Joseph L Doob

1910–2004

Joe Doob [r] receiving the National Medal of Science in 1979 from President Jimmy Carter

Joseph Leo Doob, a pioneer in the study of the mathematical foundations of probability theory and its remarkable interplay with other areas of mathematics, died in June in Urbana, Illinois, where he had lived since 1935, arriving as a new faculty member of the University of Illinois. He was 94.

Probability has been a subject of mathematical exploration for more than 300 years, but it was given a firm foundation in the 1930s by such mathematicians such as Kolmogorov in Russia and Doob in America. In his 1937 paper, Doob gave the mathematical framework for the study of continuous parameter stochastic processes, that is, families of measurable functions indexed by a parameter such that the family is pointwise continuous in the parameter.

After the pioneering work of Lèvy, Ville, and others, he began a wide-reaching development of martingale theory about 1940, publishing his paper on *processes of type E*. As David Blackwell observed, Doob's work did not catch on until he started to use the more exciting word *martingale* which had already been used much earlier by Bachelier in a mathematical context. Martingale theory is the focus of one of the chapters, nearly 100 pages long, in Doob's 1953 book *Stochastic Processes*. This treatise of over 650 pages has been one of the most important and influential books on probability since Laplace's 1812 book. One of Doob's papers, often overlooked, gives his simple martingale proof of the Strong Law of Large Numbers, and his work on the almost sure limits of inverse probabilities; see his 1949 paper *Application of the Theory of Martingales*. Martingale theory plays an essential role not only in mathematical statistics but also in the study of Markov processes, information theory, financial mathematics, combinatorics, and many other parts of mathematics, science, and technology.

In 1954, he showed how various classical potential theory concepts, such as the properties of the Perron-Wiener-Brelot solution of the first boundary value problem for harmonic functions on an arbitrary open set and arbitrary assigned boundary function, correspond to properties of superharmonic functions on Brownian motion paths. He obtained similar results for the heat equation in 1955. By the age of 45, he had made significant contributions to complex function theory, ergodic theory, Markov process theory, martingale theory, boundary theory, and much else.

His work became enormously influential. Although he retired at 68, he continued writing, and published a number of papers and two books: one of these, *Classical Potential Theory and Its Probabilistic Counterpart*, is over 800 pages long. A glimpse of his personality and mathematical style can be found in his vivid autobiographical remarks in response to Laurie Snell's well-posed questions in the November 1997 issue of *Statistical Science*.

Joe was born in Cincinnati, Ohio, February 27, 1910, the son of Leo Doob and Mollie Doerfler Doob. The family moved to New York City before he was three years old. His parents felt that he was under-achieving in grade school and placed him in the Ethical Culture School, from which he graduated in 1926. He then went on to Harvard where he received a BA in 1930, an MA in 1931, and a PhD in 1932. After postdoctoral research at Columbia and Princeton, he joined the Department of Mathematics of the University of Illinois in 1935 and served until his retirement. During World War II, he worked in Washington DC and Guam as a civilian consultant to the Navy. He was a member of the Urbana campus Center for Advanced Study from its inception in 1959.

He was married to Dr Elsie Field for nearly sixty years; she died in 1991. She was the Medical Director of Planned Parenthood of Champaign County and worked as a full-time volunteer after her retirement. He is survived by his children Stephen, Peter and Deborah, and four grandchildren.

Doob served the mathematical profession as IMS President in 1950, AMS President 1963-64, and in many other capacities. Among many honors, he was elected a member of the National Academy of Sciences in 1957, a member of the American Academy of the Arts and Sciences in 1965, and a foreign associate of the French Academy of Sciences in 1975. He was awarded the National Medal of Science in 1979. In 1984 he was given the Steele Prize for his outstanding career and "continuing profound influence" by the American Mathematical Society.

He enjoyed, in all seasons and weathers, the camaraderie of the Saturday Hikers, an informal group with nearly 100 years of existence. He also liked to canoe on the nearby Salt Fork, the Vermillion, and the Sangamon rivers, rivers immortalized in the poem *"Memory of a Scholar"* by Richmond Lattimore, the highly praised translator of the *Iliad* and *Odyssey*.

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