

OBITUARY: *Christopher Charles Heyde AM, DSc, FAA, FASSA*



Christopher Charles Heyde, 1939–2008

Chris, as he was affectionately referred to by colleagues and friends, was born in Sydney, Australia, the son of Gilbert Christoph von der Heyde and Alice Danne Wessing. His parents separated when he was very young, and Chris was brought up essentially by his mother. He went to school at Barker College, Hornsby (a suburb of Sydney), where he excelled at sports, particularly swimming for which he won many medals. He was Dux of the school in 1956.

Chris's interest in mathematics was sparked by a gifted schoolteacher; once he had tasted the delights of mathematical reasoning, Chris rapidly developed his talent. In 1957 he enrolled at the University of Sydney on a Commonwealth Undergraduate Scholarship. He completed the Fourth Year Honours Program in Mathematical Statistics in the first full year, 1960, of the existence of the Department of Mathematical Statistics, in which H. O. (Oliver) Lancaster was the Foundation Professor; he graduated with First Class Honours and the University Medal in 1961. Chris continued his studies at Sydney, and received his MSc in 1962 for a thesis on the 'Theory of characteristic functions and the classical moment problem'. His note from this period (On a property of the lognormal distribution, *Journal of the Royal Statistical Society B* 25, 392–393), in which he showed that the lognormal distribution is not determined by its moments, became a classic.

In 1961 he won a Commonwealth Postgraduate Research Scholarship to the Australian National University (ANU), and began to work in P. A. P. (Pat) Moran's Department of Statistics on a PhD thesis entitled 'Results related to first passage time problems and some of their applications'. His nominal supervisor was J. E. (Jo) Moyal, but Chris worked mainly on his own, following some suggestions made to him by Pat Moran. He was awarded his PhD in statistics in 1965, and later that year married Elizabeth (Beth) James; they had two boys, Neil born in 1967 and Eric born in 1969. At the time of Chris's death, he and Beth were the proud grandparents of Neil's two children and Eric's two children.

In September 1964 Chris joined Joe Gani, then also a member of Pat Moran's Department, and Uma Prabhu, then of the University of Western Australia, in moving to the Department of

Statistics at Michigan State University (MSU), East Lansing. The three of them attempted to build up teaching and research in stochastic processes, but met with some difficulties. When Joe Gani left MSU to take up the Chair of Probability and Statistics at the University of Sheffield, UK, at the end of 1965, Chris followed him there as a Lecturer. He was soon promoted to Special Lecturer in charge of the Statistical Laboratory at the University of Manchester in 1967, when the Manchester–Sheffield School of Probability and Statistics was formed.

Chris returned to Australia in September 1968, where he took up a Readership in Ted Hannan's Department of Statistics in the School of General Studies (SGS) at the ANU. He had by then produced some 30 papers, a dominant theme of which was the refinement of classical limit theory involving large and small deviations, rates of convergence, and domains of attraction, while displaying a breadth of interest in the contemporary issues in probability. There were strong links between Ted's teaching department and Pat Moran's purely research department in the Institute of Advanced Studies. The SGS department, which had considerable strength in research, stimulated Chris's interests in new directions, notably the theory of branching processes, statistical inference for them, and population genetics models related to them. In addition to a number of papers written individually by Chris, there were several joint papers with Eugene Seneta on these topics, and with Ted Hannan on time-series analysis. In this work, a principal focus by Chris was the martingale concept. He was to become widely known for work on the theory and application of martingale methods, not least in estimation for stochastic processes. In 1973 he was awarded a DSc by ANU 'after due examination of his published work in the field of mathematical statistics and probability'.

The period in the SGS department also saw the genesis of Chris's interest in the history of probability and statistics in company with Eugene Seneta; both were influenced by Bienaymé's 1845 discovery of the criticality theorem of branching processes, to which they had been led by remarks of Oliver Lancaster. Their 1977 book on Bienaymé (*I. J. Bienaymé. Statistical Theory Anticipated*) was effectively a history of probability and statistics in the nineteenth century, perhaps the first of a modern resurgence of books on the history of statistics.

In January 1975, Chris joined the CSIRO Division of Mathematics and Statistics, of which Joe Gani had just become Chief; Chris was first a Senior Principal Research Scientist and then, from 1977, Chief Research Scientist and Assistant Chief of the Division. He took over as Acting Chief in 1981, when Joe Gani left the Division, until September 1983 when he was appointed Professor and Chairman of the Department of Statistics at the University of Melbourne. He proved to be an excellent Chairman who strongly encouraged the pursuit of research and the use of computer facilities by staff and students. He was instrumental in creating the Statistical Consulting Centre, and gave strong support to its director and staff. In 1985 he succeeded in obtaining a very large Federal Government grant for the support of a Key Centre for Statistical Science, a joint enterprise of La Trobe, Monash and Melbourne Universities, and the Royal Melbourne Institute of Technology, of which he became the Foundation Director.

In May 1986 Chris returned to the ANU, and was Professor and Head of the ANU Department of Statistics in the Institute of Advanced Studies from July 1986 to December 1988. Pat Moran had retired in 1982, and Ted Hannan, Head till July, had retired in December 1986. From 1989 to 1992, Chris was the Foundation Dean of the ANU School of Mathematical Sciences (now the Mathematical Sciences Institute), which consisted of all mathematically oriented groups in both undergraduate and graduate sections of the ANU. Since 1993, while continuing at ANU, he was also a Professor in the Department of Statistics at Columbia University, New York. He taught there for their fall semester each year (September to December) until 2007, and was the Director of that university's Center for Applied Probability.

Chris took a serious interest in the development of mathematics and statistics both in Australia and internationally. He served the Australian Academy of Science in a variety of ways: as a member of Sectional Committee 1 for mathematics from 1978–82 (Chairman 1980–82), as Council Member from 1986–93, as Vice-President from 1988–89, and as Treasurer from 1989–93. He was Chairman of the Executive Committee of the Australian Foundation for Science from 1990–92, and was a Director of the Foundation between 1992 and 1999. He was a member of Council of the Australian Mathematical Society from 1980–83 and its Vice-President in 1981. He was Vice-President of the International Statistical Institute (ISI) from 1985–87 and again from 1993–95; he was also a member of the ISI's Bernoulli Society Council from 1979–87, its President Elect from 1983–85, and its President from 1985–87. He was a member of the Statistical Society of Australia's (SSA) Canberra Branch Council from 1973–83 and Branch President from 1987–89. When at the University of Melbourne, he was a member of the Victorian Branch Council from 1984–86, and Branch President from 1985–86. He was a member of the SSA's Central Council from 1973–86 and the Society's Federal President from 1985–86. He was a member of the Australian Mathematics Competition Board from 1981–92 and on the Board of its successor, the Australian Mathematics Trust, from 1992. His publications list contains invited articles which attest to his ongoing concern about public perception and the future of mathematical and statistical science, presented from his authoritatively perceptive standpoint.

Chris laboured mightily in the editorial vineyard. He was the Associate Editor responsible for probability and statistics of the *Journal of the Australian Mathematical Society* from 1972–74, the Editor of the *Australian Journal of Statistics* from 1973–78, the Associate Editor of *Annals of Probability* from 1974–81, *Mathematics of Operations Research* from 1976–90, *International Statistical Review* from 1980–87, and *Advances in Applied Probability* from 1972–82. He was also Associate Editor of *Stochastic Processes and Their Applications* from 1972–82, and its Editor from 1983–89. He was one of the Editors of the Springer series of books in Probability and Its Applications from 1985–2007.

He had a close association with the Applied Probability Trust from its inception. An article of his appeared in the first 1964 volume of *Journal of Applied Probability*, and there were many further articles in many subsequent volumes. He was one of the Editors of *The Mathematical Scientist* from 1982–2007, and Editor-in-Chief of *Journal of Applied Probability* and *Advances in Applied Probability* from 1990–2008, jointly with Søren Asmussen from May 2005.

He served as a valued Trustee of the Applied Probability Trust for 24 years, from 1984 until his death. He was largely instrumental in the decision to produce electronic versions of the Applied Probability journals, which are now stored with Project Euclid and JSTOR. His judgement was always sound and he contributed much to the current policies of the Trust, where his counsels will be sorely missed.

His high standards, efficiency, and integrity as editor, author, and coauthor were always greatly respected by his professional colleagues. One of the anonymous assessors for publication of *Statisticians of the Centuries* (2001) put it neatly when he said 'Everything he does, he does well'.

Chris's research ranged over many areas of probability and statistics. He authored and edited twelve books. Three are historical, namely, *I. J. Bienaymé. Statistical Theory Anticipated* (1977), the Bicentennial History Issue of the *Australian Journal of Statistics* (Special Volume 30B, 1988), and *Statisticians of the Centuries* (2001). The first was coauthored and the other two co-edited with Eugene Seneta. Six of the books are edited collections of papers for special

issues of journals, Festschriften, or overviews of particular topics such as the special issue on long-range dependence of the *Journal of Statistical Planning and Inference* (Volume 80, 1999) co-edited with V. V. Anh. Two are contributions to probability and statistics: *Martingale Limit Theory and Its Applications* (1980) with Peter Hall and the later *Quasi-likelihood and Its Applications* (1997).

His papers covered a huge variety of topics, testifying to a great breadth of interest and a remarkable ability to assimilate new directions in probability. They include works on the moment problem, first-passage problems, random walks, the iterated logarithm law, recurrent events, enzyme reactions, queueing theory, branching processes, martingale theory, estimation theory, particularly for branching and stochastic processes, genetic balance and gene survival, invariance principles, weak convergence of probability measures, the Hawkins random sieve, reproduction rates and clutch sizes of birds, outbreaks of rare infections, random trees and stemma construction in philology, long-range dependence, fractals and random fields, random matrices in demographic projections, quasi-likelihood methods, estimation for queueing processes and processes with long-range dependence, inference for time series, robustness of limit theorems, risk assessment for catastrophic events, fractal scaling, and generalizations of the Black–Scholes model in financial mathematics.

Some of the above topics are within the context of a more recent sphere of activity, financial modelling. His ideas of introducing dependence to models for financial returns, and the treatment of the heavy-tailedness of their distribution, have been hugely influential and carried on with numerous groups of students, collaborators, and disciples, to which the publications listed below attest.

The topics listed above encompass a formidable range for any single statistician to work on with authority. A forthcoming book (*Selected Works of Christopher Charles Heyde* (2008), edited by R. Maller, overviews by I. V. Basawa, P. G. Hall, R. Maller and E. Seneta (IMS Lecture Notes–Monograph Series), Institute of Mathematical Statistics) documents this range in some detail.

On the occasion of his 65th birthday, his colleagues, friends, and former students offered him a Festschrift (*Stochastic Methods and Their Applications* (2004), edited by J. Gani and E. Seneta, Journal of Applied Probability Special Volume 41A) as a token of the deep esteem and affection in which he was held by the mathematical and statistical communities, both in Australia and overseas. A list of his publications up to 2003, which contains a number of invited encyclopaedia entries, was appended to the editors' introduction of that 2004 Festschrift. The present obituary is adapted from that introduction and the listing of supplementary articles below is a continuation of the article numbering given therein.

Chris received well-merited recognition for his contributions to probability and statistics. He was elected a member of the International Statistical Institute in 1972, delivering its Fisher Lecture in 1989. He became a Fellow of the Institute of Mathematical Statistics in 1973, and served as a member of its Council from 1982–85 and again from 1991–94. He was elected a Fellow of the Australian Academy of Science (FAA) in 1977. He was invited to give the SSA's Belz Lecture in 1980, and was made an Honorary Life Member of the Society in 1981. He was awarded the SSA's Pitman Medal in 1988, the Hannan Medal of the Academy of Science in 1994, and its Lyle Medal in 1995. The University of Sydney conferred a DSc *honoris causa* upon him in 1998, and he became a member of the Order of Australia (AM) in January 2003 for his services to mathematics, more particularly to statistics and applied probability. In recognition of his contribution to the social sciences he was also elected to Fellowship of the Academy of the Social Sciences in Australia (FASSA) in 2003.

Among his many relaxations, Chris enjoyed his weekend retreat at South Durras on the New South Wales coast, where he, Beth, and their sons Neil and Eric with their families would often spend time together.

Chris was diagnosed with hairy-cell leukemia 11 years before his death, and underwent periods of treatment followed by lengthy periods of blessed remission. He completed his normal activities at Columbia University in the Fall of 2007, but early in 2008 metastatic melanoma was diagnosed in Canberra. In an email message dated 20 January 2008 to one of us, he wrote:

Whatever happens, I certainly feel that I have had a fortunate life. I will be happy to have more, ... but if not, I have had a good innings and can go in peace.

We both saw him a few days before a scheduled operation to relieve pain from a hip fracture. He died in Canberra just over a day after the operation, in the early morning of March 6.

He will be painfully missed, by his wife and family, his many friends, and the probabilistic community worldwide.

His influence will remain. May he rest in peace.

Australian National University, Canberra
University of Sydney

JOE GANI
EUGENE SENETA

C. C. HEYDE PUBLICATIONS

2004

- [203] The central limit theorem. In *Encyclopedia of Actuarial Science*, eds J. Teugels and B. Sundt, John Wiley, Chichester, pp. 651–655.
- [204] Comments on the paper ‘Evidence functions and the optimality of the law of likelihood’ by S. Lele. In *The Nature of Scientific Evidence: Empirical, Statistical and Philosophical Considerations*, eds M. L. Taper and S. Lele, University of Chicago Press, pp. 203–205.
- [205] Asymptotics and criticality for a correlated Bernoulli process. *Australian and New Zealand Journal of Statistics* **46**, 53–57.
- [206] (WITH S. G. KOU) On the controversy over tailweight of distributions. *Operations Research Letters* **32**, 399–408.
- [207] (WITH B. WONG) On the martingale property of stochastic exponentials. *Journal of Applied Probability* **41**, 654–664.
- [208] (WITH A. IRLE) On subordinated market models. In *Proceedings of the International Sri Lankan Statistical Conference: Visions of Futuristic Methodologies* (December 2004), eds B. M. de Silva and N. Mukhopadhyay, Postgraduate Institute of Science, University of Peradenya, Sri Lanka, pp. 1–15.

2005

- [209] (WITH N. N. LEONENKO) Student processes. *Advances in Applied Probability* **37**, 342–365.

2006

- [210] (WITH K. AU) On the problem of discriminating between the tails of distributions. In *Contributions to Probability and Statistics: Applications and Challenges* (Proceedings of the University of Canberra International Statistical Workshop, April 2005), eds P. Brown *et al.*, World Scientific, Singapore, pp. 246–258.
- [211] (WITH B. WONG) On changes of measure in stochastic volatility models. *Journal of Applied Mathematics and Stochastic Analysis* **2006**, 18130.

2008

- [212] (WITH A. SLY) Non-standard limit theorem for infinite variance functionals. *The Annals of Probability* **36**, 796–805.

- [213] (WITH S. LIU) On estimation in conditionally heteroscedastic time series models under non-normal distributions. *Statistical Papers* **49**, 455–469.
- [214] (WITH K. AU) A cautionary note on model choice and the Kullback–Leibler information. *Journal of Statistical Theory and Practice* **2**, 221–232.

To appear

- [215] Scaling issues for risky asset modelling. Submitted.
- [216] (WITH D. WANG) Finite-time ruin probability with an exponential Lévy process investment return and heavy-tailed claims. Submitted.
- [217] (WITH A. SLY) A cautionary note on modeling with fractional Lévy flights. To appear in *Physica A: Statistical Mechanics and Its Applications*.