UNIVERSITY OF WINDSOR

Department of Mathematics and Statistics

presents

The 16th International Workshop on Matrices and Statistics

UNIVERSITY OF WINDSOR

JUNE 1-3, 2007

IWMS 2007

(in celebration of Dr. George Styan's 70th Birthday)

PROGRAM

THANKS TO OUR SPONSORS:

ILAS

UNIVERSITY OF WINDSOR

FIELDS

Maplesoft command the brilliance

ims

SSC Statistical Society of Canada
Société Statistique du Canada

CENTRE FOR STATISTICAL CONSULTING, RESEARCH AND LEARNING SERVICES

Department of Mathematics and Statistics

University of Windsor

Director

Dr. S. Ejaz Ahmed

C. Young
Administrative Secretary

Consultants

Dr. Abdo Alfakih

Dr. Richard Caron

Dr. Karen Fung, P. Stat.

Dr. Myron Hlynka, P. Stat.

Dr. Abdul Hussein

Dr. Sévérien Nkurunziza

Dr. Sudir Paul

For further information and for a free estimate please contact:

Dept. of Mathematics and Statistics
University of Windsor
Windsor, Ontario, N9B 3P4
Phone: (519) 253-3000 ext. 3015
Fax: (519) 971-3649

E-mail cscrs@uwindsor.ca

Visit our website:
http://www.uwindsor.ca/cscrs

The Center for Statistical Consulting, Research and Learning Services (CSCRLS) has been formed within the Department of Mathematics and Statistics at the University of Windsor to provide statistical and mathematical services to clients both on campus and outside organizations.

The goals of the CSCRLS are to:

- *carry out activities to promote an environment conducive to increasing awareness and usefulness of the statistical and mathematical sciences*
- *increase the use of statistical methods to solve scientific, business and industry problems*
- *enhance prospects for research collaboration*
- *develop a link between the University and the community*

Services available:

- *Design and Analysis of Experiments and Surveys*
- *Data Exploration and Analysis*
- *Complex Data Sets of Varying Quality Collected From Various Sources*
- *Statistical Quality Assurance*
- *Scheduling and Optimization*
- *Numerical Computations and Monte Carlo Simulation*
- *Data Mining and Predictive Modeling*
- *SPSS, SAS and S-PLUS Coding*
- *Probability Models*
- *Short Courses and Professional Development*
- *Expert Witness Testimony*

First hour of consultation is free.

June 1, 2007

Dear Participants:

Welcome to the 16th International Workshop on Matrices and Statistics!!!

The purpose of this Workshop is to stimulate research, in an informal setting, and to foster the collaboration of researchers in the interface between matrix theory and statistics. The Workshop will feature both invited and contributed talks, including some talks by graduate students. A special issue of the journal *Linear Algebra and its Applications* will be published, devoted to selected papers presented at the Workshop. I think now is the time to form a Society associated with these international workshops on matrices and statistics, which would provide support and assistance to young researchers working in this area.

This is also a main concern of George Styan, who will have his 70th birthday on September 10 this year. Our Workshop celebrates this forthcoming event. It is a pleasure for me to express our gratitude and recognition for his ongoing interest in matrices and statistics. He is the only participant in this 16th Workshop who took part in all the others. Many of us will remember his efforts in organizing the 4th Workshop in Montreal in 1995. This 16th Workshop benefits again from his support and expertise.

I would like to take this opportunity to thank our speakers for coming to Windsor. Their time and valuable input are greatly appreciated. Furthermore I would also like to acknowledge our sponsors, especially the Fields Institute for Research in Mathematical Sciences, whose support has made this event possible. This Workshop is a satellite meeting of the 35th Annual Meeting of the Statistical Society of Canada, St. John's, Newfoundland, June 10–13, 2007.

I am most grateful to all the members of the Local Organizing Committee (LOC) and the International Organizing Committee (IOC) for making this Workshop a reality. My very special thanks go to Christine Young for putting it all together, from poster to website and for handling many other details. I will take this opportunity to thank all my colleagues (both faculty and staff) at the Department of Mathematics and Statistics, University of Windsor, for their help and support not only for this event, but over the past 5 years during my headship.

Above all, I am delighted that you all have come to this Workshop. I sincerely hope that you will enjoy it both scientifically and socially!

Cordially yours,

S. Ejaz Ahmed, Ph.D.
Professor and Head: Department of Mathematics and Statistics
University of Windsor, Windsor, Ontario, Canada

INTERNATIONAL ORGANIZING COMMITTEE

George P. H. Styan — Chair
McGill University, CANADA

Simo Puntanen — Vice-chair
University of Tampere, FINLAND

S. Ejaz Ahmed — Local Organizing Chair
University of Windsor, CANADA

Jeffrey J. Hunter
Massey University, Albany Campus, NEW ZEALAND

Augustyn Markiewicz
Agricultural University of Poznan, POLAND

Götz Trenkler
Universität Dortmund, GERMANY

Dietrich von Rosen
Swedish University of Agricultural Sciences, SWEDEN

Hans Joachim Werner
Universität Bonn, GERMANY

LOCAL ORGANIZING COMMITTEE

S. Ejaz Ahmed — Chair

Lihua An

Shahid Bhatti

Myron Hlynka

Md. Shakhawat Hossein

Abdul Hussein

Sévérien Nkurunziza

Wai Ling Yee

Christine Young — Workshop Administrator

Friday June 1

8:00-9:00	**REGISTRATION**
9:00-9:15	**OPENING REMARKS** S. Ejaz Ahmed, Chair, Local Organizing Committee, IWMS Head, Department of Mathematics and Statistics Neil Gold, Provost and Vice-President, Academic

SESSION 1

Session Chair:

George P. H. Styan, Chair, International Organizing Committee, IWMS
McGill University, CANADA

	KEYNOTE SPEAKER
9:15-10:00	Peter Loly, University of Manitoba, CANADA **Eigenvalues in the universe of matrix elements 1, …, n^2** [W-24]
10:00-10:30	Götz Trenkler, Universität Dortmund, GERMANY **On the Moore-Penrose inverse of magic squares** [W-41]
10:30-11:00	Kimmo Vehkalahti, University of Helsinki, FINLAND **Some comments on magic squares and Survo puzzles** [W-43]
11:00-11:30	Ka Lok Chu, Dawson College, CANADA **Some comments on magic square matrices with three nonzero eigenvalues** [W-8]
11:30-11:45	**COFFEE BREAK**

SESSION 2

Session Chair:

Jeffrey J. Hunter, International Organizing Committee, IWMS
Massey University, Albany Campus, NEW ZEALAND

11:45-12:15	Karl E. Gustafson, University of Colorado, USA **Operator trigonometry of Hotelling correlation, Frobenius condition, Penrose twistor** [W-14]
12:15-12:45	Morteza Seddighin, Indiana University East, USA **Applications of antieigenvalue techniques in statistics** [W-35]
12:45-1:15	Ravindra Khattree, Oakland University, USA **Antieigenvalues and antieigenvectors in applied statistics** [W-20]
1:15-2:15	**LUNCH BREAK**

FRIDAY JUNE 1 (CONT'D)

SESSION 3

Session Chair:
Simo Puntanen, Vice-Chair, International Organizing Committee, IWMS
University of Tampere, FINLAND

2:15-2:30	George P. H. Styan, McGill University, CANADA **A philatelic excursion with Jeff Hunter in probability and matrix theory** [W-37]
2:30-3:00	Jeffrey J. Hunter, Massey University, Albany Campus, NEW ZEALAND **Coupling and mixing times in Markov chains** [W-18]
3:00-3:30	Stanley L. Sclove, University of Illinois at Chicago, USA **Matric musings in statistical finance** [W-34]
3:30-3:45	Toulope Sajobi, University of Windsor, CANADA **A very simple Markov transition matrix** [W-33]
3:45-4:00	Myron Hlynka, University of Windsor, CANADA **Two types of retrial queue** [W-16]
4:00-4:15	**COFFEE BREAK**

SESSION 4

Session Chair:
Oskar Maria Baksalary, Adam Mickiewicz University, POLAND

4:15-4:45	Yongge Tian, Shanghai University of Finance and Economics, CHINA **Sum decompositions of weighted least-squares estimators under a general linear model** [W-40]
4:45-5:15	Jarkko M. Isotalo, University of Tampere, FINLAND **Linear sufficiency and completeness in the partitioned linear model** [W-19]
5:15-5:30	Simo Puntanen, University of Tampere, FINLAND **Effect of adding regressors on the equality of the OLSE and BLUE** [W-30]

SATURDAY JUNE 2

SESSION 5

Session Chair:

Götz Trenkler, International Organizing Committee, IWMS
Universität Dortmund, GERMANY

8:30-9:00	Hans Joachim Werner, Universität Bonn, GERMANY **On partitioned projectors** [W-45]
9:00-9:30	Oskar Baksalary, Adam Mickiewicz University, POLAND **On two representations of projectors** [W-4]
9:30-10:00	K.P.S. Bhaskara Rao, Indiana State University, USA **A result on idempotent matrices** [W-32]
10:00-10:30	Jani Virtanen, University of Helsinki, FINLAND **Norms of Toeplitz matrices and their asymptotic behaviour** [W-44]
10:30-10:45	**COFFEE BREAK**

SESSION 6

Session Chair:

Adi Ben-Israel, Rutgers University, USA

KEYNOTE SPEAKER

10:45-11:30	T.W. Anderson, Stanford University, USA **Likelihood ratio tests in reduced rank regression and blocks of structural equations** [W-3]
11:30-12:00	Yonghui Liu, Shanghai Finance University, CHINA **Reduced rank regression and canonical correlation** [W-23]
12:00-12:30	Muni S. Srivastava, University of Toronto, CANADA **Akaike Information Criterion for selecting components of mean vector in high-dimensional data with fewer observations** [W-36]
12:30-12:45	Esa Ollila, Helsinki Institute of Technology, FINLAND **ICA of non-circular sources based on generalized uncorrelating transformation** [W-28]
12:45-1:45	**LUNCH BREAK**

Saturday June 2 (cont'd)

SESSION 7

Session Chair:
Peter Loly, University of Manitoba, Canada

1:45-2:15	Shuangzhe Liu, University of Canberra, AUSTRALIA **On extensions of a Styan inequality involving the Khatri-Rao product** [W-22] *(Dedicated to George P. H. Styan on the occasion of his 70th birthday)*
2:15-2:45	Frank J. Hall, Georgia State University, USA **Interlacing results on matrices associated with graphs** [W-15]
2:45-3:15	Serge Provost, The University of Western Ontario, CANADA **On the inversion of certain moment matrices** [W-29]
3:15-3:45	Yuejiao Cindy Fu, York University, CANADA **Testing homogeneity in a mixture of von Mises distributions with a structural parameter** [W-12]
3:45-4:00	**COFFEE BREAK**

SESSION 8

Session Chair:
Hans Joachim Werner, International Organizing Committee, IWMS
Universität Bonn, GERMANY

4:00-4:15	Lihua An, University of Windsor, CANADA **Shrinkage estimation of the variance components for meta-analysis with random effects** [W-1]
4:15-4:30	Md. Shakhawat Hossain, University of Windsor, CANADA **Shrinkage, pretest and L_1 regularization-type estimators in generalized linear models** [W-17]
4:30-5:00	Carlos Coelho, New University of Lisbon, PORTUGAL **Testing for structure in covariance matrices** [W-9]

BANQUET, HILTON HOTEL

6:30--	George P. H. Styan, McGill University, CANADA **The philatelic magic squares tourist** [W-38]

PROGRAM

SUNDAY JUNE 3

SESSION 9

Session Chair:

Philip V. Bertrand, Consultant Statistician, Solihull, England, UK

KEYNOTE SPEAKER

8:30-9:15	Adi Ben-Israel, Rutgers University, USA **Probabilistic clustering** [W-5]
9:15-9:45	Edit Gombay, University of Calgary, CANADA **Change detection in autoregressive time series** [W-13]
9:45-10:15	Yogendra P. Chaubey, Concordia University, CANADA **Estimation of distinct elements of a covariance matrix: MINQUE and MINQE** [W-7]
10:15-10:45	Syed Kirmani, University of Northern Iowa, USA **Some aspects of multivariate quality control** [W-21]
10:45-11:00	**COFFEE BREAK**

SESSION 10

Session Chair:

Augustyn Markiewicz, International Organizing Committee, IWMS
Agricultural University of Poznan, POLAND

11:00-11:30	Philip V. Bertrand, Consultant Statistician, Solihull, ENGLAND, UK **All about statistical quirks** [W-6]
11:30-12:00	Yoshio Takane, McGill University, CANADA **On ridge operators** [W-39]
12:00-12:30	Pierre Druilhet, CREST-ENSAI, Bruz, FRANCE **A POD estimator based on the jumps of some bordered matrices inertia** [W-11]
12:30-1:30	**LUNCH BREAK**

Sunday June 3 (cont'd)

SESSION 11

Session Chair:
Kimmo Vehkalahti, University of Helsinki, FINLAND

1:30-2:00	Vera de Jesus, New University of Lisbon, PORTUGAL **Binary operation on prime basis factorials** [W-10]
2:00:2:30	Nizam Uddin, University of Central Florida, USA **E-optimal block designs for three treatments with conditional autonormal error process** [W-42]
2:30-3:00	Augustyn Markiewicz, Agricultural University of Poznan, POLAND **Design optimality conditions in multivariate linear models** [W-25]
3:00-3:30	Mohamed Amezziane, De Paul University, USA **Kernel estimation and bandwidth selection in multivariate function estimation** [W-1]
3:30-3:45	**COFFEE BREAK**

SESSION 12

Session Chair:
Myron Hlynka, Local Organizing Committee, IWMS
University of Windsor, CANADA

3:45-4:15	Jaakko Nevalainen, University of Tampere, FINLAND **Nonparametric methods for multivariate location problems with independent and cluster-correlated observations** [W-26]
4:15-4:45	Hannu Oja, Tampere School of Public Health, University of Tampere, FINLAND **Multivariate data analysis based on two scatter matrices** [W-27]
4:45-5:15	M. Hossein Rahbar, Michigan State University, USA **A nonparametric test for equality of several survival means** [W-31]

CLOSING REMARKS

5:15--	Simo Puntanen – Chair, International Organizing Committee, IWMS'08-Portugal Drawing of Door prizes – must be present to win

Session #	day	chair surname	talk time length	start time of talk	speaker name	title	abstract #
WS-01/1	Friday, June 1	Young	60	8:00		Registration	
WS-01/2	Friday, June 1	Ahmed	**15**	**9:00**	Neil Gold	Provost and Vice-President, University of Windsor	
WS-01/3	Friday, June 1	Styan	45	9:15	Peter D. Loly	Eigenvalues in the universe of matrix elements 1, ..., n^2	W-24
WS-01/4	Friday, June 1	Styan	30	10:00	Götz Trenkler	On the Moore–Penrose inverse of magic squares	W-41
WS-01/5	Friday, June 1	Styan	30	10:30	Kimmo Vehkalahti	Some comments on magic squares and Survo puzzles	W-43
WS-01/6	Friday, June 1	Styan	30	11:00	Ka Lok Chu	Some comments on magic square matrices with three nonzero eigenvalues	W-08
WS-01/7	Friday, June 1		15	11:30--11:45		COFFEE	
WS-02/1	Friday, June 1	Hunter	30	11:45	Karl E. Gustafson	Operator trigonometry of Hotelling correlation, Frobenius condition, Penrose twistor	W-14
WS-02/2	Friday, June 1	Hunter	30	12:15	Morteza Seddighin	Applications of antieigenvalue techniques in statistics	W-35
WS-02/3	Friday, June 1	Hunter	30	12:45	Ravindra Khattree	Antieigenvalues and antieigenvectors in applied statistics	W-20
WS-02/4	Friday, June 1		60	1:15--2:15		LUNCH	
WS-03/1	Friday, June 1	Puntanen	15	2:15	George P. H. Styan	A philatelic excursion with Jeff Hunter in probability and matrix theory	W-37
WS-03/2	Friday, June 1	Puntanen	30	2:30	Jeffrey J. Hunter	Coupling and mixing times in Markov chains	W-18
WS-03/3	Friday, June 1	Puntanen	30	3:00	Stanley L. Sclove	Matric musings in statistical finance	W-34
WS-03/4	Friday, June 1	Puntanen	15	3:30	Toulope Sajobi	A very simple Markov transition matrix	W-33
WS-03/5	Friday, June 1	Puntanen	15	3:45	Myron Hlynka	Two types of retrial queue	W-16
WS-03/6	Friday, June 1		15	4:00--4:15		COFFEE	
WS-04/1	Friday, June 1	Baksalary	30	4:15	Yongge Tian	Sum decompositions of weighted least-squares estimators under a general linear model	W-40
WS-04/2	Friday, June 1	Baksalary	30	4:45	Jarkko M. Isotalo	Linear sufficiency and completeness in the partitioned linear model	W-19
WS-04/3	Friday, June 1	Baksalary	15	5:15--5:30	Simo Puntanen	Effect of adding regressors on the equality of the OLSE and BLUE	W-30

Session #	day	chair surname	talk time length	start time of talk	speaker name	title	abstract #
WS-05/1	Saturday, June 2	Trenkler	30	8:30	Hans Joachim Werner	On partitioned projectors	W-45
WS-05/2	Saturday, June 2	Trenkler	30	9:00	Oskar M. Baksalary	On two representations of projectors	W-04
WS-05/3	Saturday, June 2	Trenkler	30	9:30	K.P.S. Bhaskara Rao	A result on idempotent matrices	W-32
WS-05/4	Saturday, June 2	Trenkler	30	10:00	Jani A. Virtanen	Norms of Toeplitz matrices and their asymptotic behaviour	W-44
WS-05/5	Saturday, June 2		15	10:30--10:45		COFFEE	
WS-06/1	Saturday, June 2	Ben-Israel	45	10:45	T. W. Anderson	Likelihood ratio tests in reduced rank regression and blocks of structural equations	W-03
WS-06/2	Saturday, June 2	Ben-Israel	30	11:30	Yonghui Liu	Reduced rank regression and canonical correlation	W-23
WS-06/3	Saturday, June 2	Ben-Israel	30	12:00	Muni S. Srivastava	Akaike Information Criterion for selecting components of mean vector in high-dimensional data with fewer observations	W-36
WS-06/4	Saturday, June 2	Ben-Israel	15	12:30	Esa Ollila	ICA of non-circular sources based on generalized uncorrelating transformation	W-28
WS-06/5	Saturday, June 2		60	12:45--1:45		LUNCH	
WS-07/1	Saturday, June 2	Loly	30	1:45	Shuangzhe Liu	On extensions of a Styan inequality involving the Khatri--Rao product	W-22
WS-07/2	Saturday, June 2	Loly	30	2:15	Frank J. Hall	Interlacing results on matrices associated with graphs	W-15
WS-07/3	Saturday, June 2	Loly	30	2:45	Serge Provost	On the inversion of certain moment matrices	W-29
WS-07/4	Saturday, June 2	Loly	30	3:15	Yuejiao Cindy Fu	Testing homogeneity in a mixture of von Mises distributions with a structural parameter	W-12
WS-07/5	Saturday, June 2		15	3:45--4:00		COFFEE	
WS-08/1	Saturday, June 2	Werner	15	4:00	Lihua An	Shrinkage estimation of the variance components for meta-analysis with random effects	W-02
WS-08/2	Saturday, June 2	Werner	15	4:15	Md. Shakhawat Hossain	Shrinkage, pretest and L1 regularization-type estimators in generalized linear models	W-17
WS-08/3	Saturday, June 2	Werner	30	4:30--5:00	Carlos Coelho	Testing for structure in covariance matrices	W-09
WS-08/4	Saturday, June 2	Ahmed & Young		6:30--...		BANQUET	
WS-08/5	Saturday, June 2	Ahmed	15	ca. 9:00	George P. H. Styan	The philatelic magic squares tourist	W-38

Session #	day	chair surname	talk time length	start time of talk	speaker name	title	abstract #
WS-09/1	Sunday, June 3	Bertrand	45	8:30	Adi Ben-Israel	Probabilistic clustering	W-05
WS-09/2	Sunday, June 3	Bertrand	30	9:15	Edit Gombay	Change detection in autoregressive time series	W-13
WS-09/3	Sunday, June 3	Bertrand	30	9:45	Yogendra P. Chaubey	Estimation of distinct elements of a covariance matrix: MINQUE and MINQE	W-07
WS-09/4	Sunday, June 3	Bertrand	30	10:15	S. Kirmani	Some aspects of multivariate quality control	W-21
WS-09/5	Sunday, June 3		15	10:45--11:00		COFFEE	
WS-10/1	Sunday, June 3	Markiewicz	30	11:00	Philip V. Bertrand	All about statistical quirks	W-06
WS-10/2	Sunday, June 3	Markiewicz	30	11:30	Yoshio Takane	On ridge operators	W-39
WS-10/3	Sunday, June 3	Markiewicz	30	12:00	Pierre Druilhet	A POD estimator based on the jumps of some bordered matrices inertia	W-11
WS-10/4	Sunday, June 3		60	12:30--1:30		LUNCH	
WS-11/1	Sunday, June 3	Vehkalahti	30	1:30	Vera de Jesus	Binary operation on prime basis factorials	W-10
WS-11/2	Sunday, June 3	Vehkalahti	30	2:00	Nizam Uddin	E-optimal block designs for three treatments with conditional autonormal error process	W-42
WS-11/3	Sunday, June 3	Vehkalahti	30	2:30	Augustyn Markiewicz	Design optimality conditions in multivariate linear models	W-25
WS-11/4	Sunday, June 3	Vehkalahti	30	3:00	Mohamed Amezziane	Kernel estimation and bandwidth selection in multivariate function estimation	W-01
WS-11/5	Sunday, June 3		15	3:30--3:45		COFFEE	
WS-12/1	Sunday, June 3	Hlynka	30	3:45	Jaakko Nevalainen	Nonparametric methods for multivariate location problems with independent and cluster-correlated observations	W-26
WS-12/2	Sunday, June 3	Hlynka	30	4:15	Hannu Oja	Multivariate data analysis based on two scatter matrices	W-27
WS-12/3	Sunday, June 3	Hlynka	30	4:45--5:15	M. Hossein Rahbar	A nonparametric test for equality of several survival means	W-31
WS-12/4	Sunday, June 3	Ahmed	15	5:15	Simo Puntanen	IWMS17-Tomar: 23--26 July 2008 www.ipt.pt/iwms08	

Abstracts

[W-1] Kernel estimation and bandwidth selection in multivariate function estimation

Mohamed AMEZZIANE, *De Paul University, USA*

Results from matrix algebra and matrix calculus are used to minimize local and global L_2 criteria of kernel estimates of multivariate density and distribution functions. Under different matrix structures, optimal bandwidth matrices are derived and their estimators are shown to possess good asymptotic properties. [Joint work with Ibrahim A. Ahmad]

[W-2] Shrinkage estimation of the variance components for meta-analysis with random effects

Lihua AN, *University of Windsor, Canada*

In this communication, we deal with the estimation of the variance components in meta-analysis with random effects. James–Stein type estimators for the random effect variance are proposed and their risk is simulated and compared to some existing estimators. The simulation study shows that our shrinkage estimators outperform the base estimator. [Joint work with S. Ejaz Ahmed]

[W-3] Likelihood ratio tests in reduced rank regression and blocks of structural equations

T. W. ANDERSON, *Stanford University, USA*

When the rank of a multivariate regression matrix is restricted, the matrix satisfies a set of linear restrictions. The rank of the restriction matrix is complementary to the rank of the regression matrix. Likelihood ratio tests of null hypotheses of a specified regression matrix and of a specified restriction matrix are studied. The powers of the tests are improved by limiting the alternative hypotheses to identified models. Applications to econometric problems exemplify the procedures.

[W-4] On two representations of projectors

Oskar Maria BAKSALARY,
Adam Mickiewicz University, Poland

Two representations of projectors on a finite dimensional vector space (i.e., idempotent matrices) as partitioned matrices are explored. The first of them is based on the known fact that a given square matrix is a projector if and only if it is expressible as the Moore–Penrose inverse of the product of two orthogonal projectors (i.e., Hermitian idempotent matrices). The idea behind the second representation refers to the fact that a given square matrix is an orthogonal projector if and only if it is unitarily similar to a direct sum of the identity matrix (of order determined by the rank of the projector) and zero matrix. The usefulness of both representations is demonstrated by establishing several new results as well as reestablishing the ones already available in the literature. [Joint work with Götz Trenkler]

[W-5] Probabilistic clustering

Adi BEN-ISRAEL, *Rutgers University, USA*

We report on a new (iterative, batch) method of probabilistic (soft) clustering that is proving fast and accurate. The method uses cluster memberships that depend on distances from cluster centers, and on the cluster sizes. The cluster sizes are known in some applications (e.g., capacitated multi-facility location problems), and unknowns to be estimated in other applications (e.g., estimation of parameters in mixtures of distributions.) The method is based on the Joint Distance Function (JDF), a weighted harmonic mean of the distances in question, that approximates the data in its lowest contours. The JDF evolves during the iterations, and the cluster centers are updated as the stationary points of the JDF. [Joint work with Cem Iyigun]

[W-6] All about statistical quirks

Philip V. BERTRAND,
Consultant Statistician, Solihull, England, UK

Nearly all data which have not been collected through a properly designed experiment will likely lead to incorrect conclusions. Either because the data have the property of being either a statistical quirk or an anti-quirk. To show this in high-dimensional situations requires matrix methods. Examples of such statistical quirks and anti-quirks are presented.

[W-7] Estimation of distinct elements of a covariance matrix: MINQUE and MINQE

Yogendra P. CHAUBEY, *Concordia University, Canada*

The method of MINQUE (Minimum Norm Quadratic Unbiased Estimation), originally proposed [C. R. Rao (1970)] for estimating heteroscedastic covariance matrix of a linear model and later generalized in a series of papers [C. R. Rao (1971, 1972)] for variance and covariance components. In some situations it may produce negative values for estimating non-negative variance components. For this reason, P.S.R.S. Rao and Chaubey (1978) proposed some modifications. Chaubey (1977) [see also P.S.R.S. Rao and Chaubey (1978)] showed how this method can be adapted for estimating the distinct elements of a variance-covariance matrix in a covariance-components model. This extension is straightforward when no a priori guess is incorporated in the estimation process. However, for the case when an a priori guess about distinct elements is used, in general, we may need to consider a different minimization problem, whose solution is provided in this paper. It is shown that for the particular case of the intra-class correlation model, the original solution holds with slight modification.

[W-8] Some comments on magic square matrices with three nonzero eigenvalues

Ka Lok CHU, *Dawson College, Canada*

All 880 four-by-four classic magic square matrices are studied in detail. The matrix results may be different if one rotates, transposes or flips the matrices. Eight different magic square matrices can be constructed from each classic magic square matrix, but they can be categorized into two main groups. Some numerical computations will be presented using MATLAB. In addition, we will present a closed-form formula for the odd powers of certain magic square matrices with three nonzero eigenvalues. [Joint work with George P. H. Styan]

[W-9] Testing for structure in covariance matrices

Carlos COELHO, *New University of Lisbon, Portugal*

The advantage of the use of conditionally independent tests in building near-exact distributions for test statistics is shown. We show how several rather elaborate structures for covariance matrices may be tested by decomposing the null hypotheses under study in a number of 'partial' hypotheses which are conditionally independent. Using this technique we are able not only to construct quite easily the overall likelihood ratio test statistics but also to obtain, from the decomposition of the characteristic functions of the statistics used to test the 'partial' hypotheses, several near-exact distributions for such overall test statistics.

These distributions are of great importance given the intractability of the exact distributions and the non-existence of asymptotic distributions for most cases. The tests studied are the tests of multi-sample block-scalar sphericity and multi-sample block-matrix sphericity and their particular cases. As partial tests we use the test for independence of several sets of variates, the test of equality of several covariance matrices and the sphericity test. [Joint work with Filipe J. Marques]

[W-10] Binary operation on prime basis factorials

Vera DE JESUS, *New University of Lisbon, Portugal*

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, and 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. The notion of a model strictly associated to a commutative Jordan algebra is introduced and applied to prime basis factorials. [Joint work with João Tiao Mexia & Sandra Oliveira]

[W-11] A POD estimator based on the jumps of some bordered matrices inertia

Pierre DRUILHET, *CREST-ENSAI, Bruz, France*

Biased regression is an alternative to ordinary least squares (OLS) regression when explanatory variables are highly correlated in order to improve the mean squared error (MSE). Among biased estimators, projected-onto-directions (POD) estimators are obtained by projecting the OLS estimator onto some directions. These estimators achieve the best OLS fit to the data over estimators constrained to belong to the subspace spanned by these particular directions. Principal component regression (PCR) estimators and partial least squares (PLS) estimators are examples of POD estimators. In a previous paper, we have shown that the PLS directions come from the signal-to-noise ratio (SNR). In this paper, we propose a sequence of new POD estimators whose directions are obtained from the jumps of some bordered matrices' inertia. These directions appear to be the eigenvectors of the Hessian matrix of the SNR. We show that these new estimators shrink uniformly on the subspace spanned by their directions with a shrinkage factor belonging to [0,1]. The number of directions and then the estimator can be chosen from these shrinkage factors. [Joint work with Alain Mom]

[W-12] Testing homogeneity in a mixture of von Mises distributions with a structural parameter

Yuejiao Cindy FU, *York University, Canada*

Testing homogeneity has always been an important and difficult research problem in finite mixture models, especially in the presence of a structural parameter. The von Mises distribution and its mixture are widely used for circular data arising naturally from many sciences. The modified likelihood ratio test has been successfully applied for the homogeneity test in a variety of mixture models. We propose the use of the modified likelihood ratio test and the iterative modified likelihood ratio test in general two-component von Mises mixture with a structural parameter. Two accuracy enhancing methods are developed. The limiting distributions of the resulting test statistics are derived. Simulations show that the test statistics have accurate type I errors and adequate power. A real data example is also provided. [Joint work with Jiahua Chen & Pengfei Li]

[W-13] Change detection in autoregressive time series

Edit GOMBAY, *University of Calgary, Canada*

Autoregressive time series models of order p have $p + 2$ parameters, the mean, the variance of the white noise and the p autoregressive parameters. Change in any of these over time is a sign of disturbance that is important to detect. The methods of this paper can test for change in any one of these $p + 2$ parameters, or in any collection of them. They are available in forms that make one-sided tests possible; furthermore, they can be used to test for temporary change. The test statistics are based on the efficient score vector. The large sample properties of the change-point estimator are also explored.

[W-14] Operator trigonometry of Hotelling correlation, Frobenius condition, Penrose twistor

Karl E. GUSTAFSON, *University of Colorado, USA*

I will first quickly review the essentials of operator trigonometry, which I created 40 years ago. Then I will quickly recall its first application to matrix statistics, which I initiated 8 years ago, and reported to IWMS14 in Auckland 2 years ago. Then I will quickly present 3 new applications of the operator trigonometry to 3 diverse mathematical domains: matrix statistics, numerical analysis, theoretical physics.

[W-15] Interlacing results on matrices associated with graphs

Frank J. HALL, *Georgia State University, USA*

Given a graph G, the adjacency matrix, the standard Laplacian, and the normalized Laplacian have been studied intensively. In this talk, interlacing inequalities are given for each of these three matrices under the two operations of removing an edge or a vertex from G. Examples are given to show that the inequalities are the best possible of their type. In addition, an interlacing result is proven for the adjacency matrix when two vertices of G are contracted. [Joint work with Kinnari Patel & Michael Stewart]

[W-16] Two types of retrial queue

Myron HLYNKA, *University of Windsor, Canada*

We present a quasi birth-and-death model for retrial queues. The model includes retrial customers which behave independently of each other and retrial customers which must line up to attempt to reenter the system.

[W-17] Shrinkage, pretest and L_1 regularization-type estimators in generalized linear models

Md. Shakhawat HOSSAIN, *University of Windsor, Canada*

We consider the estimation problem for the generalized linear models which may have a large collection of potential predictor variables and some of them may not have influence on the response of interest. In this situation, selecting the statistical model is always a vital component in estimation. The objective is to provide natural adaptive estimators that are free of subjective choices. In the context of two competing models (full and reduced), we demonstrate the relative performances of James and Stein (J-S) type shrinkage and pre-test estimators based on the asymptotic analysis of quadratic risk functions and it is found that the J-S type estimator outperforms the maximum likelihood estimator uniformly.

On the other hand, the pretest estimator dominates the maximum likelihood estimator only in a small part of the parameter space, which is consistent with the theory. We also consider an L_1 regularization type estimator for generalized linear models and give a Monte Carlo simulation comparison of shrinkage, pretest and the L_1 regularization type estimators. The comparison shows that the shrinkage method performs better than the L_1 type estimation method when the dimension of the restricted parameter space is large. [Joint work with S. Ejaz Ahmed]

[W-18] Coupling and mixing times in Markov chains

Jeffrey J. HUNTER,
Massey University, Albany Campus, New Zealand

The properties of the time to coupling and the time to mixing in Markov chains are explored. In particular, the expected time to coupling is compared with the expected time to mixing (as introduced by the author in "Mixing times with applications to perturbed Markov chains" [*Linear Algebra and its Applications*, 417, 108–123 (2006)]. The two-state cases and three-state cases are examined in detail.

[W-19] Linear sufficiency and completeness in the partitioned linear model

Jarkko M. ISOTALO, *University of Tampere, Finland*

We consider the estimation of the subvector β_1 of the unknown parameter vector $\beta = (\beta_1', \beta_2')'$ in the partitioned linear model. In particular, we consider linear sufficiency and linear completeness in the context of estimating β_1. We give new characterizations for linear sufficiency, and define and characterize linear completeness in a case of estimation of β_1. We also introduce a predictive approach for obtaining the best linear unbiased estimator of β_1, and subsequently, we give the linear analogues of the Rao–Blackwell and Lehmann–Scheffé Theorems in the context of estimating β_1. [Joint work with Simo Puntanen]

[W-20] Antieigenvalues and antieigenvectors in applied statistics

Ravindra KHATTREE, *Oakland University, USA*

Antieigenvalues and antieigenvectors have been used in statistical work for several years although they were not characterized by these nomenclatures. The present talk provides a brief survey of statistical work where these quantities arise naturally. The emphasis is on their applications in regression modeling and multivariate analyses.

[W-21] Some aspects of multivariate quality control

Syed KIRMANI, *University of Northern Iowa, USA*

Our objective is two-fold: to give a quick survey of the problems in multivariate quality control, and to introduce a new approach to mutivariate process capability. The proposed approach to modeling and assessment of process capability is based on the notion of Löwner ordering. A statistic is developed as a measure of potential process capability and bootstrapping is proposed to assess its significance.

[W-22] On extensions of a Styan inequality involving the Khatri–Rao product

Shuangzhe LIU, *University of Canberra, Australia*

Styan (1973) established an inequality involving the Hadamard product using statistical reasoning in the context of multivariate analysis. Inequalities are studied to involve the Khatri–Rao product in the positive semidefinite matrix and the symmetric nonsingular matrix cases. The inequalities with conditions for them to become an equality are given based on a Schur complement method. Related inequalities in the positive definite matrix case are also discussed. [This paper is dedicated to George P. H. Styan on the occasion of his 70th birthday.]

[W-23] Reduced rank regression and canonical correlation

Yonghui LIU, *Shanghai University of Finance and Economics, China*

Reduced rank regression was proposed by Anderson (1951) and studied further by many authors. The model has been widely applied in *Signal Processing, Biometrics*, etc. In 1981, Davies & Tso gave procedures of reduced rank regression through the singular value decomposition and Eckart–Young theorem; Stoica & Viberg (1996) studied the reduced rank regression problem in a maximum likelihood sense. Recently, Elden & Savas (2005) obtained a new numerical procedure in terms of the *LU* decomposition and the singular value decomposition. By applying the canonical correlation decomposition of matrix pairs, in this paper, we examine the maximum likelihood estimation and the least squares estimation in a reduced rank regression model and propose an alternative numerical procedure. [Joint work with Yongge Tian]

[W-24] Eigenvalues in the universe of matrix elements $1, \ldots, n^2$.

Peter D. LOLY, *University of Manitoba, Canada*

Semi-magic squares have identical row and column sums, an n-agonal eigenvector and line sum eigenvalue (also termed doubly stochastic). The addition of main diagonals with the same sum defines magic squares. Finite sets of normal magic squares of order n are found for sequential integer matrix elements, usually $1, \ldots, n^2$. Moreover the antipodal pair sum constraint gives regular or associative magic squares, while parallel diagonals with the same line sum under tiling or periodic boundary conditions give pandiagonal squares. Mattingly (2000) showed that even order regular magic squares have odd algebraic multiplicity (m) of eigenvalues and are thus singular. For fourth order regular squares we find 8 cases with $m = 3$. This group of 48 squares is completed by 40 squares with $m = 1$. A surprise finding for pandiagonal squares is that they alternate between $m = 1$ and $m = 3$ on matrix rotation. Mattingly also proved that odd order regular magic squares have even multiplicity, $m = 0, 2, 4, \ldots$

Singular value decomposition of the 4th order set of 880 magic squares falls into 5 subsets. Analyzing results from exact backtracking calculations we find 652 singular 5th order regular squares with $m = 2$, and four with $m = 4$. There are also 20,604 singular seventh order ultramagic (regular and pandiagonal) squares with $m = 1$, demonstrating singularity with the co-existence of regularity and pandiagonality. Our study makes use of parameterizations of magic squares for low orders, including factorization of the linesum eigenvalue from the characteristic polynomial. See also `www.wolframscience.com/conference/2006/presentations/materials/loly.pdf`
[Joint work with Ian D. Cameron, Daniel Schindel & Walter Trump.]

[W-25] Design optimality conditions in multivariate linear models

Augustyn MARKIEWICZ,
Agricultural University of Poznań, Poland

Optimality of designs under multivariate normal models is studied. It is assumed that the error dispersion matrix is known or partially unknown. In the case of known dispersion matrix optimality is considered with respect to the information matrix while in the case of partially unknown dispersion matrix optimality is considered with respect to the precision matrix in maximum likelihood estimation. In both cases, depending on model assumption, design optimality conditions are derived.

[W-26] Nonparametric methods for multivariate location problems with independent and cluster-correlated observations

Jaakko NEVALAINEN, *University of Tampere, Finland*

We have developed efficient nonparametric multivariate methods for independent and identically distributed (i.i.d.) observations and for cluster correlated observations. The talk deals with spatial sign and spatial rank methods for the one-sample multivariate location problem with i.i.d. and cluster correlated observations. Weighted generalizations are also considered in this framework. The statistical properties of the procedures are carefully investigated. It is shown that the spatial sign and rank methods have competitive efficiency properties relative to the classical techniques, particularly if the data is heavy-tailed or clustered. The efficiencies and other statistical properties of the methods can be improved even further by weighting them in an optimal way. Furthermore, the methods are valid even without moment assumptions, and are efficient when the underlying distribution deviates from normality or in the presence of outliers. [Joint work with Denis Larocque, Hannu Oja & Riina Haataja]

[W-27] Multivariate data analysis based on two scatter matrices

Hannu OJA, *University of Tampere, Finland*

The regular mean vector and covariance matrix are popular tools for describing the location and scatter of a multivariate data cloud. Weighted mean vectors and covariance matrices, M and S estimators, for example, yield typically less efficient but more robust estimates of the symmetry center and covariance matrix in the multivariate normal and elliptic case.

In this talk we show how two different scatter matrices can be used together to analyze multivariate data: They give an invariant coordinate system (ICS) and then the transformation-retransformation (TR) technique can be used to build invariant/equivariant multivariate inference methods. Two scatter matrices with the so-called independence property can be used to find independent components in the independent component analysis (ICA). Several examples are given to illustrate the approach. [The talk is based on joint work and numerous discussions with Frank Critchley, Jan Eriksson, Anna-Liisa Kankainen, Visa Koivunen, Klaus Nordhausen, Esa Ollila, Davy Paindaveine, Seija Sirkiä, Sara Taskinen & David Tyler (among others).]

[W-28] ICA of non-circular sources based on generalized uncorrelating transformation

Esa OLLILA, *Helsinki Institute of Technology, Finland*

In this paper, we show that a novel data transformation, called generalized uncorrelating transformation (GUT), is a separating matrix estimator for complex-valued independent component analysis (ICA) when at most one source random variable possess circularly symmetric distribution. GUT can be viewed as an extension of the whitening transformation for complex random vectors based upon generalized estimators of covariance and pseudo-covariance matrix, called the scatter matrix and spatial pseudo-scatter matrix, respectively. Our approach yields a large family of estimators of the separating matrix, which, depending on the choices of the scatter and spatial pseudo-scatter matrix, can have largely different statistical properties. Our approach is computationally among the most attractive ones as it avoids optimization tasks and is based solely on straigthforward matrix computations. Simulations and examples are used to confirm reliable performance of our method. [Joint work with Hyon-Jung Kim and Visa Koivunen]

[W-29] On the inversion of certain moment matrices

Serge PROVOST, *The University of Western Ontario, Canada*

An explicit representation of the elements of the inverse of a certain patterned matrix involving the moments of some weight function is derived. More specifically, it is explained that, given any nonnegative weight function whose moments exist, one can generate a sequence of monic orthogonal polynomials by making use of a Hankel determinant, and that the inverse of the corresponding moment matrix can then be expressed in terms of the coefficients and orthogonality factors associated with those polynomials. Such matrix inverses are in fact eminently useful when it comes to approximating mathematically intractable probability density functions whose exact moments can nevertheless be evaluated. Several examples illustrate the results. [Joint work with Hyung-Tae Ha]

[W-30] Effect of adding regressors on the equality of the OLSE and BLUE

Simo PUNTANEN, *University of Tampere, Finland*

We consider the estimation of regression coefficients in a partitioned linear model, briefly denoted as $M_{12} = \{y, X_1\beta_1 + X_2\beta_2, V\}$. We call M_{12} a full model, and correspondingly, $M_1 = \{y, X_1\beta_1, V\}$ a small model. We introduce a necessary and sufficient condition for the equality between the ordinary least squares estimator (OLSE) of β_1 and the best linear unbiased estimator (BLUE) of β_1 under the full model M_{12} assuming that they are equal under the small model M_1. [Joint work with Jarkko Isotalo & George P. H. Styan.]

[W-31] A nonparametric test for equality of several survival means

M. Hossein RAHBAR, *Michigan State University, USA*

Statistical procedures for assessment of treatments often involve complexities due to incompleteness of the data. Here we propose a new nonparametric method for testing the homogeneity of survival means based on randomly right-censored data. We develop a new test statistic based on Kaplan–Meier means. We derive asymptotic properties of this test statistic.

Through simulations we compute and compare the power of this new procedure with that of the log-rank, Wilcoxon, and the Cox models. Our results indicate that the performance of some of these estimation procedures depends on the level of censoring and appropriateness of the underlying assumptions for each procedure. When the assumptions of log-rank test and the Cox model are met, these procedures are more powerful than the Wilcoxon and our proposed test. However, when the objective is testing homogeneity of survival means rather than survival curves, our test statistic and the Wilcoxon test seem to have some advantages. [Joint work with Sangchoon Jeon & Joseph C. Gardiner]

[W-32] A result on idempotent matrices

K. P. S. Bhaskara RAO, *Indiana State University, USA*

We give a new proof of the result that every real square singular matrix is a product of idempotent matrices. We shall also examine the corresponding result for matrices over principal ideal domains. [Joint work with Surekha Rao]

[W-33] A very simple Markov transition matrix

Toulope SAJOBI, *University of Windsor, Canada*

A very simple Markov transition matrix is presented with a steady state vector involving every second Fibonacci number. We look at a variety of extensions and implications of this initial model.

[W-34] Matric musings in statistical finance

Stanley L. SCLOVE, *University of Illinois at Chicago, USA*

According to the classical Geometric Brownian Motion model for stock prices, the differences of the log price (the continuous rates of return) are independent and identically distributed according to a Normal distribution. The model is a good starting point but has inadequacies, especially due to the changing volatilities of stock rates of return. In particular, the covariance matrix of stocks' rates of return is not stationary. Remedies for this, including GARCH and hidden Markov models, are discussed. Estimation of the covariance matrices in these and other models is explored. Portfolio optimization in the context of these models is discussed.

[W-35] Applications of antieigenvalue techniques in statistics

Morteza SEDDIGHIN, *Indiana University East, USA*

In a 2002 paper, Karl Gustafson outlined the similarities between the Antieigenvalue Theory he founded and several finite dimensional matrix optimization theorems for positive matrices arising in statistics. In this paper, we will show how the techniques that the author and Karl Gustafson have used for computation of Antieigenvalues can also be applied to prove and generalize those matrix optimization theorems arising in statistics. We will primarily focus on two techniques which we have used in Antieigenvalue computations in recent years. These two techniques are a two-nonzero-component property for a certain class of functionals, and converting matrix optimization problems into a convex programming problem (minimizing a convex function on the numerical range of an operator). Indeed, these two techniques allow us to generalize some of the matrix optimization problems arising in statistics to non-positive infinite dimensional operators on a Hilbert space.

[W-36] Akaike Information Criterion for selecting components of mean vector in high-dimensional data with fewer observations

Muni S. SRIVASTAVA, *University of Toronto, Canada*

The Akaike Information Criterion (AIC) has been successfully used in model selection for large sample size N and small number of parameters p. The case when p is larger than N has not been considered in the literature. We consider this case in this article in the context of finding the number of components of the mean vector that may be different from zero in one-sample multivariate analysis. Using simulation, it has been shown that the proposed AIC procedure performs well. [Joint work with T. Kubokawa]

[W-37] A philatelic excursion with Jeff Hunter in probability and matrix theory

George P. H. STYAN, *McGill University, Canada*

We present a philatelic excursion with Jeff Hunter, visiting some of his research topics. Specifically, we will present some facts about certain people whose work seems to have influenced Jeff in his scientific career; we illustrate our presentation with postage stamps that have been issued in honour of these people. Our main guide is the two-volume book by Jeffrey J. Hunter entitled *Mathematical Techniques of Applied Probability* (Academic Press, 1983).

One of the first entries in this two-volume book is "Bernoulli trial" (vol. 1, p. 10) named after Jacob Bernoulli I (1654–1705), who is famous for his *Ars Conjectandi* and his work on the law of large numbers. [Joint work with Götz Trenkler]

[W-38] The philatelic magic squares tourist

George P. H. STYAN, *McGill University, Canada*

We will visit China, Germany, India, Italy, Spain, and the USA, finding magic squares, starting with the Luoshu associated with Yu the Great.

We will identify associated postage stamps from Aitutaki/Cook Islands, Australia, British Indian Ocean Territory, China, Germany, Ghana, India, Maldives, Mongolia, Spain, and the USA.

[W-39] On ridge operators

Yoshio TAKANE, *McGill University, Canada*

Let X be an $n \times p$ matrix, and define $\mathcal{R}_X(\lambda) = X(X'X + \lambda P_{X'})^- X'$, which we call the ridge operator, where λ is a nonnegative constant (called the ridge parameter), and $P_X = X'(XX')^- X$ is the orthogonal projector onto the row space of X. Various properties of $\mathcal{R}_X(\lambda)$ are discussed, including additive decompositions of this matrix similar to those of $P = \mathcal{R}_X(0) = X(X'X)^- X'$, orthogonal projector onto the column space of X. These properties and decompositions are useful, especially in the ridge estimation of reduced rank regression and multiple-set canonical correlation analyses. The ridge operator is further extended to a generalized ridge operator defined by $\mathcal{R}_X^{(L,V)}(\lambda) = X(X'VX + \lambda L)^- X'$, where V is nonnegative definite and such that $\mathrm{rank}(VX) = \mathrm{rank}(X)$, and L is nonnegative definite and such that $\mathrm{Sp}(X) = \mathrm{Sp}(L)$. The generalized ridge operator has similar properties as $\mathcal{R}_X(\lambda)$. [Joint work with Haruo Yanai]

[W-40] Sum decompositions of weighted least-squares estimators under a general linear model

Yongge TIAN, *Shanghai University of Finance and Economics, China*

For the partitioned linear model $\mathcal{M} = \{y,\ X_1\beta_1 + X_2\beta_2,\ \sigma^2\Sigma\}$, this paper investigates decompositions of the weighted least-squares estimator (WLSE) of $X_1\beta_1 + X_2\beta_2$ under $\mathcal{M}$ as sums of the WLSEs under the two small models $\{y,\ X_1\beta_1,\ \sigma^2\Sigma\}$ and $\{y,\ X_2\beta_2,\ \sigma^2\Sigma\}$. Some consequences on the sum decomposition of the unique best unbiased linear estimator (BLUE) of $X_1\beta_1 + X_2\beta_2$ under $\mathcal{M}$ are also given. [Joint work with Yoshio Takane]

[W-41] On the Moore–Penrose inverse of magic squares

Götz TRENKLER, *Universität Dortmund*

Starting from the famous 4×4 magic square appearing in Dürer's engraving *Melencholia I*, we consider the problem under which conditions the Moore–Penrose inverse of a magic square is magic again. By a magic square we mean a square matrix of real numbers where columns, rows and both diagonals add to the same constant. We also pay attention to semi-magic squares where the diagonal property does not necessarily hold. The main focus is on 3×3 and 4×4 squares, the latter case mainly exhibiting properties of so-called pandiagonal magic squares.

[W-42] E-optimal block designs for three treatments with conditional autonormal error process

Nizam UDDIN, *University of Central Florida, USA*

This paper deals with E-optimal incomplete block designs in blocks of size three when observations within each block are correlated according to a conditional autonormal process. The optimality problem is addressed within various subclasses of connected designs using generalized least squares estimation of treatment contrasts in block effects model. The proposed E-optimal designs are obtained by adding disjoint blocks to a class of neighbor balanced block designs.

[W-43] Some comments on magic squares and Survo puzzles

Kimmo VEHKALAHTI, *University of Helsinki, Finland*

Following the work of George P. H. Styan and others, we study the 640 classic 4×4 magic squares of Dudeney Types I–VI having rank equal to three. Focusing on the so-called sweets-and-sours, i.e., the regular and flipped forms of the matrices, we demonstrate the computations and visualizations of the real and complex eigenvalues, principal minors, and other results using Seppo Mustonen's Survo and its matrix interpreter, macro language, and graphics.

Finally, we note that the magic squares can be seen as special cases of Mustonen's Survo puzzles, which offer new challenges for Sudoku or Kakuro players, but also give rise to interesting research questions, e.g., in combinatorics and linear algebra.

[W-44] Norms of Toeplitz matrices and their asymptotic behaviour

Jani A. VIRTANEN, *University of Helsinki, Finland*

Many questions regarding finite Toeplitz matrices can be easily answered by mathematical software if the dimension is reasonably small. However there are situations in which one needs to know what happens when the dimension gets very large, e.g., many applications in statistical physics require asymptotic formulas. We deal with questions arising in asymptotic linear algebra of Toeplitz matrices, and in particular concentrate on the behavior of their norms as the dimension goes to infinity.

[W-45] On partitioned projectors

Hans Joachim WERNER, *Universität Bonn, Germany*

Projectors play an important role in many fields such as linear algebra, probability theory and statistics. This talk focuses on some results on the ranks and Schur complements of certain kinds of symmetrically block-partitioned projectors.

IWMS'08

TOMAR | PORTUGAL

17TH INTERNATIONAL WORKSHOP ON MATRICES AND STATISTICS

IN HONOUR OF PROF. T.W. ANDERSON´S 90TH BIRTHDAY

23 - 26 JULY 2008

TOMAR - PORTUGAL

INVITED SPEAKERS

S. Ejaz Ahmed (Canada)
T. W. Anderson (USA)
Carlos Braumann (Portugal)
Tadeusz Caliński (Poland)
Charles R. Johnson (USA)
Thomas Mathew (USA)
Stanisław Mejza (Poland)
Augustyn Markiewicz (Poland)
Ingram Olkin (USA)
Dinis Pestana (Portugal)
Friedrich Pukelsheim (Germany)
Alastair J. Scott (New Zealand)
George P. H. Styan (Canada)
Götz Trenkler (Germany)
Dietrich von Rosen (Sweden)
Roman Zmyślony (Poland)

INTERNATIONAL ORGANIZING COMMITTEE

George P. H. Styan - Honorary Chair (Canada)
Simo Puntanen - Chair (Finland)
Augustyn Markiewicz - Vice-Chair (Poland)
Jeffrey J. Hunter (New Zealand)
S. Ejaz Ahmed (Canada)
Götz Trenkler (Germany)
Dietrich von Rosen (Sweden)
Hans Joachim Werner (Germany)

LOCAL ORGANIZING COMMITTEE

João T. Mexia - Portugal (Chair)
Carlos A. Coelho - Portugal (Co-Chair)
Francisco Carvalho - Portugal
Katarzyna Filipiak - Poland
Ricardo Covas - Portugal
Miguel Fonseca - Portugal

www.ipt.pt/iwms08

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

CMA fct.unl
centro de matemática e aplicações

Universidade Nova de Lisboa

IPT
INSTITUTO POLITÉCNICO DE TOMAR