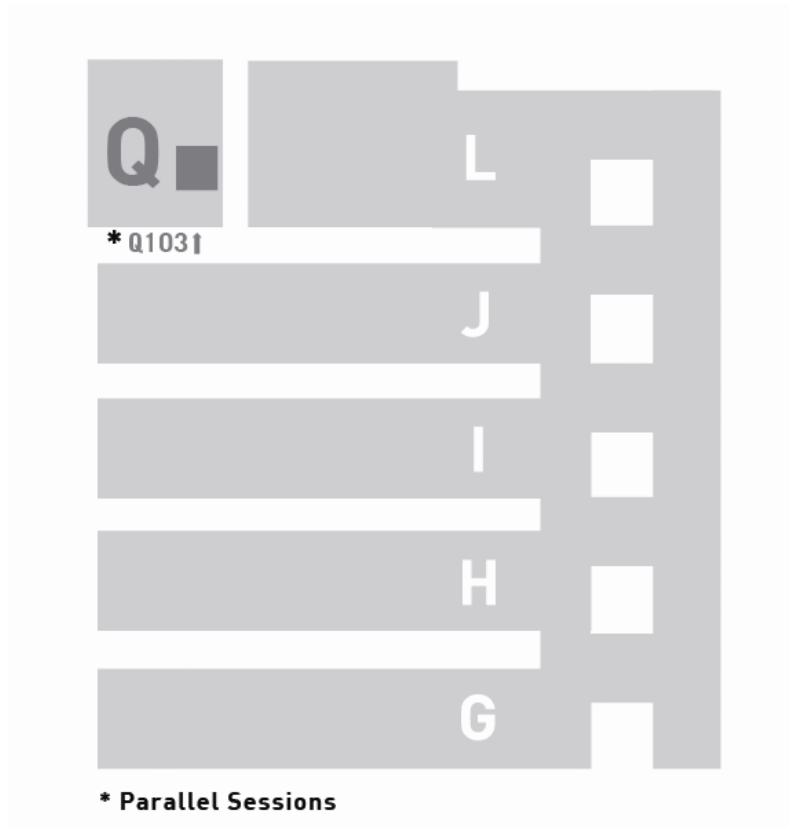


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