International Workshop on Linear Models,
Experimental Designs,
and Related Matrix Theory

Monday 6 August –Wednesday 8 August 1990
Tampere, Finland

Proceedings to be published in special issues of the
Journal of Statistical Planning and Inference
and *Linear Algebra and Its Applications*.

Submission deadline: 31 October 1990.

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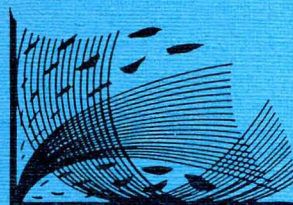(931) 156 288 (domestic)
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27 July 1990

International Workshop
on Linear Models,
Experimental Designs,
and Related Matrix Theory

6 – 8 August 1990

Statistics Unit
Department of Mathematical Sciences
University of Tampere
Tampere, Finland

International Workshop on Linear Models,
Experimental Designs,
and Related Matrix Theory

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Workshop Sponsors

Ministry of Education of Finland
University of Tampere
Foundation of the University of Tampere
Finnish Cultural Foundation
City of Tampere
Cultural Foundation of Pirkanmaa

Workshop Organization

A local committee within the Statistics Unit of the
Dept. of Mathematical Sciences, University of Tampere

Workshop Addresses

The Workshop Secretary, C123
Department of Mathematical Sciences
University of Tampere, P.O. Box 607
SF-33101 Tampere, FINLAND

Electronic mail: epl@uta.fi
Tel: (358-31) 156 288; (931) 156 288 (domestic)
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PROGRAMME

The idea of the Workshop is to gather together groups of scientists working on some joint problems. The Workshop will take place over three days and will comprise group meetings, invited talks, and a Keynote Address.

Opening Session

The Opening Session of the Workshop, chaired by Dr. Erkki P. LISKI (University of Tampere) and Professor George P. H. STYAN (McGill University), will be held in Room A I of the University of Tampere on Monday 6 August 1990, starting at 10:00 a.m.

Tarmo PUKKILA, Rector of the University of Tampere:
"The Finnish Research Jubilee"

C. Radhakrishna RAO, Eberly Professor of Statistics at The Pennsylvania State University, University Park, and National Professor of India:
"Uncertainty, statistics and creation of new knowledge"

Plenary Session

On Wednesday 8 August 1990 (11:30–12:15) Professor **C. Radhakrishna RAO**, Eberly Professor of Statistics at The Pennsylvania State University, University Park, and National Professor of India, will present the Keynote Address entitled:

"Some recent contributions to estimation of parameters in a linear model"

Invited Speakers

Jerzy K. Baksalary, Tadeusz Kotarbiński Pedagogical University, Zielona Góra, Poland, and University of Tampere, Finland,
"Admissibility and sufficiency of linear estimators in the Gauss-Markov model"

R. Dennis Cook, University of Minnesota, St. Paul, Minnesota, USA,
"Dynamic graphics for linear models"

Yadolah Dodge, University of Neuchâtel, Switzerland,
"Least absolute deviation method for detection of leverage points in linear regression"

Shanti S. Gupta, Purdue University, West Lafayette, Indiana, USA,
"On combining selection and estimation in the search for the largest binomial parameter"

Sujit Kumar Mitra, Indian Statistical Institute, New Delhi, India,
"Outer inverses: a richer source for developing matrix partial orders" (Joint work with Robert E. Hartwig)

Heinz Neudecker, University of Amsterdam, The Netherlands,
"Generalized Kronecker products with multivariate statistical applications"

Ingram Olkin, Stanford University, California, USA,
"Interface between statistics and linear algebra"

Friedrich Pukelsheim, University of Augsburg, FRG,
"Rotatable experimental designs"

Jagdish N. Srivastava, Colorado State University, Fort Collins, Colorado, USA,
"Identification of the correct linear model"

George P. H. Styan, McGill University, Montréal, Québec, Canada,
"More about canonical correlations in the three-way layout" (Joint work with Julie Bérubé)

Group Meetings

Group organizers have full freedom to choose their personal style in organizing their groups. For example, the group activity may consist of discussions only, without minute-by-minute schedule, if the group considers it fruitful. Of course, certain combinations of "classic" presentation of papers and discussions may still serve well.

The schedule for the group meetings appears in the middle pages of this booklet. The first-mentioned groups meet in Room A I, the second in C IX (except on Monday in the Main Auditorium), and the third in A III.

Two new groups, not previously announced, will be led by: Professor Ingram Olkin on Gustav Elfving (1908–1984) and Professor Jagdish N. Srivastava on "Editorial policy in statistical journals and other publications".

Further details, albeit preliminary, about the groups appear on pp. 6–11 and on p. 14. Each group can also organize additional sessions if needed. For the latest schedule please see the Workshop's notice board.

Groups are also encouraged to hold informal and spontaneous meetings: such face-to-face discussions by the participants are the core of the Workshop.

Workshop Proceedings

Both the *Journal of Statistical Planning and Inference* (JSPI) and *Linear Algebra and Its Applications* (LAA) will produce special issues of papers presented at the Workshop. The Special Editors of both these issues are Professors Jerzy K. Baksalary and George P. H. Styan. The deadline for submission is 31 October 1990.

Manuscripts (4 copies) submitted for the JSPI special issue should be mailed to Prof. Jerzy K. Baksalary (Department of Mathematics, Tadeusz Kotarbiński Pedagogical University, Plac Stowiański 9, PL-65-069 Zielona Góra, Poland), and those submitted for LAA to Prof. George P. H. Styan (Department of Mathematics and Statistics, McGill University, 805 ouest, rue Sherbrooke Street West, Montréal, Québec, Canada H3A 2K6).

Group Organizers and Topics

BAKSALARY, Jerzy K.
Zielona Góra, Poland
Tampere, Finland
Admissibility and sufficiency in linear models

CALIŃSKI, Tadeusz
Academy of Agriculture
Poznań, Poland
Balance, efficiency, and orthogonality concepts in experimental designs

COOK, R. Dennis
U of Minnesota
St. Paul, MN, USA
Dynamic graphical methods in linear models

FAREBROTHER, R. W.
U of Manchester, UK
Statistical computing for linear models

FUJIKOSHI, Yasunori
Hiroshima U, Japan
Multivariate linear models

HETTMANSPERGER, Thomas P.
Penn State U
University Park, PA, USA
Nonparametric tests

KAGEYAMA, Sanpei
Hiroshima U, Japan
Combinatorics in experimental designs

KLEFFE, Jürgen
A of Sciences, Berlin, GDR
Variance components

MITRA, Sujit Kumar
Indian Statistical Institute
New Delhi, India
Matrix theory for linear models

MUSTONEN, Seppo
U of Helsinki, Finland
SURVO 84C

NEUDECKER, Heinz
U of Amsterdam
The Netherlands
Generalized Kronecker products and related concepts

PUKELSHEIM, Friedrich
U of Augsburg, FRG
Rotatable factorial designs

RISSANEN, Jorma
IBM Almaden Research Ctr.
San Jose, CA, USA
Stochastic complexity in linear models

SHAH, K. R.
U of Waterloo, Waterloo
Ontario, Canada
Optimal block designs and related topics

SRIVASTAVA, Jagdish N.
Colorado State U
Fort Collins, CO, USA
Identification of the correct linear model

STYAN, George P. H.
McGill U, Montréal
Québec, Canada
Matrix tricks for statistics

TRENKLER, Götz
U of Dortmund, FRG
Minimax estimation in linear models

WANG, Song-Gui
U of Science and Technology
Hefei, Anhui, PRC
Regression diagnostics

YANAI, Haruo
National Centre for University
Entrance Examination, Tokyo, Japan
Canonical correlations

There will also be group meetings on Gustav Elfving (1908-1984), led by Ingram OLKIN, and on "Editorial policy in statistical journals and other publications", led by Jagdish N. SRIVASTAVA.

Further Details about the Groups

The following preliminary information about the group activities has been received from the group organizers. Changes are very probable—please see the notice board at the Workshop desk.

BAKSALARY, Jerzy K.   *Admissibility*
Tuesday: 9:30–11:30   *and sufficiency*
Room C IX   *in linear models*

Part 1: Gauss-Markov model

BAKSALARY, J. K.: "On the concepts of linear sufficiency, quadratic sufficiency, and invariant linear sufficiency in the Gauss-Markov model"
[based on the paper "A note on the concepts of sufficiency in the general Gauss-Markov model" by J. K. BAKSALARY & H. DRYGAS]

MARKIEWICZ, A.: "Admissible linear estimation with respect to an arbitrary quadratic risk function"
[based on the paper "Admissible linear estimation in the general Gauss-Markov model with respect to an arbitrary quadratic risk function" by J. K. BAKSALARY, A. MARKIEWICZ & C. R. RAO]

Part 2: General linear model

KLONECKI, W.: "On the structure of unbiased admissible estimators"
[based on the paper with the same title by W. KLONECKI & S. ZONTEK]

ZONTEK, S.: "Nonnegative admissible estimation of variance components in a one-way balanced random model"
[based on the paper "Strictly positive estimators for variance components" by A. WIGGINS & S. ZONTEK]

CALIŃSKI, Tadeusz   *Balance, efficiency, and*
Monday: 16:15–17:45   *orthogonality concepts in*
Main Auditorium   *experimental designs*

CALIŃSKI, T.: "Balance, efficiency, and orthogonality concepts in block designs"
– First discussant K. NORDSTRÖM

BAKSALARY, J. K.: "Balance, efficiency, and orthogonality concepts in two-way elimination of heterogeneity designs"
– First discussant J. A. JOHN

TJUR, T.: "An algorithm for optimization of block designs"
– First discussant D. VON ROSEN

COOK, R. Dennis   *Dynamic graphical*
Tuesday: 9:30–11:30   *methods in linear*
Room A I (Further meetings in Room A IIb) *models*

The graphics methods group will focus on the use of modern graphical methods in analyses based on linear models. Graphical methods will be demonstrated by using XLISP-STAT, a graphics programming environment developed recently by Luke TIERNEY (University of Minnesota). This environment allows easy access to virtually all of the modern graphical methods — high-dimensional rotation, animation, brushing, linking, identification, touring, slicing and so on. Workstations will be available in Room A IIb and all participants should have an opportunity to try various graphical methods, including those presented on Monday during the talk by R. Dennis COOK.

The format for the meeting will be informal. Statistical graphics is a relatively new area and discussion on how to make effective use of this new methodology in linear models will be encouraged. Near the end of the session Seppo KAITALA (University of Helsinki) will give a short presentation on "Graphical methods to analyze direct and carry-over effects in factorial crossover experiments".

FAREBROTHER, R. W.   *Statistical computing*
                                      for linear models

1. Monday: 16:15-17:45.   Room A III
   Computing the distribution of a quadratic form in
   normal variables. Lead paper by R. W. FAREBROTHER.

2. Monday: 17:45-19:15.   Room A III
   Estimation of ARMA models in the time and
   frequency domains. Lead paper by D. S. G. POLLOCK.

3. Tuesday: 12:45-14:15.   Room C IX
   Autoregressive models with an additive white noise
   contamination. Lead paper by D. S. G. POLLOCK.

4. Tuesday: 14:15-15:45.   Room A III
   L_1-estimation in simple linear models. Lead paper by
   R. W. FAREBROTHER.

5. Wednesday: 8:00-9:30.   Room C IX
   Diagnostics for collinearity-influential points in linear
   regression. Lead paper by H. NYQUIST.

FUJIKOSHI, Yasunori   *Multivariate linear*
Tuesday: 16:15–17:45   *models*
Room A I

PYNNÖNEN, S.: "Testing for redundancy of variables in
   quadratic discriminant analysis"
VON ROSEN, D.: "On maximum likelihood estimators in
   an extended growth curve model"
FUJIKOSHI, Y.: "Asymptotic expansions for the standard-
   ized and Studentized estimates in the growth curve
   model"
Discussions: Some recent results on multivariate linear
   models and related unsolved problems.

KAGEYAMA, Sanpei   *Combinatorics in*
Monday: 17:45–19:15   *experimental designs*
Room C IX

KAGEYAMA, S.: "Combinatorial aspects of block designs"
SHAH, K. R.: "Some combinatorial problems associated
   with row-column designs"
GHOSH, S.: "Some recent developments in statistical
   design of experiments"
Discussions about some unsolved problems will be
   presented here. Any topics related to combinatorics
   are welcome from all participants.

KLEFFE, Jürgen   *Variance components*
Tuesday: 17:45–19:15
Room C IX

MATHEW, T.: "Nonnegative estimation of variance com-
   ponents"
SEIFERT, B.: "Testing hypotheses in mixed linear models"
KLEFFE, J. (with J. N. K. RAO): "Inadmissibility but
   near optimality of the Beamer-Stokes estimator for
   correlated response variance"
Discussions on testing hypotheses for unbalanced mod-
   els, computation of admissible estimators, new
   concepts for nonnegative estimation, nonlinear
   variance-covariance structures.

MITRA, Sujit Kumar   *Matrix theory for*
Tuesday: 12:45–14:15   *linear models*
Room A I

HAUKE, J. and MARKIEWICZ, A.: "On some extensions of
   the Löwner partial ordering"
POLLOCK, D. S. G.: "An index notation for multivariate
   statistical analysis"
PUNTANEN, S. (with S. K. MITRA): "Shorted operator
   statistically interpreted"
VON ROSEN, D.: "Homogeneous matrix equations and
   multivariate linear models"
WANSBEEK, T. J.: "Sum-constrained covariance matrices"

MUSTONEN, Seppo   *SURVO 84C*
Monday: 16:15–17:45
Room A I

MUSTONEN, S.: "SURVO 84C as a working environment
    for statisticians"
PUNTANEN, S.: "SURVO 84C in the teaching of statistics"
Demonstrations throughout the Workshop.

SHAH, K. R.   *Optimal*
Wednesday: 8:00–9:30   *block designs*
Room A I   *and related topics*

JOHN, J. A.: "Construction of cyclic designs using inte-
    ger programming"
GNOT, S.: "Best estimation of variance components with
    arbitrary kurtosis in mixed models corresponding to
    block designs"
WONG, W. K.: "Heteroscedastic optimal designs"
TJUR, T.: "Connection between block designs and electri-
    cal networks"
BAKSALARY, J. K. (with F. PUKELSHEIM): "Adjusted orthog-
    onality properties in multi-way block designs"

SRIVASTAVA, Jagdish N.   *Identification*
Tuesday: 14:15–15:45   *of the correct*
Room A I   *linear model*
GHOSH, S. "Understanding interactions using search designs"

STYAN, George P. H.   *Matrix tricks*
Tuesday: 17:45–19:15   *for statistics*
Room A I

OLKIN, I.: "Some comments on Samuelson's inequality"
BÉRUBÉ, J.: "Decomposable three-way layouts"
STYAN, G. P. H. (with J. K. BAKSALARY): "Around a
    formula for the rank of a matrix product"
Participation expected by:
H. V. HENDERSON, J. K. MERIKOSKI, S. PUNTANEN, *et al.*

TRENKLER, Götz   *Minimax estimation*
                                               in linear models

1. Tuesday: 8:00–9:30.   Room A I
HEILIGERS, B. (with N. GAFFKE): "Linear Bayes- and mini-
    max estimation in linear models with restricted pa-
    rameter space"
MATHAR, R. (with N. GAFFKE): "Linear minimax estima-
    tion under restricted parameter space, Bayes *L*-op-
    timal design, and computational algorithms"
PILZ, J.: "Admissible improvements over nonadmissible
    linear estimators through minimax estimation"
SCHIPP, B.: "Approximate minimax estimators in the
    simultaneous equations model under partial and
    complete restrictions"
STAHLECKER, P. & TRENKLER, G.: "Minimax estimation
    in linear regression with singular covariance struc-
    ture and convex polyhedral constraints"

2. Tuesday: 16:15–17:45.   Room A III
LAUTERBACH, J. & STAHLECKER, P.: "A numerical method
    for an approximate minimax estimator in linear
    regression"
LISKI, E. P.: "On a relationship between minimax-linear
    and admissible linear estimators in regression"
PORDZIK. P. (with J. K. BAKSALARY): "Preliminary test
    estimation of a vector of parametric functions in
    the general Gauss-Markov model"
SCHIPP, B., STAHLECKER, P. & TRENKLER, G.: "Assessing
    inclusion probabilities for approximative minimax
    estimators with respect to interval restrictions"
SCHMIDT, K. & STAHLECKER, P.: "On the performance of
    some inequality-restricted estimators in linear re-
    gression"
TOUTENBURG, H.: "MSE-comparisons of minimax and
    least squares estimators in case of misspecified
    prior regions"

International Workshop on Linear Models, Experimental Designs & Related Matrix Theory
6–8 August 1990, University of Tampere, Tampere, Finland

Monday, 6 August	Tuesday, 7 August	Wednesday, 8 August
10:00–10:45 *Opening Session:* Tarmo PUKKILA Chair: E.P. Liski C. Radhakrishna RAO Chair: G.P.H. Styan	**8:00–9:30** *Group Meetings:* Trenkler-1 Wang Hettmansperger	**8:00–9:30** *Group Meetings:* Shah Farebrother-5
Invited Talk: **10:45–11:30** Ingram OLKIN Chair: J.K. Baksalary	**9:30–11:30** Cook Baksalary	**9:30–11:00** Editorial Policy in Statistical Journals
11:30–12:45 ⚊ *Lunch*	**11:30–12:45** 🍴 *Lunch*	**11:00-11:30** ☕ *Coffee*
		11:30–12:15 *Keynote Address:* C. Radhakrishna RAO Chair: T. Caliński
Invited Talks: **12:45–13:30** Sujit Kumar MITRA **13:30–14:15** R. Dennis COOK Chair: F. Pukelsheim	*Group Meetings:* **12:45–14:15** Mitra Farebrother-3 **14:15–15:45** Srivastava Yanai Farebrother-4	**12:15-13:30** 🍴 *Lunch*
14:15–14:45 ☕ *Coffee*	**15:45–16:15** ☕ *Coffee*	*Invited Talks:* **13:30–14:00** Jagdish N. SRIVASTAVA **14:00–14:30** Shanti S. GUPTA **14:30–15:00** Yadolah DODGE Chair: T.P. Hettmansperger
Group Meetings: **14:45-15:45** Gustav Elfving: 1908–1984 **16:15–17:45** Mustonen Caliński Farebrother-1	*Group Meetings:* **16:15–17:45** Fujikoshi Pukelsheim Trenkler-2 **17:45–19:15** Styan Kleffe Neudecker	**15:00–15:30** ☕ *Coffee*
		15:30–16:00 Heinz NEUDECKER **16:00–16:30** Friedrich PUKELSHEIM Chair: N.R. Draper
17:45–19:15 Rissanen Kageyama Farebrother-2		**16:30–17:00** ☕ *Coffee*
20:00–... 🍷🍴 *Reception*	**20:30–...** 🌲🌲🌲🌲🌲 *Sauna Party*	**17:00–17:30** George P. H. STYAN **17:30–18:00** Jerzy K. BAKSALARY Chair: T. Pukkila

The first-mentioned groups meet in Room A I, the second in C IX (except on Monday in the Main Auditorium), and the third in A III.

WANG, Song-Gui — *Regression diagnostics*
Tuesday: 8:00–9:30
Room C IX

LISKI, E. P. (with S.-G. WANG): "Effects of observations on the eigensystem of a sample covariance matrix"
NYQUIST, H.: "A note on the score test and local sensitivity transformation diagnostics"
WANG, S.-G.: "On centering, standardizing and measuring multicollinearity"

YANAI, Haruo — *Canonical correlations*
Tuesday: 14:15–15:45
Room C IX

14:15–14:25 YANAI, H.: "Opening remarks"
14:25–14:45 YANAI, H. (with Y. TAKANE): "Canonical correlation analysis with linear constraints"
14:45–15:05 SHIGEMASU, K.: "Bayesian robust estimation of canonical correlation vectors"
15:05–15:25 WANG, S.-G.: "Some notes on canonical correlations and measures of multivariate association"
15:25–15:45 BAKSALARY, J. K. (with S. PUNTANEN & H. YANAI): "Canonical correlations associated with symmetric reflexive g-inverses of the dispersion matrix"

Workshop Fee

There is no workshop fee for invited speakers and group organizers. For other participants the fee is:

Full participants:	FIM 750
Students:	FIM 150

The workshop fee includes entrance to all sessions, the Monday-evening reception, and coffee. For full participants daily lunches and the Sauna Party on Tuesday evening are also included (if reservation is indicated on the application form).

Accommodation

Blocks of rooms are reserved at the following hotels. All prices (subject to changes) are in Finnish marks.

	Single	Double
Hotel Ilves	530	680
Hotel Cumulus	370-380 (250^w)	
Hotel Victoria	360 (210^w)	460
Hotel Tampere	355 (270^w)	
Hotel Domus	130 (180^s)	180 (240^s)

^{w} weekends ^{s} with shower

Approximate Exchange Rates

US$1.00 = FIM 3.8, C$1.00 = FIM 3.3,
NZ$1.00 = FIM 2.3, DM 1.00 = FIM 2.2,
UK£1.00 = FIM 7.0, NLG1.00 = FIM 2.1,
JP¥1.00 = FIM 0.025, SEK 1.00 = FIM 0.65,
DKK 1.00 = FIM 0.62.

Bank Accounts

The bank account numbers of the Workshop are:
KOP-Tampere-Yliopisto 145350-561 and
OKOBANK-Tampere-Koskikeskus 573196-1800.

List of Participants

98 participants   27 July 1990

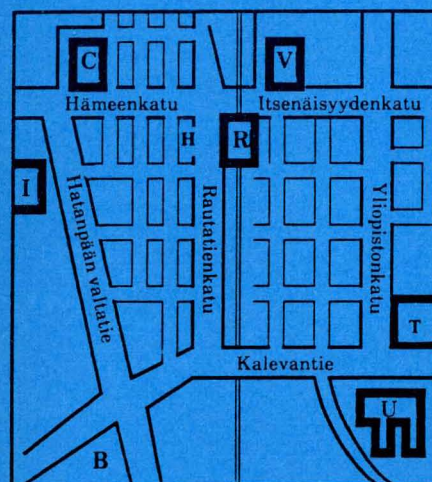|	
ARJAS, Elja, U of Oulu,	Finland
BAKSALARY, Jerzy K., Tampere and Zielona Góra,	Poland
BÉRUBÉ, Julie, McGill U, Montréal, Québec,	Canada
BOUCELHAM, Jamel, U of Helsinki,	Finland
CALIŃSKI, Tadeusz, A of Agriculture in Poznań,	Poland
COOK, R. Dennis, U of Minnesota, St. Paul, MN,	USA
DODGE, Yadolah, U of Neuchâtel,	Switzerland
DOL, Wietse, Groningen,	Netherlands
DRAPER, Norman R., U of Wisconsin, Madison, WI,	USA
FAREBROTHER, R. W., U of Manchester,	UK
FELLMAN, Johan, Swedish S of Econ, Helsinki,	Finland
FUJIKOSHI, Yasunori, Hiroshima U,	Japan
GHILAGABER, Gebrenegus, Uppsala U,	Sweden
GHOSH, Subir, U of California at Riverside, CA,	USA
GNOT, Stanisław, A of Agriculture in Wrocław,	Poland
GUPTA, Shanti S., Purdue U, West Lafayette, IN,	USA
HAUKE, Jan, A of Agriculture in Poznań,	Poland
HEILIGERS, Berthold, RWTH Aachen,	FRG
HELLA, Heikki, Union Bank of Finland, Helsinki,	Finland
HENDERSON, Harold V., Ruakura Agr C, Hamilton,	NZ
HETTMANSPERGER, Thomas P., Penn State U, PA,	USA
HIETALA, Paula, U of Tampere,	Finland
HUUHTANEN, Pentti, U of Tampere,	Finland
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KALLINEN, Arto, U of Tampere,	Finland
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MANNINEN, Pentti, U of Tampere,	Finland
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MILO, Władysław, U of Łódź,	Poland
MISRA, Chandra, Indian I of Management, Lucknow,	India
MITRA, Sujit Kumar, Indian Statist. I, New Delhi,	India
MUSTONEN, Seppo, U of Helsinki,	Finland
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NORDSTRÖM, Kenneth, U of Helsinki,	Finland
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NURHONEN, Markku, U of Tampere,	Finland
NYBLOM, Jukka, U of Tampere,	Finland
NYQUIST, Hans, U of Umeå,	Sweden
ÖFVERSTEN, Jukka, Agric Res Ctr, Jokioinen,	Finland
OJA, Hannu, U of Oulu,	Finland
OLKIN, Ingram, Stanford U, CA,	USA
PARRING, Anne-Mai, U of Tartu,	Estonia
PILZ, Jürgen, Bergakademie Freiberg,	GDR
POLLOCK, D. S. G., Queen Mary College, London,	UK
PORDZIK, Paweł, A of Agriculture in Poznań,	Poland
PUKELSHEIM, Friedrich, U of Augsburg,	FRG
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SALORANTA, Seppo, U of Tampere,   Finland
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SCHMIDT, Karsten, U of Mainz,   FRG
SEIFERT, Burkhardt, A of Sciences, Berlin,   GDR
SHAH, K. R., U of Waterloo, Ontario,   Canada
SHIGEMASU, Kazuo, Tokyo I of Tech, Yokohama,   Japan
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USA	12	India	2
FR Germany	10	New Zealand	2
Poland	10	UK	2
Japan	4	Denmark	1
Netherlands	4	Israel	1
Canada	3	PR China	1
German DR	3	Switzerland	1
Sweden	3		

Tampere City Centre

U = University
B = Bus Terminal
R = Railway Station
T = Tampere-talo
C = Hotel Cumulus and City Air Terminal
I = Hotel Ilves
H = Hotel Tampere
V = Hotel Victoria

THE UNIVERSITY OF TAMPERE

with more than 10,000 students, is one of the largest universities in Finland. The University's five faculties (Social Sciences, Economics and Administration, Education, Humanities, and Medicine) and three vocational sections are the foundation for a wide-ranging program of teaching and research, in which the viewpoints of both society and science have traditionally played an important role. The Department of Mathematical Sciences belongs to the Faculty of Economics and Administration and comprises three subjects: Mathematics, Philosophy, and Statistics.