



CHAPTER – 9

FAMOUS INDIAN STATISTICIANS AND THEIR CONTRIBUTIONS TO INDIAN STATISTICS

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1. Introduction

The discipline of statistics, often described as the science of data, has been instrumental in shaping decision-making processes in government, industry, and scientific research. From designing experiments to evaluating public health interventions, and from analyzing economic trends to decoding genetic data, statistics has grown to be an essential tool in the modern world. While the global development of this field has seen contributions from many countries, India has played a particularly unique and influential role, producing some of the most revered statisticians in history.

The story of Indian statistics is not just about numbers or equations—it is a narrative of visionary thinkers, institution builders, and pioneers who laid the foundation for data-driven inquiry long before it became a global imperative. Indian statisticians have not only advanced theoretical frameworks but also pioneered practical applications that have had lasting societal impacts. Their work has facilitated major developments in sample survey methodology, multivariate analysis, Bayesian inference, spatial data modeling, and experimental design.

The legacy begins with Prasanta Chandra Mahalanobis, who institutionalized the use of statistics in Indian governance by founding the Indian Statistical Institute (ISI) and introducing large-scale surveys. His contemporaries and successors—like C.R. Rao, R.C. Bose and S.N. Roy further expanded the frontiers of statistical knowledge and shaped the field on an international scale. Later generations, including Jayanta Kumar Ghosh, Malay Ghosh, and Sudipto Banerjee, continued this tradition of excellence, ensuring that Indian contributions remained at the cutting edge of global statistical research.

In this chapter, we explore the profound achievements of these great minds—not merely to honor them, but to understand the significance of their ideas and their continuing relevance in the data-rich world we inhabit today. Through their stories, we gain insight into the intellectual foundations and practical innovations that have defined the Indian statistical tradition.

2. Prasanta Chandra Mahalanobis (1893–1972)

Prasanta Chandra Mahalanobis stands tall among the pioneers of statistics in India. Born on June 29, 1893, in Kolkata (then Calcutta), Mahalanobis was a polymath with a deep interest in science, mathematics, and social issues.

He completed his education at Presidency College, Calcutta, and later at King's College, Cambridge, where his exposure to the journal *Biometrika* ignited his passion for statistics.

Mahalanobis is best remembered for introducing the Mahalanobis distance, a multivariate metric used to measure the distance between a point and a distribution. This measure has found applications across disciplines, including pattern recognition, cluster analysis, and classification in machine learning. It remains a cornerstone in multivariate statistical theory.

However, Mahalanobis's contributions extend far beyond theoretical formulations. He was a visionary institution builder who recognized the importance of statistics in national planning and policy-making. In 1931, he founded the Indian Statistical Institute (ISI), which became a globally renowned center for statistical research and education. Under his leadership, ISI nurtured generations of statisticians, including the legendary C.R. Rao.

Another of his landmark achievements was the establishment of the National Sample Survey (NSS) in 1950, which revolutionized data collection and social research in India. By introducing large-scale sample surveys, Mahalanobis ensured that policy makers could rely on empirical data for decision making. He also played a central role in formulating India's second five-year plan, where he developed the Mahalanobis model, an input-output economic model focused on rapid industrialization. This plan significantly shaped India's early economic development trajectory.

Mahalanobis' impact was not limited to academia or national policy; he was a global figure who served as a statistical advisor to multiple international bodies, including UNESCO and the United Nations. His efforts laid the foundation for the integration of statistical thinking into governance and scientific progress. In recognition of his contributions, Mahalanobis received numerous accolades, including Padma Vibhushan in 1968. His birthday, June 29, is celebrated in India as National Statistics Day in his honor.

Mahalanobis was not only a statistician but a visionary leader whose interdisciplinary approach bridged the gap between theory and application. His legacy continues to inspire statisticians, data scientists, and policymakers.

3. Calyampudi Radhakrishna Rao (1920–2023)

Calyampudi Radhakrishna Rao, widely known as C. R. Rao, was a pioneering Indian-American statistician whose foundational work has profoundly influenced the field of statistics. Born on September 10, 1920, in Huvina Hadagali, Karnataka, India, Rao's contributions have left an indelible mark on statistical theory and its applications across various disciplines. He passed away on August 22, 2023, at the age of 102.

Rao completed his early education in mathematics at Andhra University, earning a bachelor's degree in 1939 and a master's degree in 1940. He then pursued a master's degree in statistics from the University of Calcutta in 1943. Rao obtained his Ph.D. from King's College, Cambridge, in 1948 under the supervision of Ronald Fisher. Later, in 1965, he was awarded the prestigious Sc.D. degree from Cambridge University.

Rao's work has been instrumental in shaping modern statistical theory. Some of his most significant contributions include:

- **Cramér-Rao Bound:** A fundamental result providing a lower bound on the variance of unbiased estimators, establishing a benchmark for estimator efficiency.
- **Rao-Blackwell Theorem:** Developed independently by Rao and David Blackwell, this theorem offers a method to improve estimators by conditioning on sufficient statistics.
- **Fisher-Rao Metric:** A Riemannian metric foundational to information geometry, with applications in statistical inference and machine learning.
- **Orthogonal Arrays:** Introduced by Rao in 1947, these are used in the design of experiments to study the effects of multiple factors efficiently.
- **Generalized Inverses:** Rao defined the generalized inverse (g-inverse) of a matrix, which has applications in linear models and multivariate analysis.

Beyond these, Rao's work extended to multivariate analysis, estimation theory, differential geometry, and the development of statistical methods applicable to fields such as genetics, neuroscience, and machine learning. Rao's career spanned several prestigious institutions:

- **Indian Statistical Institute (ISI):** Rao served as the Head and later Director of the Research and Training School at ISI for over 40 years, playing a pivotal role in developing research and training programs that positioned India prominently on the global statistical map .

- **University of Pittsburgh and Pennsylvania State University:** After moving to the United States, Rao held professorial positions at these institutions, contributing to research and mentoring students.

- **University at Buffalo:** In his later years, Rao was a professor in the Department of Biostatistics at the University at Buffalo's School of Public Health and Health Professions .

Rao also served as president of several major statistical organizations, including the International Statistical Institute, the Institute of Mathematical Statistics, and the International Biometric Society .

Rao's exceptional contributions have been recognized with numerous awards and honors:

- **Padma Bhushan (1968) and Padma Vibhushan (2001):** Among India's highest civilian honors.

- **Shanti Swarup Bhatnagar Award (1963):** For notable and outstanding research in statistics.

- **National Medal of Science (2002):** The highest scientific honor in the United States, awarded for his pioneering contributions to statistical theory.

- **Guy Medal in Silver (1965) and Guy Medal in Gold (2011):** Awarded by the Royal Statistical Society, with Rao being the first non-European and non-American recipient of the Gold medal.

- **International Prize in Statistics (2023):** Often regarded as the "Nobel Prize of Statistics," recognizing his significant contributions to the discipline.

- **Fellow of the Royal Society (1967):** One of the highest honors a scientist can receive.

Additionally, Rao received 38 honorary doctoral degrees from universities in 19 countries and was a member of eight national academies across India, the United Kingdom, the United States, and Italy.

C. R. Rao's legacy extends beyond his theoretical contributions. He was instrumental in developing India's national statistical system, working under the direction of P.C. Mahalanobis to set up state statistical bureaus and a network of statistical agencies at the district level . He founded the Indian Econometric Society and the Indian Society for Medical Statistics, promoting quantitative studies in economics and medical research.

Rao authored 15 books and over 400 research papers, with his works translated into multiple languages, influencing generations of statisticians worldwide. His mentorship produced over 50 Ph.D. students, many of whom became leading figures in the field.

Institutions and awards have been named in his honor, including the C.R. Rao Advanced Institute of Mathematics, Statistics and Computer Science in Hyderabad and the biennial "The Professor C.R. Rao' Award instituted by the Government of India to recognize outstanding contributions in statistics.

Rao's profound impact on statistics and its applications across various domains ensures that his legacy will endure for generations to come.

4. Raj Chandra Bose (1901–1987)

Raj Chandra Bose was a distinguished Indian-American mathematician and statistician, renowned for his fundamental contributions to design theory, finite geometry, and error-correcting codes. Born on June 19, 1901, in Hosangabad, India, and passing away on October 31, 1987, Bose's mathematical innovations have had a lasting impact on both theoretical and applied mathematics.

Bose earned his M.A. in pure mathematics from the University of Calcutta. Despite facing personal and financial difficulties, he pursued his academic career with great determination. His early career began under the guidance of P. C. Mahalanobis at the Indian Statistical Institute (ISI), where he would later influence generations of statisticians, including C. R. Rao.

Raj Chandra Bose is best known for:

- **Design Theory:** Bose made groundbreaking contributions to combinatorial design theory, particularly in block designs and symmetric designs.

- **Finite Geometry:** He introduced and developed several concepts in finite projective and affine planes, which have become foundational in the field.

- **Error-Correcting Codes:** He co-invented the BCH codes (Bose–Chaudhuri–Hocquenghem codes), which are crucial in digital communication and data storage systems.

- **Mathematical Structures:** Bose's work in algebraic and statistical structures has influenced research in cryptography, coding theory, and information systems.

After a significant period at ISI, Bose moved to the United States and held academic positions, most notably at the University of North Carolina at Chapel Hill. He was highly respected not only for his research but also for his mentorship and leadership in academia.

Raj Chandra Bose's work laid the groundwork for many modern technological applications, particularly in information theory and statistical design. His mathematical creativity and perseverance continue to inspire mathematicians and statisticians around the world.

5. Samarendra Nath Roy (1906–1964)

Samarendra Nath Roy was a distinguished Indian statistician and mathematician, widely recognized for his seminal work in multivariate analysis and the application of matrix theory in statistics. Born in 1906, Roy played a foundational role in shaping statistical theory during its formative years, especially in the context of multivariate distributions. He passed away in 1964.

Roy earned his early degrees from Calcutta University, where he also came under the mentorship of Prasanta Chandra Mahalanobis. He became closely associated with the Indian Statistical Institute (ISI), contributing immensely to its academic rigor and global reputation. Roy later pursued higher studies and research abroad, including work in the United States.

Roy's research was pivotal in developing the theoretical backbone of multivariate statistical analysis. His major contributions include:

- **Multivariate Analysis:** Roy was one of the early pioneers to systematize multivariate statistical methods, especially canonical correlation analysis.

- **Roy's Largest Root Test:** This statistical test is used for hypothesis testing in multivariate analysis, particularly in the context of the likelihood ratio test.

- **Matrix Algebra in Statistics:** He advanced the use of matrix algebra in theoretical statistics, making the mathematical framework more robust and applicable.

- **Statistical Education and Training:** Roy was deeply involved in building statistical curricula and mentoring future statisticians, significantly influencing academic training in India and abroad.

Roy held key academic and administrative positions at the Indian Statistical Institute. He also worked at several universities and research institutions internationally, including in the United States, further strengthening cross-national academic collaboration.

Samarendra Nath Roy's legacy is embedded in the very foundations of modern multivariate statistics. His rigorous theoretical work and contributions to statistical education continue to influence generations of

statisticians.

6. J. B. S. Haldane (1892–1964)

John Burdon Sanderson Haldane, popularly known as J. B. S. Haldane, was a pioneering geneticist, evolutionary biologist, and statistician. Born on November 5, 1892, in Oxford, England, Haldane became a key figure in the development of population genetics and made foundational contributions to modern evolutionary biology. He passed away on December 1, 1964, in Bhubaneswar, India.

Haldane was educated at Eton and New College, Oxford, where he studied mathematics and classics. He later pursued a scientific career that spanned physiology, genetics, and statistics, eventually becoming a professor at University College London and later at the Indian Statistical Institute in Kolkata.

Haldane was instrumental in merging Mendelian genetics with Darwinian evolution, forming what is now known as the modern synthesis. His contributions include:

- **Mathematical Population Genetics:** Developed mathematical models to describe gene frequency changes under natural selection, mutation, and genetic drift.
- **Haldane's Rule:** Describes the patterns of sterility and inviability in hybrid offspring between species.
- **Haldane's Dilemma:** Addressed the cost of natural selection and its implications for evolutionary change.
- **Applied Genetics and Physiology:** Conducted research on human physiology under extreme conditions and made early predictions about in vitro fertilization and gene therapy.

In 1957, Haldane emigrated to India, citing political disagreements with British foreign policy. He became a naturalized Indian citizen and joined the Indian Statistical Institute in Kolkata, where he continued his research and mentored young scientists. His later years were spent promoting science and rationalism in India.

J. B. S. Haldane is remembered as a visionary scientist who bridged disciplines and championed the use of mathematics in biology. His legacy endures through his profound impact on genetics, evolutionary theory, and scientific communication.

7. Impact and Legacy

The contributions of India's pioneering statisticians extend far beyond their individual achievements—they collectively established a robust statistical tradition that resonates through academic institutions, public administration, and global scientific inquiry. Their influence has helped shape India into a recognized leader in the field of statistics, while also contributing substantially to the global statistical community.

The establishment of the Indian Statistical Institute (ISI) by Prasanta Chandra Mahalanobis served as a foundational moment in India's scientific history. ISI not only became a hub for cutting-edge statistical research but also emerged as a vital training ground for future generations of statisticians. The institute set high standards for research and academic rigor, which have been emulated across India and in institutions worldwide.

Concurrently, the National Sample Survey Office (NSSO), initiated under Mahalanobis's guidance, institutionalized the use of large-scale statistical surveys in governance. This revolutionized how data was collected and interpreted in the Indian subcontinent. These surveys provided empirical foundations for socio-economic planning, thus bridging the gap between theoretical statistics and public policy.

Statisticians such as C.R. Rao extended the intellectual reach of Indian statistics through groundbreaking theoretical advancements, such as the Rao-Blackwell theorem and the Cramér-Rao bound. Their work has become a fundamental part of statistical inference and is taught globally in statistical education.

Contributions by Raj Chandra Bose in design theory and error-correcting codes, Samarendra Nath Roy in multivariate analysis, and J.B.S. Haldane in population genetics, created interdisciplinary bridges between mathematics, biology, and information theory. These intersections proved instrumental in shaping domains like

cryptography, genetics, and machine learning.

Collectively, their legacies are visible in curricula, journal literature, policy frameworks, and global collaborations. The international recognition they garnered through prestigious awards and academic positions underscores the global impact of their work. Most importantly, their mentorship, institutional building, and scholarly dedication have inspired countless students and professionals, ensuring the perpetuation of their ideas and methods across generations.

8. Conclusion

The legacy of India's forgotten yet foundational statisticians is not only preserved in academic texts or the walls of venerable institutions; it lives on through the continuous evolution of statistical science and its ever-expanding applications. Their pioneering efforts laid the groundwork for a culture of data-driven inquiry at a time when such a paradigm was nascent, both in India and across the world.

Their stories reveal not only intellectual brilliance but also a steadfast commitment to the social relevance of statistics. From developing multi-variate techniques to crafting policies through data-informed planning, these statisticians exemplified how abstract theory can be harnessed for concrete social good.

As the world increasingly relies on data to inform decisions, from health care and economics to climate science and artificial intelligence, the relevance of their work grows ever more pronounced. Recognizing and revisiting their contributions is more than an academic exercise; it is an acknowledgment of the foundational role they played in shaping a discipline that governs much of the modern world.

Their lives and work serve as a powerful reminder that true greatness in science lies not only in discovery but also in the vision to transform that discovery into lasting impact. As we look to the future of statistics in the age of big data and AI, the principles they championed, rigor, utility, and innovation, remain the guiding light.

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