OPTIMA

Nº 27

MATHEMATICAL PROGRAMMING SOCIETY NEWSLETTER

AUGUST 1989

Report on *Mathematical Programming, Series A*

THE MAJOR CHANGES IN THE JOURNAL IN THE LAST THREE years have been the establishment of ***Mathematical Programming Series B*** and the reduction from three volumes (nine issues) to two for MPA. As a result of the considerable efforts of Michel Balinski, Jan Karel Lenstra, Bill Pulleyblank and Laurence Wolsey and their negotiations with North-Holland, I believe we have a much more rational structure for the Society's publications, with more control over quality and scheduling for MPB than with the Studies and a more realistic frequency of publication for MPA, with no loss to the members.

The editorial board consists of distinguished and dedicated members of the mathematical programming community and reflects the international nature of the Society. We have two Co-Editors from Europe and two from the U.S. Of the 26 associate editors, 12 reside in the U.S., eight in Europe, three in Canada, and one each in Japan, South America and the Soviet Union. MPB has eight associate editors, including three who also serve on the editorial board of MPA, as does its Editor-in-Chief, Bill Pulleyblank. It is clear that there should be a close relationship between the Editors-in-Chief of the two publications to allow the flexibility of transfers when appropriate and agreed to by the authors.

Two special issues have appeared in MPA, 35(2) on probabilistic analysis of the simplex algorithm and 41(2) on nonconvex optimization. Both were published in order to alleviate scheduling difficulties (lack of material for MPA and backlogs for the Studies) and

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with the new structure I do not anticipate the need for future special issues in MPA.

The quality of the journal remains high, and the mix of papers appears to be roughly constant. For example, in the nine issues in 1987, a crude characterization reveals 14 papers each in nonlinear programming algorithms and combinatorial optimization, 13 in nonlinear programming theory, 10 in complementarity and homotopy theory and methods, and seven on linear programming. The comparative figures for 1986 were 17, 15, 10 and 19 (including the special issue on probabilistic analysis of the simplex method). We are attracting a reasonable number of good papers in combinatorial and integer optimization (with strong competition from ***Combinatorica, Discrete Mathematics, Journal of Combinatorial Theory*** and the computer science journals) and computationally oriented nonlinear programming (competing with SIAM's journals on Numerical Analysis (*SINUM*), and on Control and Optimization (*SICOPT*), and with the Journal of Optimization and Applications (*JOTA*)). As always we have stiff competition from ***Mathematics of Operations Research*** on more theoretical papers and ***Operations Research*** and ***Management Science*** on more applied papers. (While the division above is on methodological lines, we publish a small but reasonable number of good applications.) Finally, we have been able to attract some good papers related to parallel computation, and we are in excellent shape with regard to articles on new linear programming methods, with three of the five papers on standard-form variants of the projective method, five of the six on path-following methods, etc.

It was pointed out at the Council meetings in Tokyo that the SIAM journals SINUM and SICOPT have become if anything less serious competitors to MPA; SINUM has moved more towards differential equations, SICOPT to control theory. Perhaps closer are SISSC, the SIAM Journal on Scientific and Statistical Computing, and certainly the new Journals on Discrete Mathematics and on Matrix Analysis and Applications. Furthermore, SIAM is splitting SICOPT and developing a new journal devoted to optimization.

I have heard from a number of members that they are concerned that the Society and its publications are changing their emphasis more and more away from continuous and towards discrete optimization. I do not believe this is the case and so informed the members; however, there is certainly a perception among some that the balance has changed considerably. I believe it is important that this balance be maintained and seen to be maintained.

We receive about 200 papers each year. Of the 212 received in 1986, 68 (31%) were accepted, 114 (54%) rejected or withdrawn, and 32 (15%) are still active. For 1987, the figures are 37 (19%) accepted, 71 (35%) rejected/withdrawn, and 94 (46%) in process, out of a total of 204. In 1988, we received 201 papers and so far in 1989 we have 89 papers. The current backlog is about nine months.

Overall, I judge that the quality of MPA remains very high and that the new structure has alleviated the pressing problems of the past. I would like to wish Bob Bixby all the best as the new Editor-in-Chief.

–M. J. TODD

Journals

Vol.44, No.2

F. Barahona, M. Junger and G. Reinelt, *"Experiments in Quadratic 0-1 Programming."*
Y. Crama, *"Recognition Problems for Special Classes of Polynomials in 0-1 Variables."*
Y. Ye and E. Tse, *"An Extension of Karmarkar's Projective Algorithm for Convex Quadratic Programming."*
A. Sassano, *"On the Facial Structure of the Set Covering Polytope."*
M.E. Dyer and A.M. Frieze, *"A Randomized Algorithm for Fixed-Dimensional Linear Programming."*
W. Kern, *"A Probabilistic Analysis of the Switching Algorithm for the Euclidean TSP."*
S. Wright, *"An Inexact Algorithm for Composite Nondifferentiable Optimization."*
D. deWerra, *"Generalized Edge Packings."*

Computational Reporting Guidelines Distributed

The draft report of an ad hoc committee on the guidelines for reporting computational experiments has been published in the COAL newsletter dated March, 1989, and sent to all Society members. The report reviews existing guidelines and discusses the issues of performance claims, measurements of performance and computational testing on the new computer architectures. Researchers in computational mathematical programming are urged to study the report and communicate their comments to the committee: Richard H. F. Jackson (NIST), Chair; Paul T. Boggs (NITS), Stephen G. Nash (George Mason) and Susan Powell (London School of Economics). Full addresses are given in the report.

Annals of Operations Research

Editor-in-Chief: Peter L. Hammer, Rutcor, Hill Center for the Mathematical Sciences, Rutgers University, Busch Campus, New Brunswick, NJ 08903.

New in 1988:

MULTI-ATTRIBUTE DECISION MAKING VIA O.R.- BASED EXPERT SYSTEMS

Editors: R.L. Keeney, R.H. Möhring, H. Otway, F.J. Radermacher and M.M. Richter

Proceedings Intl. Conference, Univ. Passau, West Germany, April, 1986

1988. Appr. 400 pages. ISSN 0254 5330

Annals of Operations Research, vol. 16

I. CONTRIBUTIONS FROM ARTIFICIAL INTELLIGENCE

K.D. Althoff et al., Planning Systems and Artificial Intelligence

C. Beckstein et al., An Integration of Object-oriented Knowledge Representation and Rule-oriented Programming as a Basis for Design and Diagnosis of Technical Systems

P. Bock, A Perspective on Artificial Intelligence: Learning to Learn

G. Jäger, Some Logical Aspects of Information Processing

C. Lengauer, A View of Automated Proof Checking and Proving

L. Pun, Are Intelligent Systems Old or New - An Overview

H. Volger, On the Natural Language Front End of an Expert System

II. MODELLING AND PREFERENCE ASSESSMENT

G. Bamberg, W.F. Richter, Decision-theoretic Analysis of Envisaged Income Tax Reforms for FRG and US

H. Jungermann, M. Thüring, The Labyrinth of Expert's Minds: Some Reasoning Strategies and their Pitfalls

R. Ramash et al., Theory of Convex Cones in Multicriteria Decision Making

R. von Nitzsch, M. Weber, Utility Function Assessment on a Micro-computer: An Interactive Procedure

B. von Stengel, Decomposition of Multi Attribute Expected-utility Functions

D. von Winterfeldt, User-model Interaction in Decision Support Systems for Risk Management

III. QUANTITATIVE MODELS, DATA STRUCTURING AND INFORMATION PROCESSING

M. Bartusch et al., Scheduling Project Networks with Resource Constraints and Time Windows

A.J.M. Beulens, Transforming Algebraic Data Structures into Relational Data Structures in DSS

J. Blazewicz et al., Scheduling Unit-Time Tasks on Flowshops under Resource Constraints

K. Donner, Data Structures and Dynamic Programming Background for Editing Highly Structured Texts

W. Hahn, Perspectives of Data-flow Architectures

P. Hammer, On the Logic of Cause-effect-relationships

T. Kämpke, Simulated Annealing: Use of a New Tool in Bin Packing

W Schweitzer, Aspects of Decision Support for the Exploratory Analysis of Univariate Data

IV. KNOWLEDGE SOURCES AND DESIGN ASPECTS FOR APPLIED SYSTEMS

R. Bardens, D. Karagiannis
Knowledge-based Manpower Planning

K. Golabi, Applications and Limitations of Knowledge-based Expert Systems in Highway Maintenance Planning

M. Jarke, The Design of a Database for Multiperson Decision Support

P. Jedrzejowicz, An Overview on Available Models and Techniques for the Multicriteria Reliability Problem with Emphasis on a Potential Use in a DSS for this Problem Type

A. Lamatsch et al., SCHEDULE, an Expert-like System for Machine Scheduling

H. Otway, P. Haastrup, Designing Risk Management Support Systems

H. Wildemann, Analysis and Evaluation of Basic Strategies in Investement Planning for Modern Flexible Technologies

FORTRAN CODES FOR NETWORK OPTIMIZATION

Editors: B. Simeone, P. Toth, G. Gallo, F. Maffioli and S. Pallottino.

1988. 442 pages. ISSN 0254 5330

Annals of Operations Research, vol. 13

G. Gallo, S. Pallottino, Shortest path Algorithms

D. Goldfarb, M.D. Grigoriadis, A Computational Comparison of the Dinic and Network Simplex Methods for Maximum Flow

D.P. Bertsekas, P. Tseng, The Relax Codes for Linear Minimum Cost Network Flow Problems

G. Carpaneto et al., Algorithms and Codes for the Assignment Problem

U. Derigs, Solving Non-Bipartite Matching Problems via Shortest Path Techniques

P.M. Camerini et al., Algorithms for Finding Optimum Trees: Description, Use and Evaluation

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M. Fischetti, S. Martello, A Hybrid Algorithm for Finding the kth Smallest of n Elements $O(n)$ Time

Author Index, List of Algorithms, List of Subroutines, List of Subdirectories.

Available 1984 - 1987:

Vol. 10-11: Ibaraki, T., Enumerative Approaches to Combinatorial Optimization. 2 volumes. 1987. 602 pages.

Vol. 8-9: Albin, S.L. and C.M. Harris, Statistical and Computational Issues in Probability Modelling. 2 volumes. 1987. 644 pages.

Vol. 7: Blażewicz et al., Scheduling under Resource Constraints - Deterministic Models. 1986. 359 pages.

Vol. 6: Osleeb, J.P. and S.J. Ratick, Locational Decisions: Methodology and Applications. 1986. 328 pages.

Vol. 4-5: Monma, C.L., Algorithms and Software for Optimization. 2 volumes. 1986. 632 pages.

Vol. 3: Stecke, K.E. and R. Suri, Flexible Manufacturing Systems: Research Models and Applications. 1985. 488 pages.

Vol. 2: Thompson, R.G. and R.M. Thrall, Normative Analysis for Policy Decisions, Public and Private. 1985. 360 pages.

Vol. 1: Archetti, F. and F. Maffioli, Stochastics and Optimization. 1984. 366 pages.

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Conference Notes

Mathematical Sciences Institute
Workshop Announcement
Cornell University
Ithaca, New York
October 19-20, 1989

The Mathematical Sciences Institute (MSI) at Cornell University is sponsoring a workshop on Large-Scale Numerical Optimization. This workshop will discuss recent algorithmic and software developments in numerical optimization with a special focus on large-scale problems. Particular emphasis will be on practical methods, specific applications, and parallel computation. In addition, recent advances in parallel methods for sparse linear systems will be considered and discussed with respect to their relevance for large-scale optimization. Approximately 18 half-hour, invited talks will be delivered by leading researchers in the field. There will be no contributed talks. The workshop will conclude with a discussion session on the topic, "What should optimizers do with parallelism?"

Published proceedings will be available soon after the conclusion of the workshop which will be held at Cornell immediately following the ORSA-TIMS meeting in New York City.

For more information on the scientific content contact:

Tom Coleman
Department of Computer Science
311a Upson Hall
Cornell University
Ithaca, NY 14853
(607) 255-9203
coleman@gvax.cs.cornell.edu

or

Yuying Li
Department of Computer Science
311b Upson Hall
Cornell University
Ithaca, NY 14853
(607) 255-9203
yuying@gvax.cs.cornell.edu

To attend the workshop, contact MSI at 201 Caldwell Hall, Cornell University, Ithaca, NY 14853-2602, (607)255-7740, 8005, or 7763.

Computational Aspects of Combinatorial Optimization
Oberwolfach
January 9-13, 1989

The conference was organized by R. E. Burkard (Technical University of Graz) and M. Grötschel (University of Augsburg). The participants came from 13 countries and presented (in 52 talks) new results on the following topics:

- Generalized traveling salesman and routing problems;
- Design of survivable networks;
- New algorithms for network flows;
- Combinatorial problems in VLSI-design;
- Solving NP-hard problems on supercomputers or on distributed machines;
- Scheduling problems;
- Probabilistic analysis of simple algorithms.

Several participants provided a demonstration of their software packages, featuring:

- Linear programming codes;
- Algorithms on graphs;
- Codes for scheduling problems;
- A CAM-system for manufacturing.

The unique setting of the research institute in Oberwolfach was, as usual, very inspiring for all the participants and contributed considerably to the success of the conference.

CALL FOR PAPERS

Optimization: Theory and Engineering Applications

The Editorial Board of the Arabian Journal for Science and Engineering plans to publish in October 1990 an issue that will deal principally with topics in the field of Optimization Theory and its engineering applications. The AJSE hope to bring together in a single publication papers in optimization theory, methodology and algorithms and engineering optimization applications.

The technical editors are Dr. Katta G. Murty, Department of Industrial and Operations Engineering, University of Michigan, Dr. Salih Osman Dufuaa, Systems Engineering Department, KFUPM, Dr. Shokri Zaki Selim, Systems Engineering Department, KFUPM, and Dr. Abdul Raouf, AJSE Editor for System Engineering.

Three copies of complete manuscripts, including illustrations and references, should be submitted by January 1, 1990 to:

Managing Editor
THE ARABIAN JOURNAL FOR SCIENCE AND ENGINEERING
KFUPM Box 8
King Fahd University of Petroleum and Minerals
Dhahran 31261, Saudi Arabia

Papers accepted but not included in the theme issue will be considered for publication in a subsequent issue of the AJSE.

Authors may obtain details of the format and style adopted by the AJSE either by referring to previous issues or by contacting the Managing Editor at the above address, telephone (966-3) 860-5418, telex 801060 KFUPM SJ, FAX (966-3) 860-3306.

Technical Reports & Working Papers

Northwestern University Department of Industrial Engineering and Management Sciences

Evanston, IL 60208

S. Mehrotra and J. Sun, *"A Method of Analytic Centers for Quadratically Constrained Convex Quadratic Programs,"* TR 88-01.
S. Mehrotra, *"A Method for Solving Piece-Wise Linear Programs by Shrinking Polytopes,"* TR 88-04.
J.T. Simon and W.J. Hopp, *"Availability and Average Inventory of Balanced Assembly-Line Flow Systems,"* TR 88-05.
E.S. Theise and P.C. Jones, *"Alternative Implementations of a Diagonalization Algorithm for Multiple Commodity Spatial Price Equilibria,"* TR 88-06.
N. Pati and W.J. Hopp, *"Optimal Inventory Control in a Production Flow System with Failures,"* TR 88-07.
S. Mehrotra and J. Sun, *"An Interior Point Algorithm for Solving Smooth Convex Programs Based on Newton's Method,"* TR 88-08.
W-L. Hsu and W-K. Shih, *"An Approximation Algorithm for Coloring Circular-Arc Graphs,"* TR 88-09.
W-L. Hsu and W-K. Shih, *"An $0(min[m*n, n^2 loglog\ n])$ Maximum Weight Clique Algorithm for Cicular-Arc Graphs,"* TR 88-10.
S. Mehrotra and J. Sun, *"On Computing the Center of a Quadratically Constrained Set,"* TR 88-11.
W-L. Hsu and W-K. Shih, *"An $0(N^{1.5})$ Algorithm to Color Proper Circular-Arc Graphs,"* TR 88-12.
E.S. Theise and P.C. Jones, *"Thirty Linear, Single Commodity Spatial Price Equilibrium Problems and Their Solutions,"* TR 88-13.
E.S. Theise and P.C. Jones, *"A Computational Comparison Between an Import Equilibration Algorithm and the Expanding Equilibrium Algorithm for the Linear, Single Commodity Spatial Price Equilibrium Problem,"* TR 88-14.
E.S. Theise and P.C. Jones, *"Nonlinear, Single Commodity Spatial Price Equilibria and the Expanding Equilibrium Algorithm: Two Strategies for Implementation,"* TR 88-16.
R.R. Inman and P.C. Jones, *"Economic Lot Scheduling of Bottlenecks with External Setups,"* TR 88-17.
M.L. Spearman, *"An Analytic Congestion Model for Closed Production Systems,"* TR 88-23.

RUTCOR Rutgers Center for Operations Research Hill Center

New Brunswick, New Jersey 08903

L.J.Billera and L.L.Rose, *"Gröbner Basis Methods for Multivariate Splines,"* RRR 1-89.
M.H. Rothkopf, T.J. Teisberg and E.P. Kahn, *"Why are Vickrey Auctions Rare?"* RRR 2-89.
A.S. Manne and M.H. Rothkopf, *"Analyzing U.S. Policies for Alternative Automotive Fuels,"* RRR 3-89.
P. Hansen, B. Jaumard, S-H. Lu, *"An Analytical Approach to Global Optimization,"* RRR 4-89.
J. Kahn and R. Meshulam, *"On mod p Transversals,"* RRR 5-89.
F. Harary, S. Kim and F.S. Roberts, *"Extremal Competition Numbers as a Generalization of Turan's Theorem,"* RRR 6-89.
S.D. Flåm, *"On Finite Convergence and Constraint Identification of Subgradient Projection Methods,"* RRR 7-89.
M. Zheng and X. Lu, *"On the Maximum Induced Forest of a Connected Cubic Graph without Triangles,"* RRR 8-89.
B. Avi-Itzhak and S. Halfin, *"Response Times in Gated M/G/1 Queues: The Processor-Sha-Ring Case,"* RRR 9-89.
P. Hansen, B. Jaumard and O. Frank, *"An $0(N^2)$ Algorithm for Maximum Sum-of-Splits Clustering,"* RRR 10-89.
R.P. McLean, *"Random Order Coalition Structure Values,"* RRR 11-89.
P.L. Hammer, U.N. Peled and X. Sun, *"Difference Graphs,"* RRR 12-89.
P.L. Hammer, N.V.R. Mahadev and U.N. Peled, *"Bipartite Bithreshold Graphs,"* RRR 13-89.
E. Boros, Y. Crama and P.L. Hammer, *"Upper Bounds for Quadratic 0 - 1 Maximization,"* RRR 14-89.
E. Boros and P.L. Hammer, *"A Max-Flow Approach to Improved Roof Duality in Quadratic 0 - 1 Minimization,"* RRR 15-89.
P.L. Hammer, F. Maffray and M. Preissmann, *"A Characterization of Chordal Bipartite Graphs,"* RRR 16-89.
P. Hansen, B. Jaumard and G. Savard, *"A Variable Elimination Algorithm for Bilevel Linear Programming,"* RRR 17-89.

University of Southern California Department of Industrial and Systems Engineering

Los Angeles, CA 90089-0193

B.C. Tansel and E. Erkut, *"On Parametric Medians of Trees,"* 88-01.
B.C. Tansel and G.F. Scheuenstuhl, *"Facility Location on Tree Networks with Imprecise Data,"* 88-03.

A.S. Kiran and P. Kouvelis, *"The Plant Layout Problem in Automated Manufacturing Systems,"* 88-04.
A.S. Kiran, *"A Tardiness Heuristic for Scheduling Flexible Manufacturing Systems,"* 88-06.
G. Nadler, J.M. Smith and C.E. Frey, *"Problem Formulation Methods in Engineering Design,"* 88-08.
A.S. Kiran, *"A Combined Heuristic Approach to Dynamic Lot Sizing Problems,"* 88-09.
M.H. Chignell and R.G. Narayan, *"An Empirical Evaluation of Efficient Ranking Methods,"* 88-10.
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E. Balas and S.M. Ng, *"On the Set Covering Polytope: II. Lifting the Facets with Coefficients in {0,1,2,3},"* 88-21.
A.S. Kiran and S. Karabati, *"The Station Location Problem on Unicyclic Material Handling Networks,"* 88-25.

Operations Research Group
The Johns Hopkins University
Baltimore, MD

M.H. Schneider, *"Matrix Scaling, Entropy Minimization, and Conjugate Duality (I): Existence Conditions,"* 89-02.
M.H. Schneider, *"Matrix Scaling, Entropy Minimization, and Conjugate Duality (II): The Dual Problem,"* 89-03.
H. Schneider and M.H. Schneider, *"Max-Balancing Weighted Directed Graphs,"* 89-04.
R.D. Parker, *"Calculating the Weights of a Mask for Character Recognition,"* 89-05.
H. Schneider and M.H. Schneider, *"Towers and Cycle Covers for Max-Balanced Graphs,"* 89-06.
J.R. Current, C.S. ReVelle and J.L. Cohon, *"An Interactive Approach to Identify the Best Compromise Solution for Two Objective Shortest Path Problems,"* 89-07.
W. Cook, M. Hartmann, R. Kannan and C. McDiarmid, *"On Integer Points in Polyhedra,"* 89-08.
V.A. Hutson and C.S. ReVelle, *"Maximal Direct Covering Tree Problems,"* 89-09.
J-S. Shih and C.S. ReVelle, *"Hedging Rules for the Single Water Supply Reservoir,"* 89-10.

Universitá di Pisa
Dipartimento di Matematica
Sezione di Matematica Applicata
Gruppo di Ottimizzazione e Ricerca Operativa
Pisa, Italy

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E. Medova-Dempster, *"The Circulant Traveling Salesman Problem,"* 160.
L.F. Escudero, *"On Solving a Nondifferentiable Transshipment Problem,"* 161.

BOOK REVIEWS

Combinatorics of Experimental Design

A. P. Street and D. J. Street
Oxford University Press, Oxford, 1987
ISBN 0-19-853255-5

The book under review is intended as an introductory text (aimed at 3rd and 4th year undergraduates in both mathematics and statistics) on the combinatorial and statistical aspects of Design Theory. To quote from the introduction: "There is an obvious dichotomy in the literature of designs; they are considered as incidence structures by combinatorialists and as experimental plans or layouts by statisticians, and members of each of these groups are sometimes unaware of related developments and problems arising in the other area. We aim to bridge this gap by providing the background necessary to make the combinatorial aspects of statistical literature more easily accessible to combinatorialists, and vice versa." Consequently, the book contains parts where the emphasis is on combinatorics as well as parts where the statistical aspect dominates. Unfortunately, there is quite often the feeling of a rather abrupt transition between both points of view; thus I am not quite sure whether the authors have fully achieved their (difficult) goal. However, the book certainly is quite interesting and worth studying.

Let me list the main topics covered as indicated by the titles of chapters: 1. Introduction; 2. Balanced incomplete block designs; 3. Difference set constructions; 4. Isomorphism and irreducibility; 5. Latin squares and triple systems; 6. Mutually orthogonal Latin squares; 7. Further results on Latin Squares; 8. Resolvable designs and finite geometries; 9. Symmetrical factorial designs; 10. Single replicate factorial designs; 11. Designs with partial balance; 12. Existence results: Symmetric balanced designs; 13. Existence results: designs with index 1 and given block size; 14. Designs balanced for neighboring varieties; 15. Competition designs. As this list indicates, the main concern is on the existence and construction of various types of (pairwise) balanced designs; thus some rather important basic topics like t-designs, automorphism groups, characterizations, connections to coding theory have been (almost) totally excluded. In view of the vast amount of literature on designs, this is justified for an introductory text, though a few more references to the missing topics would have been welcome. Also, I would have liked to have some other applications of Design Theory (except for statistical ones) at least mentioned, in particular, those to computer science and algorithms.

Still, the reader gets a good introduction at least to the constructive aspects regarding block designs and Latin squares. The presentation is generally clear and well-written. As always, one finds minor faults; e.g., the terminological confusion between difference families and sets is annoying. The proof of the first multiplier theorem given in Ch. 4 is the original involved one, even though a much more transparent approach (due to Lander) is known now. In Ch. 7, the three mutually orthogonal Latin squares of order 14 should not have been displayed explicitly, as they are in fact constructed by a difference method which would have simplified the presentation considerably. These imperfections are balanced by some highlights not yet found in any other text book: e.g., a proof of the sufficiency of the necessary conditions for triple systems based on Latin squares or Stinson's proof for Tarry's theorem (i.e., for the non-existence of a pair of orthogonal Latin squares of order 6).

There are two other recent books on Design Theory: Another introductory text by D. R. Hughes and F. C. Piper ("Design Theory," Cambridge University Press, 1985) and one co-authored by the reviewer (T. Beth, D. Jungnickel and H. Lenz: "Design Theory," Bibliographisches Institut Mannheim, 1985, and Cambridge University Press, 1986) which aims at graduates and experts in the area. All three books stress quite different aspects: While Hughes and Piper also is of an introductory nature, this text emphasizes the algebraic aspects of designs (treating e.g. Witt designs and Mathieu groups) and quite neglects the existence question. Thus this book and the one under review rather nicely complement each other and together provide an introduction to all the most important parts of Design Theory. As already mentioned, my own (and my co-authors') efforts were more concerned with providing a somewhat deeper treatment and a reference for the expert working in the area. Thus all three books serve their different purposes: If one wants to specialize in Design Theory, all three books are needed; if one only wants to get acquainted with designs, either the present text or that by Hughes and Piper or both (depending on your personal preference for a more constructive or more algebraic treatment) are well worth buying.

–D. JUNGNICKEL

Surveys in Game Theory and Related Topics

Edited by H. J. M. Peters and O. J. Vrieze
CWI Amsterdam, 1987
ISBN 90-6196-322-2

This book is a collection of 13 survey papers on game theory and related topics and was dedicated to Professor Stef Tijs of the Catholic University of Nijmegen in The Netherlands on the occasion of his 50th birthday. The foreward tells us the wonderful history of how he has developed the Dutch school of game theory, now one of the leading

CONTINUES

research groups in this field, since he finished his Ph.D. thesis, "Semi infinite and infinite matrix games and bimatrix games," in 1975. All the authors of the papers were introduced to game theory by Professor Tijs, and 10 of them have finished or are preparing their Ph.D. theses under his supervision.

The papers cover a wide range of game theory and related topics: equilibrium points in noncooperative games (by Eric van Damme and by Mathijs Jansen), games with incomplete information (by Peter Borm), stochastic games (by Koos Vrieze and by Frank Thuijsman), a relationship between game theory and decision theory (by Peter Wakker), cooperative games in characteristic function form (by Theo Driessen and by Jean Derks), cooperative games arising from combinatorial and/or linear optimization problems (by Imma Curiel and by Jos Potters), the bargaining theory (by Hans Peters) and the theory of social choice (by Ton Storcken). All papers are clearly written and provide concise surveys of recent developments in their respective topics. They also include both new results by the authors themselves and useful references. The readers can obtain a review of the state of the art in the areas of game theory mentioned above and also can learn that many tools in mathematical programming play an important role in those areas. Since most papers emphasize mathematical aspects of the results such as the proof methods for the existence of various solution concepts and their computation, I think that the book should be accessible to many researchers in the field of mathematical programming who have little knowledge of game theory.

This book is recommended to researchers and graduate students who are interested in recent developments in various fields of mathematical game theory.

–A. OKADA

Recent Advances and Historical Development of Vector Optimization

by J. Jahn and W. Krabs
Springer, Berlin, 1987
ISBN 3-540-18215-2

In August 1986, J. Jahn and W. Krabs organized an international conference on vector optimization in Darmstadt, West Germany. Besides four state-of-the-art tutorials, numerous talks cover various aspects and purposes of vector optimization, such as: abstract theory, duality, sensitivity, numerical methods, parametric optimization, multicriteria-decision-making, application of MCDM, etc. Several talks are collected in this proceedings. In the following, the state-of-the-art tutorials of the Professors W. Stadler, J. M. Borwein, P. L. Yu, and H. Eschenauer will be discussed in detail.

In his article "Initiators of Multicriteria Optimization," Stadler describes the historical development of vector optimization. A vector optimization problem is a problem with several objective functions. In general, there is conflict between them. Usually, one solves such problems by introducing a so-called utility function such that a solution of the problems with this utility function is a solution of the initial problem. Such questions were first handled in economic theory. The economists A. Smith (The Wealth of Nations, 1776), F. Edgeworth (The Edgeworth Box in Mathematical Physics, 1881), and V. Pareto (Pareto-optimality, 1906) can be said to be the founders of multicriteria optimization as an inherent part of economic equilibrium.

Stadler presents the fundamental statements in the work of Edgeworth and Pareto for welfare theory. In their original papers, one can already see the well-known scalarization of the weighted objective functions. Instead of n objectives and m variables, they speak about n consumers and m goods. The notion of "efficiency" occurs for the first time in Koopmans' work on production theory in 1951.

Mathematically, as Stadler writes, the first formulation of a vector optimization problem is due to Kuhn and Tucker. In their famous paper from 1951, they give a necessary condition for "proper" solutions. The first basic treatment of vector optimization can be found in Hurwicz's paper in 1958 where he considered optimization problems in linear spaces.

In a conclusion section, some areas of future research are pointed out: (1) vector optimization theory with respect to partial orders and preorders; (2) development of computational algorithms to generate the efficient point set; (3) multicritera aspects of natural phenomena; (4) further applications.

This paper is very interesting to read because of its detailed historical information and the biographies and pictures of the founders of multicriteria optimization which are added to the article. In my opinion, the only missing thing is a discussion about the general development and movement in vector optimization after Hurwicz's paper to the present.

In the article "Convex cones, minimality notions, and consequences," Borwein presents vector optimization problems in arbitrary vector spaces. In every section and subsection, he uses the following scheme: (a) definitions, (b) properties and relations between the introduced concepts, (c) theorems, and (d) examples and applications in some special spaces as L_p and ℓ_p. Most proofs are omitted (but references are cited); some proofs are sketched.

The section on cone structures deals, among other things, with order intervals, monotone sequences and nets, normality of a cone, the Daniell property of a cone, the base of a cone, and Banach lattices. In every subsection, Borwein shows the relationships between the introduced concepts in complete detail. Thus, this section is a reference-book on where to find conditions on whether a cone with property (A) has property (B), or property (C) is equivalent to property (D).

Minimality notions are introduced in the next section: Pareto-optimal (or efficient, non-dominated, minimal) points, least elements (or strong minimum point, dominating point), weak-efficient point, proper efficient point are optimal points of a set with respect to a given cone. Figures illustrate the differences between these concepts. Some existence theorems of efficient points and a characterization of proper

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efficiency are given.

Finally, Borwein outlines the theory of lattice complementary problems, i.e. to solve $\min_K \{x,F(x)\} = 0$ for $F:X \to X$, X a Banach lattice, K a cone. For instance, a standard linear programming pair can be rewritten as such a problem.

The paper of Borwein treats the introduced concepts very comprehensively, but in my opinion it is a little bit too compact. More discussion would be better for a reader who is not familiar with vector optimization problems in abstract spaces. Nevertheless, the complete discussion of the broached questions is impressive as was Borwein's excellent talk at the conference.

In their article, "Foundations of Effective Goal Setting", Yu and Chien give a readable, detailed introduction to the field of effective goal setting. Their purpose is to formulate a complex multicriteria optimal control system in which problems of effective goal setting can be transformed.

Usually in multicriteria decision making there is a fixed set of objectives and alternatives, and the aim is to find "optimal" solutions. But many decision problems have alternative sets and criteria functions which are not fixed, but change, for instance, with time. For example, in reaching a great goal one gives oneself a series of "increasing" goals for motivation.

For their purpose, the authors use the concepts of human behavior mechanism and habitual domain: each individual is endowed with an internal information processing and problem solving capacity and has a set of goals to reach and maintain. In comparison between real and ideal values, one tries to find goals and alternatives which produce great charges and reduce the level of charges by selecting other alternatives or by active problem solving or avoidance justification. This dynamic behavior mechanism, although changing with time, can stabilize and can have stable habitual patterns for processing information. This leads to habitual domains, divided into potential domains, actual domains, and reachable domains. An essential role is played by the cores of the habitual domains, i.e. the set of central ideas or concepts.

Utilizing these concepts, the authors can formulate problems of effective goal setting into a complex multiple criteria optimal control system by (a) selecting measurable goal functions, (b) setting goal achievement levels, and (c) determining effective supportive systems as control variables. The stated variables are working conditions, charge structures and confidence; the objectives are to maximize the attention allocation of time to job-related works, to maximize the efficiency and effectiveness of work performance, and to maximize the favorability of the working environment. Finally, some empirically known results are discussed.

In his paper, "Multicriteria Optimization Procedures in Application on Structural Mechanics Systems," Eschenauer presents a computer program package called SAPOP (Structural Analysis Program and Optimization Procedure) to support a decision maker by solving vector optimization problems for structural analysis. What objectives are to be considered for these problems? Of course, a decision maker wants to minimize the costs of developing and manufacturing machines. But other criteria may shape accuracy and reliability of the systems, among others.

The program SAPOP coordinates the three main parts of the optimization process and the data exchange between them: (1) optimization algorithms, (2) optimal modelling, and (3) structural analysis.

In part (1), SAPOP makes available a lot of optimization algorithms because there is no procedure which is at the same time efficient and applicable for all problems.

Part (3) is the starting point of every structural optimization problem. As Eschenauer indicates, this first step must be done very carefully because the computation depends essentially on the quality of the mathematical-mechanical model. Among these models one distinguishes between (a) ordinary differential equation models, (b) difference equation models, (c) partial differential equation models, and (d) algebraic (non-difference) equation models.

Part (2) is the link between the other two parts. Here, strategies to find efficient solutions were created. Some scalarizations (weighted objective functions, distance functions, trade-off-method, min-max-formulation) are discussed.

Finally, some applications and numerical results are quoted. Eschenauer describes how to find an optimal layout of a shell structure. These problems arise, for instance, in the field of antenna and telescope construction.

This paper gives a good discussion of problems of structural analysis with several objectives and a brief introduction to the program SAPOP. For deeper insight, references are cited.

–S. HELBIG

Algorithmic Information Theory

by G. J. Chaitin
Cambridge Tracts in Theoretical Computer Science 1
Cambridge University Press, Cambridge, 1987
ISBN 0-521-34306-2

One way of stating certain famous theorems of Gödel, Church, and Turing is that there is a function f such that no computer program can decide, for all natural numbers a, whether there is a natural number x with

$f(x) = a$.

The f in these results typically examined an x intended to encode a proof (or a computation) with $f(x)$ being an encoding of the final result. The functions f constructed in these results involved many definitions by cases - using one formula if x was even, another if

$x = 4k + 1$, and so forth. The search for results involving f with "neater" definitions culminated in Matijasevic's 1970 solution of Hilbert's tenth problem: a polynomial in several variables $f(x_i,a_i)$ was

CONTINUES

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constructed such that no program can tell, for all natural number vectors a, whether there is a natural number vector x with $f(x,a) = 0$. The construction is quite complex, in spite of simplifications by Davis, Robinson, and others. In 1984, Jones and Matijasevic gave a much simpler construction for f which included expressions involving exponents.

The author presents this most recent construction and explores its implications. No advanced results from number theory or theory of equations are required. In order to establish results about computer programs, one must have a precise definition. The author has chosen for this purpose a version of LISP which he develops from scratch in twelve pages. Perhaps fortunately, the reader unfamiliar with LISP can accept on faith the construction of f and proceed to the half of the book dealing with implications.

The proof of non-computability is different from the usual one. The author obtains contradictions by focussing on the smallest program that will print a specified string. The author has done much work in which finite strings which require long programs are considered to be pseudo-random, and this aspect receives considerable attention here.

In both halves of the book, the author has taken the trouble to supply motivational remarks and exhortations ("Initially, the material will seem completely incomprehensible, but all of a sudden the pieces will snap together into a coherent whole"). It would help the reader if he has seen previous work by the author on these issues (for example, "Randomness and Mathematical Proof," Scientific American, 1975).

Matijasevic's work was used in a paper by Jeroslow, "There Cannot be any Algorithm for Integer Programs with Quadratic Constraints" (Operations Research, 1973). I suspect that most Mathematical Programming Society members are more interested in establishment of lower bounds on the difficulty of problems for which computer programs exist. This book does not directly address such issues, but my impression is that the type of reasoning developed here might help on some problems of this kind.

–C. E. BLAIR

Mathematical Programming: An Introduction to Optimization

Pure and Applied Mathematics Series

by Melvyn W. Jeter
Marcel Dekker, Basel, 1986
ISBN 0-8247-7478-7

Whenever a new textbook with a title like "Mathematical Programming" or "Introduction to Optimization" is published, my first reaction is usually a rather cynical comment on this $(n+1)^{st}[n \to \infty]$ book of its type.

With Jeter's book my reaction was different. Students will enjoy using this book because of two main reasons: (1) Most of the mathematical facts which are stated are proved in a clear and understandable way. There are hardly any of these "obviously" or "as can easily be seen" sequences which scare so many of our students away; (2) Every detail of the presented material is accompanied by worked examples and further supported by exercises. But Jeter avoids the flaw of many mathematical programming textbooks of replacing theory completely by examples.

Because of the thoroughness of the presentation of the chosen material, the author evidently had to make some sacrifices in the material selection. In Chapter 1 different types of mathematical programs are introduced. Chapter 2 reviews elementary linear algebra and affine and convex sets. Furthermore, LPs and their basic properties are introduced. Chapters 3, 4 and 5 cover various versions of the simplex method including a chapter on duality and linear complementarity. The cycling phenomenon is discussed, but I was surprised not to see Bland's simple cycle avoiding rule.

The sixth chapter on network programming is somewhat disappointing. The classic Ford/Fulkerson algorithm for finding maximal flows is discussed without any reference to more efficient procedures. Sections on network programming problems different from flow problems are missing.

Chapter 7 provides the mathematical tools needed in dealing with convex functions of one or more variables. The last three chapters give an overview of nonlinear, continuous programs. In Chapter 8 optimality conditions are discussed. Chapter 9 deals with search techniques for unconstrained problems, and Chapter 10 introduces penalty methods.

As the preceding summary shows, most instructors will add supplemental material to various parts of Jeter's book. Since the book is written so nicely, one may in an advanced course actually concentrate on supplemental material and assign large parts of Jeter's text as reading assignments.

–H. HAMACHER

Fractional Programming

by B. D. Craven
Heldermann Verlag, Berlin, 1988
ISBN 3-88538-404-3

The book deals with nonlinear programming problems where the objective function is a ratio of two functions or involves even several ratios. These so-called fractional programs often have properties which they do not share with general nonlinear programs. A linear fractional program is one where both numerator and denominator are affine-linear and the constraints are linear. The book covers applications, theory and algorithms for linear and nonlinear fractional programs.

In Chapter 1 several (potential) applications of fractional programming are surveyed. These include planning problems in production, scheduling, finance as well as stochastic programming and stochastic processes. Chapter 2 is devoted to linear fractional programs where

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equivalent programs and duality are discussed. Chapter 3 focuses on the more general problem of maximizing the ratio of a concave and a convex function. Equivalent problems and the relationship to generalized convexity are dealt with. Duality and sensitivity of nonlinear fractional programs are presented in Chapter 4. In Chapter 5 the author discusses algorithms in linear and nonlinear fractional programming. The final chapter addresses three problems in multi-ratio fractional programming: maximizing the sum of ratios, maximizing the smallest of several ratios and multiobjective fractional programming.

Each chapter ends with exercises and a selective bibliography. The book can serve as a textbook for students who are familiar with the basics of linear and nonlinear programming and who are acquainted with the fundamentals of linear algebra and calculus. The book is an introduction to fractional programming rather than a detailed survey of the extensive literature. But it reaches a depth that makes it attractive also to the researcher in the field. It is the first book on fractional programming that appeared after the initial monograph of the reviewer in 1978. I warmly recommend it to anyone interested in fractional programming or general nonlinear programming.

–S. SCHAIBLE

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Gallimaufry

Kurt Anstreicher *(Yale) will spend the 1989-90 academic year at CORE...*Carl Harris *(George Mason University) has issued a call for nominations for the 1988 Lanchester Prize...The IFORS '90 conference will be held June 25-29, 1990 in Athens, Greece.* Jens Clausen *has taken over production and distribution of the COAL newsletter and* Faiz A. Al-Khayyal *(Georgia Tech) is the U. S. co-editor.*

¶ OPTIMA Wine *is available from Optima Vineyards, Sonoma County, CA.*

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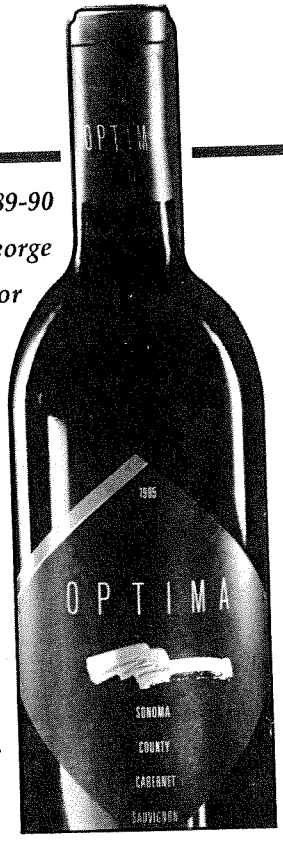

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