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PAPERS IN
Algebra, Analysis and Statistics

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PAPERS IN

Algebra, Analysis and Statistics

PROCEEDINGS OF THE 21ST SUMMER RESEARCH INSTITUTE

AUSTRALIAN MATHEMATICAL SOCIETY

HELD AT THE UNIVERSITY OF TASMANIA
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EDITED BY

R. LIDL

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INTRODUCTION

The Summer Research Institute of the Australian Mathematical Society is an annual event held each (southern hemisphere) summer for a period of about four weeks. The objects of the Institute are, according to its constitution, to promote research and advance scholarship in mathematics. The Council of the Society appoints a Director who is solely responsible for all scientific, administrative and financial aspects of "his" institute. Each Institute is organized to achieve its aims in three ways:- Firstly it enables its members to pursue their mathematical studies and researches in an atmosphere which is free from the distractions of their own University and domestic environments. Secondly, the Institute provides an opportunity for lengthy discussions with fellow research workers in one's mathematical speciality or other areas of research. Thirdly, and perhaps most importantly, each year the Summer Research Institute invites several distinguished mathematicians from overseas to give short courses of lectures on advanced current mathematical topics. As well, a number of other leading overseas and Australian mathematicians are invited to give lectures or organize and participate in specialist sessions.

The 21st Summer Research Institute was held at the University of Tasmania from 12th January until 6th February 1981. It covered a wide range of topics in mathematics and statistics and these Proceedings consist mainly of those invited lectures and some contributed specialist session papers which are not otherwise available.

During the first week of the Institute Professor P.J. Davis (Brown University) and Dr. N.J.A. Sloane (Bell Laboratories) were the invited speakers. The second week included a series of invited lectures by Dr. T.J. Rivlin (I.B.M., New York) and Professor G.S. Watson (Princeton University). Invited talks were also presented by Professor D. Elliott (University of Tasmania), Professor P.M. Gruber (Technische Universität Wien) and Professor M. Mendès France (Université de Bordeaux). During the third week Professor F. Hirzebruch (Universität Bonn) and Professor E.C. Zeeman (University of Warwick) each gave a series of five invited lectures. In the final week of the Institute, Professor C.W. Curtis (University of Oregon), Professor R. Delbourgo (University of Tasmania), Professor G. Glauberman (University of Chicago), Professor I.G. Macdonald (University of London) and

Professor G. Pilz (Universität Linz) were the invited speakers. Most of these invited lectures are included in these Proceedings, a few are published elsewhere. The Director found it particularly pleasing that there was considerable interest of participants in lectures on topics outside their own areas of expertise with resulting discussions across the boundaries of specialist disciplines. The following first few pages give a list of all participants, the scientific programme of the 21st Summer Research Institute and a table of contents of these proceedings.

The Director of the Summer Research Institute is always responsible for raising the necessary funds to organize his Institute. Although a proper financial statement for the 21st Institute can be found elsewhere, nevertheless I would like to note in particular the generous support received from IBM Australia Ltd., Qantas Airways Ltd., and the State Government of Tasmania, whose contributions together with donations from twelve other Australian companies or institutions were greatly appreciated.

I am indebted to all those who assisted me in organizing the Institute, especially the other officers of the 21st Summer Research Institute, J.D. Donaldson (Secretary) and P.G. Trotter (Treasurer). My sincere thanks to the Vice-Chancellor of the University of Tasmania, Professor D.E. Caro, for making facilities available to the Institute. I am grateful to R. Matthews for helping me in preparing these proceedings and to Mrs. M.S. Barton for her excellent typing.

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R. Lidl
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21st Summer Research Institute.

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SCIENTIFIC PROGRAMME OF THE 21ST SUMMER RESEARCH INSTITUTE

INVITED LECTURES

(in alphabetical order)

C.W. Curtis, "Homology Representations of finite groups of Lie type".
    (3 lectures).

P.J. Davis, "Personal Reminiscences of the Gauss-Christoffel Formula"
    "On the Nature of Utility in Mathematics"
    "Fourier Matrices and Circulants"
    "Non-analytic aspects of Mathematics"
    "Regions admitting Quadrature Formulas".

R. Delbourgo, "Matrix Correlation Functions".

D. Elliott, "Some Aspects of Singular Integral Equations".

G. Glauberman, "Some Simplifications in the proof of the Feit-Thompson Theorem"
    (4 lectures).

P.M. Gruber, "A Survey of Convexity"
    "Applications of Convexity and its Relations to other Fields".

F. Hirzebruch, "Introduction to the Theory of Algebraic Surfaces with a
    Discussion of Concrete Examples, e.g. Modular Surfaces". (5 lectures).

I.G. MacDonald, "Lie Groups, Combinatorics and Number Theory" (2 lectures).

M. Mendès France, "Paper Folding, Space-Filling Curves and Rudin-Shapiro
    Sequences".

G. Pilz, "Near Rings: What they are and what they are good for" (2 lectures).

T.J. Rivlin, "The optimal Recovery of Functions" (5 lectures).

N.J.A. Sloane, "Spherical Codes" (5 lectures).

G.S. Watson, "Orientation Analysis - Theory and Data Analysis (with
    applications to cometary orbits, palaeomagnetism and biology)"
    (3 lectures).

E.C. Zeeman, "Bifurcations, Catastrophes and Turbulence" (5 lectures).

CONTRIBUTED PAPERS

(in specialist sessions)

1. ANALYSIS

W.R. Bloom, "Multipliers of Lipschitz spaces on zero dimensional groups".

J.H. Chabrowski, "Representation theorems for parabolic systems in the sense
    of I.G. Petrowskii".

E.N. Dancer, "Conley's homology index, symmetries and the solvability of some
    partial differential equations".

M.A.B. Deakin, "The formal power series approach to catastrophe theory".

P.M. Gruber, "Approximation of convex bodies".

B.R. Jefferies, "Cylindrical measures and the differentiability of vector measures".

K. Mackenzie, "The cohomology of Lie algebroids - infinitesimal results on extensions of principal bundles".

W. Meersman, "Ideals and stability".

J. Mitchell, "Singular integrals on bounded symmetric domains in $\mathbb{C}^N (N > 1)$".

R.V. Nillsen, "Extreme points of invariant means on $L^\infty(G)$".

W.J. Ricker, "Product of spectral measures".

L. Simon, "Remarks on boundary regularity for the capillary equations".

G. Szekeres, "Experiments with Abel's functional equation".

H.B. Thompson, "A Dirichlet problem with L^2 data".

D.T. Yost, "Geometry of Banach spaces and convex subsets of $\mathbb{C}^2$".

2. COMBINATORICS

R. Duke, "Lifts of matroids".

J. Fitzgerald, "Permutations arising in multi-product inventory manufacture".

G.D. Glynn, "New results and methods in finite geometry".

C.J. Smyth, "A vertex-colouring problem".

3. GEOMETRY AND TOPOLOGY

G. Davis, "Orbit spaces of Bianchi groups (after Mennicke and Grunewald)".

R. Hartley, "Proving knots are non-invertible".

C.D. Hodgson, "Lens spaces without simple homotopy theory".

S.A. Morris, "Undressing free compact groups".

J.L. Noakes, "Decomposable fibrations".

N.R. O'Brian, "Grothendieck-Riemann-Roch for complex manifolds".

P.F. Price, "Geometry in physics: the canonical connection on a symmetric space is a source-free Yang-Mills field".

J.S. Richardson, "Fundamental groups of regular hyperbolic polyhedra".

R.W. Richardson, "Orbits, invariant representations associated to involutions of reductive groups".

W.J. Ricker, "A class of convex bodies".

J.H. Rubinstein, "Minimal surfaces and Heegaard decompositions of 3-manifolds".

N. Smythe, "The Burau representation of the braid group is pairwise free".

J.C. Stillwell, "Computational complexity of topological problems".

4. GROUP THEORY

V.V. Deodhar, "On central extensions of rational points of algebraic groups".

G. Glauberman, "Recent results on local analysis of finite groups".

F. Gross, "Complements and supplements of normal subgroups which are direct products".

R.B. Howlett, "System normalizers and groups of central type".

D.C. Hunt, "Ree groups".

J.D. Jarrat, "The decomposition of crystal families".

G. Karpilovsky, "On commutative group algebras".

G.I. Lehrer, "The dual of an arbitrary representation".

I.G. Macdonald, "Conjugacy classes and representations of odd degrees of finite Coxeter groups".

G. Maxwell, "Sphere packings and hyperbolic reflection groups".

M.F. Newman, "A subgroup orbit problem".

R.W. Richardson, "Weyl group representations induced from centralizers of involutions".

5. NUMBER THEORY

E.S. Barnes, "The minimum determinant of a Minkowski-reduced quadratic form".

W.A. Coppel, "Polynomial lattices".

R. Matthews, "Some results on permutation polynomials".

C.J. Smyth, "More on Lehmer's question".

A.J. van der Poorten, "Automata and functional equations".

R. Yager, "P-adic L-functions and Iwasawa theory".

6. NUMERICAL ANALYSIS AND APPROXIMATION THEORY

B.R. Benjamin, "Applications of surface fitting".

W.R. Bloom, "Application of the real interpolation method to approximation theory".

J. Kautsky, "Stable evaluation of the knots of Gaussian quadratures with some knots pre-assigned". "Stable evaluation of the weights of interpolatory quadrature".

T.M. Mills, "A new estimate for the approximation of functions by Hermite-Fejer interpolation polynomials".

D.F. Paget, "Hadamard finite part integration".

I.H. Sloan, "Quadrature methods for integral equations of the second kind over infinite intervals".

7. RING THEORY AND OTHER TOPICS IN ALGEBRA

D.F. Fearnley-Sander, "Euclid via Grassmann and Clifford with an unfamiliar ring".

B.J. Gardner, "Absolute retracts, relatively injective simple objects and Brown-McCoy radicals".

G. Karpilovsky, "On group rings of ordered groups".

G. Pilz, "Polynomial near-rings". "Euclidean rings in computer science".

P. Schultz, "Modules with isomorphic endomorphism rings".

S. Scott, "Tame near-rings and N-groups".

P.G. Trotter, "Homomorphisms of regular semigroups".

8. STATISTICS

D. Broadfoot, "Forms Entry Software".

R.M. Clark, "Smoothing of directional data".

R. Corluy, "Mathematics and Phylogeny".

P. Dichomides, "Statistical problems in stereology".

F.J. Ecker, "Linear Models with stably-distributed errors".

N.I. Fisher, "Goodness-of-fit and outlier detection".

L. Hamey, "Z80 Microprocessor Software".

M. Hudson, "Statistical problems arising in clinical trials".

D. McNeil, "What is a clinical trial?" "Analysis of physiological data".

B.P. Murphy, "Getting statistical packages onto Z80 Microcomputers".

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