SUJIT KUMAR MITRA

(23 January 1932 – 18 March 2004)

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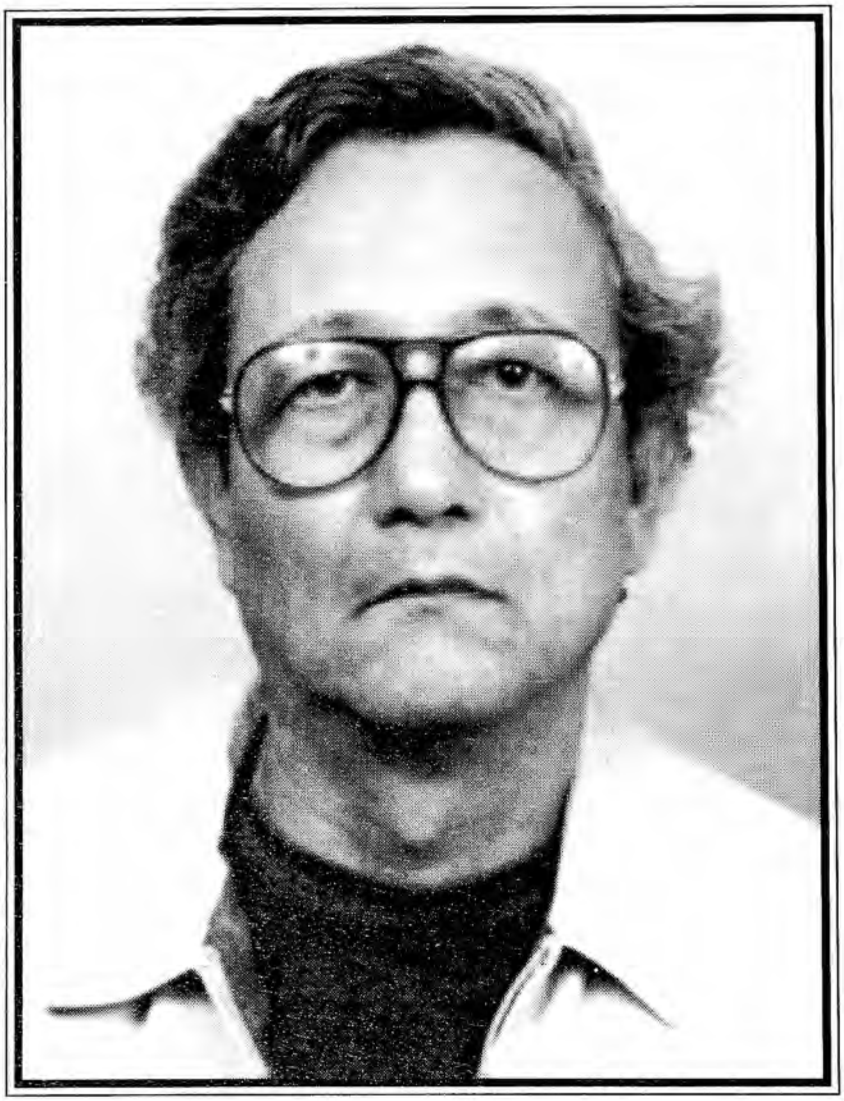

S. K. Mitra

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(1932-2004)

Elected Fellow 1981

EARLY EDUCATION

SUJIT KUMAR MITRA was born on the 23rd of January 1932 in Kolkota, India. He was the eldest son of Ashalatha and Sunil Kumar Mitra. He had his early education in Jeypore, Orissa. His first motivation and inspiration came from his mother and his school teacher Ballav Panda. He was equally good in Sanskrit and Mathematics. Mitra skipped most of the early years in school and got admitted directly to Grade 8. Hence he could complete his schooling at the age of twelve. He completed Intermediate Science from St. Paul's college in 1947. He completed Bsc (Honours) in Statistics from Calcutta University in 1949. He stood first in his class. His teachers Dr CRRao and NH Nandi motivated him to do higher studies in Statistics. The famous stastician, his uncle, D Basu also motivated him. He completed his MSc from Presidency College, Calcutta in the year 1951. He was awarded Calcutta University Gold Medal for his outstanding performance in MSc.

HIGHER EDUCATION

After completing his MSc, Professor Mitra worked as a technician in ISI, Calcutta between 1952 and 1954. He proceeded to the University of North Carolina, Chappel Hill, USA in 1954 for his PhD under the guidance of Professor Samarendra Nath Roy. He got his degree in 1956 on Contributions to Statistical Analysis of categorical data.

He returned to India to rejoin ISI, Calcutta and worked there till 1971.

POSITIONS HELD

Professor Mitra was a Lecturer at ISI, Calcutta, till 1958. He was Reader between 1958 and 1961. He worked as a Professor of Statistics between 1962 and 1971. He worked as a Visiting Professor at Indiana University, Bluemington, USA during 1971 and 1974 and was also a Visiting Professor in Keio University, Yokohama, Japan in 1974. He rejoined as Professor of Statistics, ISI, New Delhi and worked there between 1975 and 1991. He was a distinguished Emeritus Scientist till 1992. During his tenure in Delhi, he worked as a Visiting Professor in Purdue University, USA in 1981 and in the University of Texas, Dallas, USA in 1984.

RESEARCH INTERESTS

Professor Mitra has worked on tolerance limits for normal distribution, effect of non normality on variable sampling plans, unbiased estimation in power series distribution, integration of sample surveys, asymptotic power of frequency chi-square tests, Cornish Fisher type expansion related to the variance ratio, distribution and characterisation of the Wishart distribution, density free treatment of matrix variate beta distribution, singular linear models, generalized inverse matrices, matrix operation induced by electrical networks and matrix partial orders.

RESEARCH CONTRIBUTION

Mitra's work was on uniformly minimum variance unbiased estimator for the parameter θ in a family wide class of discrete distributions introduced by Noak, statistical analysis of categorical data, derivation of Pitman limiting power for goodness of fit chi-square test, characterisation of Wishart distribution and optimal integration of two or three PPS surveys. His work on generalized inverse of matrices can be summarized thus.

Generalised inverse of matrices

This is an area in which interestingly statisticians have made valuable contributions mainly because they are among the first to realize the usefulness of this concept in various statistical applications. A little later came the application in electrical network theory.

Mitra's book on this subject with CRRao was like a crusade against the Moor-Penrose inverse. The Moore-Penrose inverse is certainly useful, but until recently its role was somewhat overemphasized mainly because of one's obsession with uniqueness. There are problems where other inverses that are computationally much simpler could serve the purpose just as well and some others where the Moore-Penrose inverse should definitely be not used. Non uniqueness of generalized inverse in the sense of Rao leads to interesting invariance and characterisation problems some of which were solved by Mitra. Part of this work appeared in joint publication with CRRao and Bhimasankaran. For example, a matrix is uniquely determined by its class of generalized inverses, if A and B are complex matrices of the same order and the Moore-Penrose inverse of A is a generalized inverse of B and vice versa, then A and B are equal. The following interesting result was proved in an earlier paper which appeared in *Sankhya A* (1971). If G is a generalized inverse of A, and further for some positive integer y is a generalized inverse, then G is the Moore-Penrose inverse of A.

In an n part electrical network involving only resistors, the impedance matrix which connects the current vector with voltage vector is symmetric non negative definite. When two such networks with impedance matrices A and B are connected in parallel, the impedance matrix of the parallel connection is given by A (A+B)+B, the parallel sum of A and B (Anderson and Duffin). This operation is commutative and the parallel sum is symmetric non negative definite with its range as the intersections of ranges of A and B. It has several other interesting properties. The commutativity of the parallel sum was used by Mitra for solving consistent matrix equation A1XB1=C1 and A2XB2=C2. In extending this concept to pairs of matrices not symmetric and, it was tempting for Mitra to replace the Moore-Penrose by an arbitrary generalized inverse. A pair of matrices A and B were said to be parallel summable if A(A+B)B is unique in spite of the non uniqueness of the generalized inverse (A+B) Mitra showed that the parallel sum has properties that are strikingly similar to those of the parallel sum of the pair of n n d matrices, as shown by Anderson and Duffin. The class of symmetric non definite matrices of the same order is not saturated (maximal) class of pairwise parallel summable matrices. A large class is formed by the quasi static definite matrices of Mitra and Puri and even larger are the almost positive definite matrices of Duffin and Morley if one restricts oneself to any one of the two types. This classification of a p d matrices is due to Mitra and Odell. The search for a maximal class has still not ended. The class of generalized inverses of the parallel sum of A and B coincides with that of A+B of arbitrarily generalized inverses of A and B. Mitra showed that for a pair of matrices A and B, if there exists a matrix C such that a class of generalized matrices of C coincides with that of A+B, then A and B are parallel summable and C is the parallel sum of A and B. The only excursion required is when C is a null matrix, and either range of A is virtually disjoint with that of B or range of A′ is virtually disjoint with that of B.

Mitra showed how the shorted finite dimensional positive operators of Krein-Anderson-Trapp are connected with two sub classes of generalized inverses considered by Rao and Mitra. When some of the ports of an n port electrical network (involving only resistors) are connected to earth, the impedance matrix of the resulting network is given by an appropriate shorted version of the original impedance matrix. Mitra was able to provide a meaningful extension of this concept to matrices not necessarily symmetric to n n d, bringing in suitable shortability restrictions and show that this definition parallels the definition of Krein-Anderson-Trapp if only the lower order used here is replaced by the minus partial order of Hartwig, which could be defined even on rectangular matrices. The whole theory of matrix inequalities awaits rewriting in terms of the recent partial orders of Drazin and Hartwig. As an interesting byproduct, using the symmetry of the shorted positive operator, Mitra was able to provide solutions of linear matrix equations with prescribed feasible ranks for EXF matrices; this is of interest to electrical engineers and was posed to Mitra by people in this profession.

An optimal inverse introduced by Mitra in *Sankhya A* (1975) strikes a balance between the semi least squares and semi norm functions of the generalised Moore-

Penrose inverse also studied earlier by CR Rao and Mitra. It has properties quite similar to those of the generalized Moore-Penrose inverse. The generalised Moore Penrose inverse was shown to be the limit of a property chosen sequence of optimal inverses. Mitra also used the generalised inverse to solve the nonlinear matrix equation AXAXA=AXA and XAXAX=XAX, which occur in the distribution theory of quadratic forms in multivariate normal variables and in another paper with CGKhatri to find hermitian and sign definite solutions of linear matrix equations.

In a star semi group with an involution (denoted by*) Hastens studied the relation between a pair of elements a, b defined by aa*=ba*, aa*=a*b. It remained however for Drazin to discover that this relation indeed defines a partial order. Thus was born the star order of Drazin for rectangular or square matrices. The first such partial order was known after the positive semi definite ordering attributed to Lowener. Drazin used the Moore=Penrose inverse for the involution. Mitra showed that each of these partial orders could be defined alternatively through the inclusion of classes and subclasses of generalised matrices. Mitra introduced a unified theory of such partial orders which allows us to see the piecemeal results hitherto obtained under a proper perspective.

HONOURS AND DISTINCTION

In 1954 Professor Mitra was awarded ISI prize for team spirit. He was elected Member of the International Statistical Institute in 1969, Fellow of the Institute of Mathematical Statistic in 1974, Fellow of INSA in 1981, Fellow, Indian Academy of Sciences 1990,. He received the distinguished Services Award of the Indian Society for Probability and Statistics 1995.

MITRA AS A PERSON

Dr Sujit Kumar was an excellent scientist, a motivating teacher and a wonderful human being. Unfortunately he contacted Parkinson's disease in 1978. Despite an uphill battle against physical discomfort, he remained an active contributor in varied areas of theory and application of matrices till the end of his life. Always he remained young. He breathed his last on the 18th of March, 2004. In him, the country has lost a towering personality in Statistics.

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