

18. A 2×2 Factorial with Paired Comparisons. ROBERT M. ABELSON, AND RALPH ALLAN BRADLEY, Virginia Polytechnic Institute.

The parameters previously specified for a method of paired comparisons are redefined in such a way as to permit the use of treatments in factorial array. The algebraic procedure is shown in general but the normal equations resulting from the use of maximum likelihood are nonlinear and difficult to solve. Easy solution of the normal equations seems to be limited to the 2×2 factorial and an explicit solution is given for that case. The method of paired comparisons presented for 2×2 factorial treatments permits most of the comparisons available through usual analysis of variance. It is possible to test for the presence of both main effects and their interaction. A numerical example is included.

19. On Wald's Confidence Interval for the Ratio of Variances in a Variance Components Model. W. A. THOMPSON, JR., Virginia Polytechnic Institute and University of North Carolina.

Wald's confidence interval ("A note on regression analysis," *Ann. Math. Stat.*, Vol. 18 (1947), p. 586) is specialized to the case of incomplete block designs with random block effects. A theorem concerning the multiplicity of the characteristic roots of the variance-covariance matrix of the adjusted yields is discussed and applied to Wald's confidence interval. A practical example is discussed. This work was done under contracts with the Air Force and the Quartermaster Corps.

NEWS AND NOTICES

Readers are invited to submit to the Secretary of the Institute news items of interest

Personal Items

Paul M. Blunk has accepted the position of Operations Analyst with the Consolidated Vultee Aircraft Corporation at Fort Worth, Texas.

Dr. R. S. Burlington, Chief Mathematician of the Bureau of Ordnance, Navy Department, and head of the Evaluation and Analysis Group of the Bureau of the Ordnance, has been named Special Assistant to the Director of Research and Development, Bureau of Ordnance, Navy Department, Washington, D. C.

Visiting Associate Professor Kai Lai Chung of Cornell University has been appointed Associate Professor at Syracuse University. He is in charge of an ARDC Research project on probability and statistics there.

Charles W. Dunnett, formerly Biometrician for the Food and Drug Laboratory, Ottawa, Canada, is now on the statistical staff of the Lederle Laboratories Division of the American Cyanamid Company located in Pearl River, New York.

Edward A. Fay, formerly a graduate student at the University of California, has been employed since September 1950 as a statistician with the United States Naval Ordnance Test Station, China Lake, California.

Professor E. J. Gumbel, Columbia University, has been appointed Visiting Professor for Statistics at the Free University, Berlin (West) for the summer term 1954. Professor Gumbel has also been elected a member of the International Statistical Institute at The Hague.

Stuart T. Hadden, formerly Chemical Engineer with the Research & Develop-

ment Division of Socony-Vacuum Oil Company, Inc. in Paulsboro, New Jersey, has joined the Research Division of New York University as Research Associate in the Chemical Engineering Department and is taking graduate courses in Chemical Engineering and Mathematics.

Daniel R. Embody is now employed as a Biometrician in the Division of Analytical and Physical Chemistry of the Squibb Institute, New Brunswick, New Jersey.

Dr. J. F. Hannan, formerly of the Catholic University of America, has accepted an assistant professorship at Michigan State College, East Lansing, Michigan.

Clifford Hildreth, formerly Associate Professor in the Cowles Commission, University of Chicago, has accepted a position as Professor of Agricultural Economics, North Carolina State College, Raleigh, North Carolina.

William C. James of the United States Embassy has been transferred from Lima, Peru and expects to be stationed in Caracas, Venezuela for the next two years.

Dr. Gopinath B. Kallianpur returned to India in July 1953 and has joined the Indian Statistical Institute in Calcutta. On his way home he visited the Statistical Laboratory at Cambridge and the Institut Henri Poincaré in Paris.

E. P. King is now employed as a Consulting Statistician on the staff of the Control Division of Eli Lilly and Company.

Boyd Ladd, formerly with the Bureau of the Budget, Office of Statistical Standards, as a specialist in Statistical Methods and in Transportation Statistics, has joined the Operations Research Office, Johns Hopkins University where he is doing operations analysis in logistics problems.

Eugene Lukacs, formerly with the National Bureau of Standards, is now serving as head of the Statistics Branch, Office of Naval Research.

J. W. Mayne, formerly employed with the Defence Research Board as Chief of the Statistical Analysis Section and of The Northern Operational Research Section of the Operational Research Group, on November 1, 1953 was posted to HQ Western Command and HQ Tactical Air Command as Senior Operational Research Officer of the Joint Services Operational Research Team, Edmonton, Alberta.

O. B. Moan has accepted the position of Staff Quality Control Engineer on the Director's Staff of Hughes Aircraft Company, Culver City, California.

Cordell B. Moore, formerly instructor of mathematics and graduate student at the University of Kentucky, Lexington, Kentucky, is now employed as mathematical statistician (Senior Aerophysics Engineer), Consolidated Vultee Aircraft Corporation, Fort Worth Division, Fort Worth, Texas.

James Pachares has accepted a position as statistician at the Naval Air Missile Test Center, Point Mugu, California.

Professor Raymond P. Peterson, Jr., of the University of Washington has accepted the position of Assistant Professor and Head of the Mathematics Department, University of California, Riverside California.

Dr. L. J. Reed, who has recently retired from his position as Vice-President of the Johns Hopkins University and Hospital, has been appointed President of the University.

A. T. Reid, formerly Research Assistant, Committee on Mathematical Biology, University of Chicago, is now a Graduate Student and Research Assistant in the Department of Mathematical Statistics, Columbia University.

I. M. Sahni has accepted a position as Senior Research Officer and Private Secretary to the Deputy Chairman of the Planning Commission, New Delhi, India.

Professor Arnold J. F. Siegert has received a Guggenheim Fellowship and a leave from Northwestern University and is at the Institute for Advanced Study, Princeton, New Jersey during the current academic year.

George W. Snedecor has accepted an appointment to serve as professor in experimental statistics winter quarter 1954 at Alabama Polytechnic Institute, Auburn, Alabama. He will advise and consult with the research staff on experimental design and statistics. This work is part of a cooperative program of statistics among the southeastern states sponsored by the Institute of Statistics of the Consolidated University of North Carolina and by the General Education Board. For the spring quarter, Professor Snedecor will return to the Department of Statistics, Iowa State College.

Department of Statistics, University of Connecticut, Storrs, Connecticut

The University of Connecticut has established a Department of Statistics in the College of Arts and Sciences, beginning spring semester, 1954. The department will be under the direction of Dr. Geoffrey Beall, Biometrician and Professor of Statistics of the University. Courses in general and theoretical statistics will be concentrated in the new department but specialized applicational courses will continue to be given in other parts of the University organization.

New Members

The following persons have been elected to membership in the Institute

November 17, 1953 to February 9, 1954

Abramson, Lee R., Student, Columbia University, 315 E. 206th Street, New York 67, New York.

Adu, Anthony A., B.S. (Roosevelt College), Technical Statistician, Cowles Commission for Research in Economics, University of Chicago, Chicago 37, Illinois, 243 International House, 1414 East 59th Street, Chicago 37, Illinois.

Berndt, Gerald D., M.S. (New York Univ.), Meteorologist, Quartermaster Research & Development Center, Department of the Army, 42 Fenelon Road, Framingham, Massachusetts.

Brickley, Robert L., M.S. (Purdue Univ.), Statistician, Materials Engineering Division,

- Westinghouse Electric Corporation, *Box 230 Lincoln Hwy., East McKeesport, Pennsylvania.*
- Bright, Harold F.**, Ph.D. (Univ. of Texas), Chief, Technical Services, Human Resources Research Office, The George Washington University, Box 3596, Washington 7, D. C., *Route 4, Box 648, Old Braddock Road, Fairfax, Virginia.*
- Brooks, Samuel H.**, B.S. (Univ. of Maryland), Student, Department of Biostatistics, Johns Hopkins School of Hygiene, 615 N. Wolfe Street, Baltimore 5, Maryland.
- Buckland, William R.**, Ph.D. (London), Senior Executive Assistant, Statistical Section, Development & Research Department, London Transport Executive, 55 Broadway, Westminster, London S. W. 1, England.
- Cargo, Gerald T.**, M.S. (Univ. of Michigan), Private in the Army, Surveillance Laboratory, Ballistics Research Laboratory, Aberdeen Proving Ground, Maryland, U.S. *52346636, 9301 TSU (Ord) BRL Det., Aberdeen Proving Ground, Maryland.*
- Demén, Theodosius L.** (Rev.), B.S. (The Theological Academy of Zirc, Hungary), Graduate Student, Department of Mathematics and Assistant, Physics Department, Marquette University, *1639 N. 5th Street, Milwaukee, Wisconsin.*
- Duffett, James R.**, M.S. (Univ. of Florida), Mathematical Statistician, OCO Guided Missile Reliability Group, Los Angeles Ordnance District, *55 South Grand Avenue, Pasadena 2, California.*
- Flanagan, Joseph E.**, Ph.D. (Univ. of Illinois), Assistant Professor of Mathematics, Mathematics Department, Carnegie Institute of Technology, Pittsburgh 13, Pennsylvania.
- Goodman, Nathaniel R.**, M.S. (Illinois Inst. of Tech.), Student, Princeton University, *Room 511, 1903 Hall, Princeton University, Princeton, New Jersey.*
- Hook, Lee H.**, B.S. Ch.E. (Purdue Univ.), Teaching Assistant and Student, *706 Delaware Street, S.E., Minneapolis 14, Minnesota.*
- Merrill, W. Jay, Jr.**, A.B. (Univ. of Delaware), Statistician, Development Planning Group, IBM Engineering Development Center, Endicott, New York, *58 Grand Boulevard, Binghamton, New York.*
- Morrison, Donald F.**, B.S. (Boston Univ.), Graduate Assistant, Mathematics Department, College of Liberal Arts, Boston University, 725 Commonwealth Avenue, Boston 15, Massachusetts, *64 Boardman Avenue, Melrose 76, Massachusetts.*
- Ney, Peter E.**, M.A. (Columbia Univ.), Assistant and Student, Mathematical Statistics, Columbia University, *5410 Netherland Avenue, New York 71, New York.*
- Odeh, Robert E.**, B.S. (Carnegie Inst. of Tech.), Graduate Student, Mathematical Statistics, Department of Mathematics, Carnegie Institute of Technology, Pittsburgh 13, Pennsylvania, *5054 Forbes Street, Pittsburgh 13, Pennsylvania.*
- Perrault, William E.**, M.S. (Univ. of Michigan), Graduate Student, St. Louis University, *1237 South 14th Street, St. Louis, Missouri.*
- Roach, W. L.**, M.A. (Univ. of Oregon), Graduate Assistant, Department of Mathematics, University of Oregon, Eugene, Oregon.
- Smolak, Jean F.**, B.S. (Univ. of Michigan), Senior Statistician, Biological Control, E. R. Squibb & Sons, New Brunswick, New Jersey, *40 West Spring Street, Somerville, New Jersey.*
- Summers, J. F.**, M.A. (Univ. of Texas), Machine Methods and Procedures Analyst, The Texas Company, Producing Department, Houston, Texas, The Texas Company, P. O. Box 2332, Houston 1, Texas.
- Teng, Lincoln C.**, M.S. (Univ. of Michigan), Graduate Student in Mathematics, Massachusetts Institute of Technology, *282 Massachusetts Avenue, Cambridge, Massachusetts.*
- Turner, Malcolm E., Jr.**, B.A. (Duke Univ.), Graduate Research Assistant, Department of Biostatistics, School of Public Health, University of North Carolina, *3517 East Oak Drive, Durham, North Carolina.*
- Ullrich, Egon**, Ph.D. (Universität Graz), ord. Professor (Mathematik), Direktor des Mathe-

matik Instituts der Justus-Liebig-Hochschule (Universität) Giessen, Johannesstr. 1, (Hessen, Bundesrepublik Deutschland).

Wilkinson, John W., M.A. (Queen's Univ., Kingston, Canada), Graduate Student, Institute of Statistics, University of North Carolina, 306 McCauley Street, Chapel Hill, North Carolina.

Wine, R. Lowell, M.A. (Univ. of Virginia), Student, Virginia Polytechnic Institute, Route One, Box 311, Roanoke, Virginia.

REPORT OF THE ITHACA MEETING OF THE INSTITUTE

The fifty-ninth meeting of the Institute of Mathematical Statistics was held in Ithaca, New York on March 18–20, 1954. Among the members of the Institute who attended were:

R. R. Bahadur, Allan Birnbaum, Robert Bechhofer, Julius Blum, Isadore Blumen, Kai Lai Chung, Louis Cote, Edwin L. Cox, Cuthbert Daniel, Reed B. Dawson, Jr., Cyrus Derman, T. G. Donnelly, J. E. Dowd, Rudolf Drenick, Charles Dunnett, A. Dvoretzky, W. T. Federer, Albert Folop, M. N. Ghosh, John E. Freund, Frances Hobson, J. E. Jackson, Mark Kac, Leo Katz, Jack Kiefer, H. G. Landau, S. B. Littauer, Stuart P. Lloyd, Eugene Lukacs, Philip J. McCarthy, P. G. Moore, Norman Morse, R. B. Murphy, M. J. Netzorg, Gottfried Noether, Carl R. Ohman, Emanuel Parzen, Howard Raiffa, Herbert Robbins, Douglas S. Robson, Jerome Sacks, Richard Schwartz, Arnold Siegert, Morris Skibinsky, Milton Sobel, R. G. D. Steel, Henry Teicher, Jacob Wolfowitz.

The program of the meeting was as follows.

THURSDAY, MARCH 18, 1954

- 9:00 a.m. Registration
- 10:30 a.m. Problems of Randomness
 Chairman: R. E. Bechhofer, Cornell University
 Papers: 1. *Random Processes in Physics*, Arnold J. F. Siegert, The Institute for Advanced Study, Princeton, N. J. (on leave from Northwestern University)
 2. *Some Sequential Tests of Randomness*, Gottfried E. Noether, Boston University.
- 1:30 p.m. Contributed Papers I.
 Chairman: P. J. McCarthy, Cornell University
 Papers: 1. *Confidence Region Procedures Based on the Logarithm of the Likelihood*, Carl R. Ohman, Princeton University.
 2. *A One-Sided Confidence Interval for an Unknown Distribution Function*, Herbert E. Robbins, Columbia University.
 3. *The Mean Successive Difference in Samples from an Exponential Population*, P. G. Moore, University College, London, and Princeton University.
 4. *Application of the Duality Theorem of Linear Programming to Testing Hypotheses*, Howard Raiffa, Columbia University.
 5. *Multiple Points of Paths of Brownian Motion in the Plane*. (By Title). A. Dvoretzky, Columbia University, P. Erdos, Notre Dame University, and S. Kakutani, Yale University.

6. *On the Distribution of the Largest and Smallest Roots of a Matrix in Multivariate Analysis.* (By Title). K. C. S. Pillai, University of North Carolina and University of Travancore.

3:00 p.m. Applications of Stochastic Processes

Chairman: Isadore Blumen, Cornell University

- Papers: 1. *Remarks on the Wiener Process and the Estimation of its Parameters*, Eugene Lukacs, Office of Naval Research.
2. *On Some Problems in Stochastic Processes*, Mark Kac, Cornell University.

FRIDAY, MARCH 19, 1954

9:00 a.m. Recent Developments in Stochastic Approximation

Chairman: Leo Katz, Michigan State College

- Papers: 1. *Stochastic and Nonstochastic Approximation Methods*, Jack Kiefer, Cornell University.
2. *Strong Consistency of Stochastic Approximation Methods*, Julius Blum, Indiana University.
3. *Asymptotic Properties of the Robbins-Monro Procedure*, Kai Lai Chung, Syracuse University.

Discussant: Herbert E. Robbins, Columbia University

11:00 a.m. Biological Sampling

Chairman: Walter T. Federer, Cornell University

Papers: 1. *Tag-recapture methods*, Edwin L. Cox, Case Institute of Technology.

Discussant: Douglas S. Robson, Cornell University

1:30 p.m. Contributed Papers II.

Chairman: R. G. D. Steel, Cornell University

- Papers: 1. *A Problem in Two-stage Decision Theory, (Preliminary Report)*, Morris Skibinsky, University of North Carolina.
2. *Some Simple Sequential Tests and Estimates for Comparing Variances*, Allan Birnbaum, Columbia University.
3. *A Minimal Sequence of Statistics*, R. R. Bahadur, Columbia University.
4. *Strong Convergence of Stochastic Approximation Methods of Robbins, Monro, Wolfowitz and Kiefer*, M. N. Ghosh, University of North Carolina (Introduced by B. G. Greenberg).
5. *On an Ergodic Property of the Brownian Motion Process*, Cyrus Derman, Columbia University.
6. *On the Distribution of Hotelling's Generalized T Test.* (By Title). K. C. S. Pillai, University of North Carolina and University of Travancore.
7. *Power and Sample Size for Small Samples on Testing Hypotheses Concerning a Bernoulli Variable.* (By Title). Howard Raiffa, Columbia University.

3:00 p.m. Problems in Applied Probability

Chairman: Milton Sobel, Cornell University

- Papers: 1. *Estimation by the Minimum Distance Method*, Henry Teicher, Purdue University.
2. *The Theory of Queues*, J. Wolfowitz, Cornell University.

SATURDAY, MARCH 20, 1954

9:00 a.m. Applications of Statistics to Industrial Problems

Chairman: J. Edward Jackson, Eastman Kodak

- Papers: 1. *A Multiple Comparisons Test for Comparing Several Treatments with a*

Control, Charles W. Dunnett, Lederle Laboratories Division, American Cyanimid Co.

2. *Industrial Uses of Fractional Replication*, Cuthbert Daniel, Engineering Statistician.

Discussants: S. B. Littauer, Columbia University
R. B. Murphy, Bell Telephone Laboratories

ISADORE BLUMEN
Assistant Secretary

REPORT OF THE GAINESVILLE MEETING OF THE INSTITUTE OF MATHEMATICAL STATISTICS

The 60th meeting of the Institute of Mathematical Statistics was held jointly with the Biometrics Society, ENAR, on the campus of the University of Florida, Gainesville, Florida on Thursday, March 18, 1954.

The following 26 members of the Institute attended the meeting:

R. A. Bradley, A. C. Cohen, Gertrude Cox, Lee Crump, J. H. Curtiss, James R. Duffett, David B. Duncan, G. L. Edgett, R. J. Hader, G. Ronald Herd, Walter W. Hoy, J. S. Hunter, M. G. Kendall, Boyd Ladd, Herbert A. Meyer, Dayle D. Rippe, S. N. Roy, K. C. Seal, G. W. Snedecor, Paul N. Somerville, D. E. South, Melvin G. Springer, John W. Tukey, M. C. K. Tweedie, Harry Weingarten, and John Woodward.

On Thursday morning Dr. Linton E. Grinter, Dean of the Graduate School, University of Florida, introduced by Dr. Herbert A. Meyer, welcomed the members to the campus. Professor D. E. South, also of the University of Florida, presided at the opening session at which there were approximately 70 present. The following three papers on truncation problems and applications were presented: *Some Recent Advances Concerning Estimation from Truncated and Censored Samples*, By A. C. Cohen, Jr., University of Georgia; *Discussion and Applications of Truncation Theory, I*, by J. R. Duffett, White Sands Proving Grounds; *Discussion and Applications of Truncation Theory, II*, by John Woodward, Ballistic Research Laboratories, Aberdeen Proving Ground.

At the second morning session, with Professor G. L. Edgett, Virginia Polytechnic Institute and Queens University in the chair, contributed papers, the abstracts of which appear elsewhere in this issue, were presented as follows:

1. *On the Central Limit Theorem for m -Dependent Variables*. P. H. Diananda, University of North Carolina and University of Malaya. (Introduced by H. Hotelling).
2. *On a Property of a Class of Decision Procedures for Ranking Means of Normal Populations. (Preliminary Report)*. K. C. Seal, University of North Carolina.
3. *Simultaneous Confidence Bounds on Canonical Regressions*. S. N. Roy, University of North Carolina.
4. *A New Test of Compound Symmetry*. (By title). S. N. Roy, University of North Carolina.

A session on Quantitative Genetics with Professor G. W. Snedecor of Iowa State College presiding was conducted on Thursday afternoon at which the

following papers were presented: *A Model for the Study of Quantitative Inheritance*, by Virgil Anderson, Purdue University; and *An Extension of the Concept of Partitioning Hereditary Variance for Analysis of Covariances Among Relatives When Epistasis is Present*, by C. Clark Cockerham, North Carolina State College.

At a mid-afternoon session on The Training of Statisticians in the South, with Professor Herbert A. Meyer, University of Florida presiding, the following two papers were given: *Report of the Committee of the Institute of Statistics on the Training of Statisticians*, by G. E. Nicholson, Jr., University of North Carolina; and *Plans and Objectives of the Southern Regional Graduate Summer Sessions in Statistics in 1954*, by Ralph A. Bradley, Virginia Polytechnic Institute.

Contributed papers were presented at a late afternoon session at which Professor P. N. Somerville of Virginia Polytechnic Institute presided. The abstracts of those papers as listed are also printed in this issue:

1. *A 2×2 Factorial with Paired Comparisons*. Robert M. Abelson and Ralph Allan Bradley, Virginia Polytechnic Institute. (Presented by Professor Bradley.)
2. *On Wald's Confidence Interval for the Ratio of Variances in a Variance Components Model*. W. A. Thompson, Jr. Virginia Polytechnic Institute.

On Thursday evening the members were honored by a reception held in the Social Room of the Florida Union.

HERBERT A. MEYER
Assistant Secretary

PUBLICATIONS RECEIVED

- BLANC-LAPIERRE, A. AND R. FORTET, *Théorie des Fonctions Aléatoires*, Masson and Cie, Paris, 1953, xvi + 693 pp., 6.500 francs.
- BURINGTON, RICHARD STEVENS AND DONALD CURTIS MAY, JR., *Handbook of Probability and Statistics with Tables*, Handbook Publishers, Inc., Sandusky, Ohio, 1953, ix + 332 pp.
- DAVID, F. N. AND M. G. KENDALL, "Tables of Symmetric Functions, Part IV," *Biometrika*, Statistical Table No. 18, Cambridge University Press, 1953, 20 pp., 4 shillings.
- Économétrie*, Vol. XL, Colloques Internationaux du Centre National de la Recherche Scientifique, Paris, 1953, v + 334 pp.
- LATSCHA, R., "Tests of Significance in a 2×2 Contingency Table: Extension of Finney's Table," *Biometrika*, Statistical Table No. 17, Cambridge University Press, 1953, 13 pp., 2 shillings and sixpence.
- STEVENS, W. L., "Tables of the Angular Transformation," *Biometrika*, Statistical Table No. 16, Cambridge University Press, 1953, 4 pp., 1 shilling.