Ghosh, Jayanta Kumar

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Abstract: In this article, we describe the legacy of Jayanta Kumar Ghosh, 1937–2017 with glimpses of his career milestones, academic achievements, and personal life.

Born: May 23, 1937.

Jayanta Kumar Ghosh, known as JKG to most of his students, colleagues, and friends, was born on May 23, 1937 in Calcutta (now Kolkata) to Ambernath and Shanti Ghosh. He recalled happy times spent at a large house with many cousins in the posh southern part of the city and fond memories of his early school years.

Those who came in touch with Ghosh almost invariably talk about his scholarship, not only in Statistics and Mathematics but also in many other subjects, including Literature, History, and Philosophy. He developed a habit of reading ever since his childhood and became an avid reader. His uncle played a significant role in instilling intellectual curiosity in him. After finishing school, Ghosh joined the Statistics honors program at Presidency College, Kolkata, and received his Bachelor of Arts in 1956. He obtained his Master of Arts in 1958 and Doctor of Philosophy in Statistics from the University of Calcutta. His doctoral thesis, Optimum Properties of Sequential Tests of Simple and Composite Hypotheses, was written under the supervision of Professor H. K. Nandi.

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Ghosh started his career as a lecturer at the University of Calcutta during 1962–1964. During 1964–1966, he worked at the University of Illinois. He returned to India in 1966 and joined the Indian Statistical Institute (ISI). He served as its director during 1987–1992. When he retired in 2002, he held the prestigious Jawaharlal Nehru Professor position at the ISI and continued his association as Professor Emeritus until his demise on September 30, 2017. Ghosh regularly visited many academic institutions including the University of California, Berkeley, and Purdue University. He also held the position of Professor at the Department of Statistics, Purdue University, from 1997 to 2017, and then Professor Emeritus until his death.

Ghosh received numerous awards and honors in his life including the S. S. Bhatnagar Award for Science and Technology given by the Government of India in 1981, the Mahalanobis Gold Medal of the Indian Science Congress in 1998, the P. V. Sukhatme Prize in 2000, and the International Indian Statistical Association Lifetime Achievement Award in 2010. He was a Fellow of the Institute of Mathematical Statistics, the Indian National Science Academy, and the International Society for Bayesian Analysis. He also served as President of the International Statistical Institute during 1993–1995 and President of the Statistics Section of the Indian Science Congress in 1991. An honorary Doctor of Science degree from the ISI was conferred on him in 2012. In his academic life, he gave many plenary talks including one at the International Congress of Mathematics. The Government of India recognized his stellar achievements by awarding him the Padma Shri, one of the highest civilian awards, in 2014.

Ghosh supervised the doctoral work of nearly thirty-five students at the ISI and Purdue University in diverse areas. Many of these works will have a lasting place in Statistics literature. Professor G. Jogesh Babu, currently a professor at Pennsylvania State University and one of Ghosh’s early Ph.D. students, recalls his experience: “JKG had tremendous vision. During my thesis days, when I came up with some ideas and not sure if they were worth pursuing, he would suggest ‘why don’t you work in this direction,’ ‘why don’t you try if this works.’ At the first instance, the suggestions did not make much sense. But after I went back to my room and spent some time to think, then they made great sense and gave new ideas to pursue. It is in line with his teaching habits, where he used to skip a few steps; and this inculcated critical thinking in the students.”

Ghosh’s teaching was similar in spirit to his supervision of students. He never failed in reminding his students the questions whose answers were being sought. His teaching would awaken curiosity in his students. Moreover, he would include cutting-edge research in his courses. For instance, while teaching a course on Asymptotic Theory to a batch of first year master’s students in 1983, he gave lectures on the bootstrap, which only had appeared in 1979.

Ghosh also used to bring topics, important and of contemporary interest, to the attention of a large group of scientists at the ISI. Examples include his talks on invariance and their use in Statistics in the 1960s, resampling in the early 1980s, and later, statistical learning sometime in the early 2000s. Also, during his time at the ISI, it was a regular feature to see colleagues and students not working directly under his supervision approach him for discussion and never leave empty-handed. He not only provided leadership to Statistics at the institute but also helped Mathematics, Computer Science, and Economics grow there. He worked closely with geologists on the stochastic modeling of sediment transport using data from river flows as well as experimental data from recirculating flumes. He was also seriously interested in applications of statistics in public health and ecology.

Ghosh had very deep respect for work done by Indian statisticians. He occasionally revisited the questions explored earlier by Indian statisticians and wrote about India’s statistical heritage in several of his writings including Ghosh et al.\textsuperscript{[1,2]} He also had a keen interest in India’s official statistical system.

Ghosh served the statistics community in India and the ISI relentlessly. He was an editor of \textit{Sankhyā, The Indian Journal of Statistics}, during 1988–1999. In his stint as the Director of the ISI, Ghosh strove toward creating a culture of cooperation. His vision of the ISI was of an institution where statisticians, besides
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pursuing research in their own subject, would collaborate with scientists of other disciplines in an environment of mutual understanding and respect. Even after his retirement, he remained deeply interested in activities of the Institute and a cohesive force between different scientific communities at the ISI.

Ghosh was keen on broad questions of science and society. In Ref. 3, he wrote “As we look back on one century and prepare for another, we cannot but be aware of great changes that are taking place. One of these may be called democratization, leading to enfranchisement of new nations and new groups within nations. The other sort of change is really a second industrial revolution, of which key ingredients have been the production, marketing and consumption of information, often in a very interactive way. If these movements retain their present momentum for a considerable period of time, the future will be very different from what we are used to and not all the transitions will be easy. Many skills will become redundant and democratization will need new levels of self-discipline and tolerance of different points of view. New values and skills will be needed to survive and prosper in a changing world. Depending on how we accept the future, preparing for the future can be a challenging, rather than a frustrating or frightening, experience.”

Ghosh immensely contributed to many areas of statistics in his career spanning nearly six decades, encompassing sequential analysis, foundations, higher order asymptotics, objective Bayesian inference, semiparametric statistics, Bayesian asymptotics, Bayesian nonparametrics, model selection, and high-dimensional statistics, as well as applied work in reliability theory, statistical quality control, modeling hydrocarbon discoveries, geological mapping, and DNA fingerprinting. He collaborated with an extraordinary number of people, including his students. He authored or coauthored about 140 papers, 3 monographs, and several edited volumes. His monograph on Higher Order Asymptotics[9] is a unique book focusing precisely on higher order properties with a significant coverage of Bayesian methods. His book on Bayesian Nonparametrics[5] was the only theoretical book on nonparametric Bayesian inference when it was published and remained so for a long time. His textbook on Bayesian Statistics[6] contains a wealth of material for research as well. A detailed account of his work along with references is available in the article by Clarke and Ghosal[7].

Ghosh’s first published work was on double minimaxity, the simultaneous minimization of average Type I and II error probabilities[8]. His other significant work in sequential analysis are on the monotonicity of the operating characteristic function of the generalized sequential probability ratio test[9] and admissibility based on the Ghosh–Pratt identity, the role of sufficient statistics and complete class theorems[10]. After a gap of two decades, Ghosh again worked in sequential analysis and showed that Stein’s two-stage procedure for bounded-length confidence intervals cannot be improved in the traditional sense[11], but it can be done using a random confidence coefficient[12].

As a deep thinking person, the foundations of Statistics always fascinated Ghosh. One of his most important contributions is to show that reduction by sufficiency and by invariance can be generally interchanged[13]. The reduction by sufficiency first is easier to apply, whereas the reduction by invariance first is logically more appealing. His another significant contribution about sufficiency in a discrete setting[14] is especially useful in sample surveys.

Asymptotics was a principal tool in Ghosh’s research, and it played a part in almost all areas he studied. One of his earliest contributions is an in-probability version of Bahadur’s representation of quantiles[15] assuming only the positivity of one derivative, which is adequate for most statistical applications. One of his classic and most useful works is on the validity of formal Edgeworth expansion[16,17]. He used this and related techniques in extensively studying higher order efficiency[18,19], second-order admissibility[20], the Bartlett correction[21] and its Bayesian analog[22], the expansion of perturbed chi-square statistics[23], and comparison of the likelihood, Wald’s and Rao’s tests[24].

Ghosh was always interested in Bayesian ideas, but in the middle of his career, he became a fully committed Bayesian. However, he was very pragmatic and insisted that a good statistical method should
have both good frequentist properties and sensible conditional properties. Ghosh’s Bayesian work can be broadly categorized into the objective Bayesian methodology, the limiting behavior of posterior distributions, Bayesian nonparametrics, and model selection. He worked extensively on probability matching priors[25] and found a very curious property that the reverse reference prior, rather than the reference prior itself, generally meets the matching criterion in the two-parameter case[22,26]. Ghosh extensively studied the limiting behavior of posterior distributions such as higher order expansion beyond asymptotic normality[27], posterior normality under conditioning on the sample mean[28], and the limiting structure of posterior distribution in a general setup, covering both regular and nonregular models[29].

Ghosh was one of the pioneers of the modern theoretical development of Bayesian nonparametrics. His papers on posterior consistency in survival models[30], density estimation[31,32], semiparametric location[33], and linear regression models[34] are among the earliest studies of concrete models. Posterior consistency for the Dirichlet process mixture of the normal kernel[31] has been one of his signature works, settling a very important issue affirmatively and opening the path for further studies. Another remarkable idea of his is a construction of noninformative priors through discrete approximations that are equally applicable in nonparametric models[35]. He also made highly significant contributions in developing the general theory of rates of posterior contraction[36]. He also theoretically studied the properties of a Bayesian Robbins–Monro type algorithm for the deconvolution of mixtures[37].

Ghosh’s theoretical research mostly focused on Bayesian model selection[38,39]. In particular, he worked extensively on modifications of the Bayesian information criterion[40–42], especially for high-dimensional models. He also considered the closely related problem of multiple hypothesis testing, which became extremely important after technological advancements created huge volumes of genomics data. Computation with traditional priors is very challenging in this setting because one has to sample across different dimensions. He established a multiple testing optimality result using the horseshoe prior[43], which was one of the earliest results about optimality properties of the posterior using such priors.

Ghosh’s academic accomplishments only tell a part of the story. These do not bring out his gentleness, generosity, his catholic erudition, and the many qualities that evoked admiration and deep affection in those who came to know him.

Books were a major component of his life. He read widely, – history, literature, and general fiction. He was well versed in Bengali and English literature. Sometimes he would express his opinion by quoting Proust or Twain or Tagore or Eliot. He was familiar with most of the classics. He absorbed them, remembered them, and would, at times, succinctly describe a situation with an appropriate quote. Somewhat amused after reading a description of himself as the author of so many papers and so many books, he wrote in an e-mail: “It reminded me of Macaulay who was described by a wit as a book in breeches.”

Ghosh was not very religious but had read and had a deep understanding of religious texts. Later in his life, he found children’s books more cheerful and preferred reading them.

While much of Ghosh’s research is mathematical and theoretical, he valued good ad hoc solutions to important problems. The theory, he would say, will come later. He would quote Buddha, “when a man is wounded by a poisoned arrow, one does not ask the name and clan of the person who fired it; whether the bow was a longbow or a crossbow; whether the arrow was hoof-tipped; curved or barbed. The only concern is the removal of the arrow.”

His habit of scholarship seems to have originated early. He started his long-standing friendship with Rabi Bhattacharya, an eminent probabilist, in his college days, who recalls, “Even as a teenager Jayanta was a little shy and reserved. My special relationship with Jayanta was that among all our classmates and contemporaries I was probably the only one who felt free to talk to him as a friend on various subjects outside of statistics or mathematics. Our other classmates seemed to be somewhat in awe of
Jayanta’s intellect. We were both voracious readers of all kinds of literature—fiction and non-fiction. Every once in a while I would get some suggestions about a good book he had read (borrowed from the British Council library in Kolkata). Even during our college days, I would be impressed by his broad scholarship.”

Ghosh held his advisor H. K. Nandi in high esteem and was greatly influenced by him. Once he had given a draft of one of his papers resulting from his thesis to Nandi for comments and had listed the two of them as authors. Nandi returned the draft with his comments but scratched out his own name. This was a practice that Ghosh too adopted. He would not put his name in a paper unless he had a substantial role in its creation.

In his early days at the ISI, he was reserved but accessible. Anybody could walk into his office and discuss a problem, technical or personal. He would put aside whatever he was doing, listen, and help. He was generous with ideas and suggestions without any expectations.

Kindness and compassion came to him naturally. Sometimes, when compassion dictated it, he did not hesitate to bend rules. He believed that rules were meant as an aid to help people and not to constrain them. As the director of the ISI, this trait sometimes earned criticism, which he ignored. He took dissent well, even encouraged it. He liked informality as evident from his preference to be addressed as JKG by young students rather than by any honorific. There were occasions when he faced unexpected antagonism from persons for whom he had affection for. This made him unhappy but he would rationalize it as a one-time aberration and continue to be cordial. He would often say that “I get upset easily but try not to get angry.”

He liked humor most of the cerebral kind. After he visited Japan, someone in the Stat-Math Tea club at the ISI asked him if he could read Japanese. He promptly answered, “Yes,” adding a little later, “if it is written in English.”

His life was not without adventure. Once while visiting a national park in Tanzania, he recalled, coming out of an outhouse and facing an elephant. “I stood still,” he said, “till the elephant walked away.” On another occasion, in the city of Chandigarh, while walking he suddenly saw a swarm of bees above his head. He started running, they followed. He turned around and ran, and they still followed. The bees were beginning to sting him. “I was quite panicky. Then someone across the road signaled me to sit down and I did. The bees then went their own way in search of another head with bushy hair.”

Ghosh had a great love for the city of Kolkata. D. Basu persuaded him to return to India, at a time when he held a regular position at the University of Illinois Urbana-Champaign. Perhaps the persuasion was not necessary because he used to say that the places and people he loved were in Kolkata and ISI. Whenever he returned from Kolkata, he would start talking about his next visit to Kolkata. He would often talk of the ISI – Dr. C. R. Rao, the summer school in Visakhapatnam in the late sixties and the good old days. This love of the ISI was also a weakness, for he could not distance himself from it; and this did result in some unhappy moments. Toward the end, he wanted to go back to his city. Unfortunately, the circumstances of his illness did not allow him to go.

No mention of Ghosh’s life would be complete without mentioning his wife Ira. She was the mainstay of his life. She took care of his needs, his social obligations, and helped him to be what he was. They had many friends, many visitors, and as a host, she excelled in graciousness. She loved reading and gardening. Her presence became indispensable toward the last months of his life. Unfortunately, she herself was hit with serious illness and passed away just two weeks before him.

Ghosh was a humanist who believed in rational thought, while also being conscious of its limitations. He admired Buddhism and valued compassion. He lived a life that truly reflected these beliefs. To quote him from a letter: “Finally, the first things last, as in life. As one gets old and the once solid foundations of one’s life begin to disintegrate, a warm friendship matters more than anything else.” The warm friendships he had in plenty. He enriched the lives of all those who knew him.
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Related Articles

Bayes Factors; Bayesian Model Selection; Invariant Prior Distributions; Prior Distributions; Model Selection: Bayesian Information Criterion; Improper Distributions; Basu, Debabrata; Admissibility; Asymptotics, Higher Order; Ghosh-Pratt Identity; Semiparametrics; Invariance; Bayesian Methods; Edgeworth Expansion; Sequential Decision Making; Bayesian Nonparametrics; Nonparametric Bayes.

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