Indian Statistical Institute (ISI)

203 Barrackpore Trunk Road,

Kolkata 700108, India

Indian Statistical Institute (ISI), a unique institution devoted to research, teaching and application of statistics, natural sciences and social sciences. Founded by Professor Prasanta Chandra Mahalanobis in Kolkata on 17th December, 1931, the institute gained the status of an Institution of National Importance by an act of the Indian Parliament in 1959.

The Headquarters of ISI is located in the northern fringe of the metropolis of Kolkata. Additionally, there are three Centres located in Delhi, Bangalore, and Chennai. Research in Statistics and related disciplines is the primary activity of the Institute. Teaching activities are undertaken mainly in Kolkata, Delhi, Bangalore, and Chennai. Offices of the Institute located in several other cities in India are primarily engaged in projects and consultancy in Statistical Quality Control and Operations Research.

Introduction

What began as a small room in the Presidency College in 1931, now comprises buildings on several acres of land in four major cities (Calcutta, New Delhi, Bangalore and Hyderabad)! What began with a total annual expenditure of less than Rs. 250 in 1931, now has a total annual expenditure of over Rs.130 crore! What began in 1931 with a solitary human 'computer' working part-time, now comprises over 250 faculty members and around 880 supporting staff and several modern-day personal computers, workstations, Servers and Campus Networking! Impressive as these figures are, they convey little idea of the road

traversed, the range of activities undertaken and the intimate relationship of the Institute with the life of the nation.

MAJOR OBJECTIVES

The major objectives of the Indian Statistical Institute, as stated in its Memorandum of Association, are

1. to promote the study and dissemination of knowledge of Statistics, to develop statistical theory and methods, and their use in research and practical applications generally, with special reference to problems of planning of national development and social welfare;

2. to undertake research in various fields of natural and social sciences, with a view to the mutual development of Statistics and these sciences;

3. to provide for, and undertake, the collection of information, investigation, projects and operational research for purposes of planning and the improvement of efficiency of management and production.

Statistical Beginnings

Prasanta Chandra Mahalanobis, born in a well-to-do progressive family in 1893, had gone to study in Cambridge in 1913, and in 1915, had completed his Tripos in Physics. Just prior to his departure for India for a vacation, his tutor, W.H. Macaulay, drew his attention to some bound volumes of the journal Biometrika. Mahalanobis got so interested that he bought a complete set of volumes of the journal. These volumes were to subsequently play a decisive role in converting the physicist-Mahalanobis to the statistician-Mahalanobis.

Although Mahalanobis was due to return to Cambridge to pursue research in Physics, he did not return. Instead, he accepted the post of a Professor of Physics in the Presidency College. The first important work in Statistics in the modern sense was undertaken by Acharya B.N. Seal, who sought Mahalanobis' help in the statistical analysis of examination results of the Calcutta University.

Mahalanobis set up the Statistical Laboratory in the Presidency College sometime in the 1920s. On 17 December 1931, the Indian Statistical Institute was founded as a learned society and housed in the Statistical Laboratory. The Institute was registered on 28 April 1932, as a non-profit distributing learned society under the Societies Registration Act (XXI of 1860) and is now registered under the West Bengal Societies Registration Act XXVI of 1961 amended in 1964. Sir R.N. Mookerjee accepted the office of the President of the Institute, and held this office until his death in 1936.

Recognition of Statistics as a Key Discipline in India

During the 1920s and until the mid-1930s, all or nearly all the statistical work done in India, was done single-handedly by Mahalanobis. The early statistical studies included analyses of data on stature of Anglo-Indians, meteorological data, rainfall data, data on soil conditions, etc. Some of the findings of these early studies were of great impact in the control of floods, development of agriculture, etc., and led to the recognition of Statistics as a key discipline.

Mahalanobis' influence was so pervasive that students of Physics began to take interest in Statistics. Subhendu Sekhar Bose was the most notable of them. Later, several talented young scholars including J.M. Sengupta, H.C. Sinha, R.C. Bose, S.N. Roy, K.R. Nair, K. Kishen and C.R. Rao, joined to form an active group of statisticians. Mahalanobis continued to be the nucleus. Theoretical research in Statistics began to flourish in the Institute. Research on large scale sample surveys won Mahalanobis a Fellowship of the Royal Society. Design and analysis of agricultural experiments also bloomed and led to some international contacts, notably with Sir Ronald A. Fisher.

The First Indian Statistical Conference

In January 1938, the first Indian Statistical Conference was organised in Calcutta with R.A.Fisher as the President. During the next five years, similar conferences were organised by the Indian Statistical Institute, which, apart from their academic value, had immediate promotional value. A separate section for Mathematics and Statistics was created in the Indian Science Congress in 1942, with Mahalanobis as the Sectional President. A separate section in Statistics was created in 1945. In this way, Statistics gradually won recognition in India and in this process the Institute had played a leading role.

Statistical Training in India: The Beginnings

Even in the early days of the Institute, Mahalanobis realised the importance of training statisticians. During the years 1932-39, more than 150 officers of the Government had come to Calcutta, on deputation from all over India, for short courses of training in statistical methods. The demand for advanced training in Statistics gradually increased. Through the efforts of the staff of the Institute, a post-graduate department of Statistics was established in Calcutta University in 1941. A Research and Training School was also set up in the Institute, and C.R. Rao provided the leadership.

Increasing Awareness for Developing Statistics

While the Government of India became increasingly aware of the need for developing Statistics, it wanted the Institute to concentrate only on training and research in Statistics. But Mahalanobis viewed these roles as insufficient for the Institute and wanted it to be involved in projects of national interest in which Statistics would have a key role to play. He fought against the narrow perception of the Government. The battle was arduous and lasted nearly a decade. Mahalanobis' view was that the Institute must be allowed to take up large-scale projects, which besides being socially useful would also help in research and training to be practically oriented, and not bookish. Mahalanobis finally won the battle with the support of the Institute's President and friend C.D. Deshmukh.

The first exploratory sample survey in India was undertaken under the technical guidance of Mahalanobis as early as in 1937 for improving estimates of jute crop. This study won the praise of R.A. Fisher, who also submitted a memorandum, in 1938, to the Government of India supporting statistical studies in India; he wrote "...everything depends on the future of the Statistical Institute."

After the completion, in 1942, of the five-year jute survey, the Government of Bengal asked Mahalanobis to conduct a similar survey, which also included estimation of the yield of paddy crop, in view of the great famine of Bengal in 1943. After much debate, sample surveys were ultimately accepted as the basis for official estimates of crop yield in West Bengal in 1948, and later in other states of India.

Further Diversification of Statistical Research

Diversification of the scope of surveys and projects proceeded. At the request of the Government of Bengal in 1944, a survey of economic and social conditions in Bengal was undertaken to assess the impact of the severe famine which had occurred in 1942-43. This survey yielded information of much social significance.

In 1945, an important project on population data began. The tabulation programme of the 1941 Census of India had been severely curtailed as an economy measure. Fortunately, at the direction of M.W.M. Yeates, Census Commissioner, a 2% sample of the individual census slips had been preserved, and the Institute was asked by the Government to reconstruct age and occupation tables on the basis of this sample. This involved the transfer of information (originally recorded in many different languages) to about 7 million punched cards and then tabulating the results. As some sample slips had been incorrectly drawn and some were missing, it became necessary to devise special methods of estimation. D.B. Lahiri provided leadership in this project, which was successfully completed in 1950.

Many other projects that yielded information of great social relevance pertained to rural indebtedness, road development, family budgets, traffic flow, etc. At the request of the Government of Burma, the Institute helped in organising a sample survey of economic conditions in Rangoon in 1948-49.

The pioneering work on crop yield estimation done by the Institute attracted the attention of Prime Minister Jawaharlal Nehru, who desired that comprehensive information relating to social, economic and demographic characteristics be collected by conducting sample surveys on a countrywide basis. The Institute was asked by the Government to take charge of the design of these surveys and of processing of data thereof. The National Sample Survey (NSS) was established in 1950. This led to the regular conduct of the most comprehensive sample surveys in the world at that time, on a regular basis, under the guidance of Mahalanobis by N.C. Chakravarti, J.M. Sen Gupta, D.B. Lahiri, Nimai Ghosh, Mohanlal Ganguli, Ajit Das Gupta and S. Raja Rao.

Research on Theoretical Statistics Gains Momentum

Work on theoretical statistics in the Institute gained much momentum from the projects and surveys undertaken by the Institute. Mahalanobis' work on anthropometry led to the development of the D^2 statistic for measuring population affinities. This, in turn, culminated in the proof by R.C. Bose and S.N. Roy that the sampling distribution of the studentised D^2 is a non-central F-distribution. Crop surveys and agricultural experiments resulted in a great deal of theoretical research in multivariate analysis and construction of designs. S.N. Roy and C.R. Rao made profound contributions to multivariate analysis and R.C. Bose to the construction of designs. Sample surveys also resulted in some seminal work of philosophical depth on randomness and methods of drawing representative samples. Needless to say, Mahalanobis himself pioneered these thoughts and these are among his most lasting contributions to Statistics.

First Electronic Computer in India

With the undertaking of large scale projects and surveys, computational facilities also started improving. The Institute was the first organisation in India to acquire an electronic computer. The Hollerith Electronic Computer, HEC-2M, was in operation in the Institute in 1956. Acquisition of this electronic computer resulted in the development of numerical methods and facilitated data processing.

Statistical Quality Control Movement

The Institute also pioneered the development of Statistical Quality Control (SQC) in India. As early as in 1935, the Institute had recommended that the Government should take appropriate measures to initiate SQC methods in Indian industries. Walter A. Shewhart (the originator of SQC) came to India at the invitation of the Institute in 1947-48, toured the country, held conferences and stimulated interest among Indian industrialists. The follow-up work done by the Institute led to the recognition of SQC as a useful technique in the industry and resulted in the formation of a network of SQC Units in India.

ISI Role in National Planning

In 1940, Jawaharlal Nehru asked Mahalanobis to prepare a statistical commentary on the reports of the National Planning Committee. Nehru visited the Institute in 1946. Impressed with the activities and the

performance of the Institute, he started to take a keen interest in its work. In 1949, he asked Mahalanobis to work as Honorary Statistical Adviser to the Cabinet, Government of India. This resulted in closer connection of the Institute with national planning activities, and on 17 March 1955, Mahalanobis submitted to the Government the Draft Plan-Frame, which was accepted as the basis for the formulation of the Second Five Year Plan of India.

The Indian Journal of Statistics

Almost immediately after the Institute was set up, the need of a journal became pressing, and in 1933, a new journal -Sankhya: The Indian Journal of Statistics - was started as an official organ of the Institute. Sankhya soon established itself as a leading international journal.

"Institution of National Importance"

The Institute was declared as an Institution of National Importance by an Act of Parliament in 1959 and was vested with powers to hold such examinations and grant such degrees and diplomas in Statistics as may be determined by the Institute from time to time. The Institute, in collaboration with the International Statistical Institute, established an International Statistical Education Centre (ISEC), in Calcutta in 1950. K.B. Madhava was instrumental in giving shape to ISEC. Every year, about 50 trainees are trained at this Centre. The trainees, who are mostly Government officials engaged in statistical work in developing countries, come to ISEC for advanced training in statistical methodology. The Institute started to offer formal degree courses in Statistics leading to diplomas and certificates in the late 1930's. Advanced courses in Statistics for students holding Master's degrees was started in the late 1940's. The Act of Parliament empowered the Institute to confer degrees.

Degree Courses in Statistics

On 16 August 1960, the Institute started courses in Statistics leading to B.Stat. and M.Stat. degrees. J.B.S. Haldane, along with Mahalanobis, drafted the structure of these courses. The uniqueness of this course, which remains true even today, is that besides Statistics and Mathematics, the students are also taught natural and social sciences, so that they are able to make Statistics more useful as a key technology. The Institute's structure, philosophy and activities won international acclaim to the extent that when the first Institute of Statistics was set up in the United States of America by Gertrude Cox, the Indian Statistical Institute was used as a model - perhaps the only time an institute in a developing country was used as a model in a developed country.

The Star Becomes Brighter

By the end of the first three decades after its formation, not only was the Institute on solid ground, but Statistics also gained recognition as a key technology. The next three decades witnessed a tremendous diversification of the activities of the Institute.

By the 1960's, the Institute was already a bright star in the firmament of theoretical statistics. In addition to the research work on sample surveys and design of experiments, research in multivariate analysis, statistical inference and probability gained tremendous momentum. Research work on Mathematics, especially related to solving intricate technical problems in probability and statistics, also became a focal theme. This resulted in pioneering developments in the area of linear algebra, particularly in generalised inverses of matrices.

Emphasis on Symbiosis

Much of the early work on theoretical statistics done in the Institute stemmed from the various projects undertaken by the Institute. The Institute, therefore, decided to diversify its activities in a way that quantitative data on various sciences - social, biological, physical etc.- could be generated within the Institute. It was also foreseen that the diversification would result in a symbiotic relationship between statistics and the sciences. With this in mind, many units in other disciplines were set up. These included Economics, Sociology, Physics, Chemistry, Electronics, Crop Science, Anthropometry and Human Genetics, Biometry, Biochemistry, Geology, etc. In close collaboration with the statisticians of the Institute, scientists belonging to these units started conducting basic and applied research. The pay-off was quick. To cite just one example, the Geology Unit undertook a project to determine the direction of flow of an ancient extinct river in South India. This determination had to be performed by angular measurements of scratches on rocks. The project generated a large amount of quantitative data, the analysis of which resulted in novel statistical methodology based on analysis of circular normal distributions.

The vast amounts of data generated by the science units also led to a faster growth of electronic computing facilities. Starting from an IBM 1401 in 1964, the Institute has had a Honeywell 400 system in the 1970's followed by a Soviet EC-1033 in the 1980's and the present VAX 8650.

ISI's More Recent National-Scale Activities

The Institute continued to work in close collaboration with the Government, especially in planning and in the assessment of the various developmental projects undertaken by the Government. To cite a few examples, in the early 1970's, the Institute conducted a large-scale sample survey of households and pavement dwellers in Calcutta for the assessment of level of living and poverty. Around the same period, the Government requested the Institute to make an assessment of the costs and benefits of the rural electrification programme that was undertaken by the Government. Based on the results of this study, the Institute provided many recommendations useful for planning. However, in recent times, the Institute has preferred to conduct innovative, intensive surveys/projects rather than large-scale sample surveys. More recently, the Institute has, at the request of the Reserve Bank of India, conducted a study on the circulation and life of currency notes and coins. The results of this study will help the Reserve Bank in printing of currency notes and minting of coins. The Oil and Natural Gas Commission (ONGC) requested the Institute to conduct a study to estimate discovery cost of oil wells and to develop strategies for optimal allocation of resources for oil exploration. This project has just been completed. This project generated many theoretical statistical problems and provided a conceptual framework within which the ONGC can plan and evaluate different strategies.

One of the major problems in the development of agriculture in many parts of India is lack of irrigation facilities and the consequent dependence on rain. The agricultural scientists and sociologists of the Institute have undertaken a project to study the nature of rain-fed farming and the factors responsible for lack of transition from traditional agricultural practices to more modern practices in the rain-fed farming areas. This study is expected to make a valuable impact on planning agricultural practices in the relatively arid regions of India.

Diversification was not confined to the research areas only, but also extended to training in Statistics. Short courses, summer and winter schools are regularly held to impart training in statistical methodology to natural and social scientists. More recently, the Institute has held Data Analysis Workshops in the biological and medical sciences, schools on the use of statistical computer software, etc. The University Grants Commission has also been sponsoring refresher courses for Statistics teachers of Colleges and Universities, conducted by the Institute. With the advancement of computing technology and the consequent demand for skilled personnel in computer software, the Institute has started an M.Tech. programme in Computer Science. In the area of Computer, Communication and Information Sciences, ISI Scientists have made pioneering research contributions in diverse areas including pattern recognition, machine learning, image processing, remote sensing, data mining, bioinformatics, document analysis, VLSI Design, computational geometry, networks and cryptology. This has propelled to expand the Computer and Communication Sciences Division of the Institute, which at present, comprises six Units including the Documentation Research & Training Centre & The Systems Science and Informatics Unit. The "Centre for Soft Computing Research: A National Facility" has also been recently accorded the status of an Associate Institution of ISI. A new Unit namely Bayesian & Interdisciplinary Research Unit has also been established in the Applied Statistics Division. The increased awareness that Statistical Quality Control and Operations Research techniques are of immense help in the development of the industrial sector, has led to the introduction of an M.Tech. programme in Quality, Reliability, Operations Research, MS (Quantitative Economics), MS (Library and Information Sciences), B. Math. and M. Math.

Alumni of the Institute have won national and international acclaim in the fields of research, in various Government departments, in the banking sector and in the industry. Students of the Institute are in great demand and most of them are recruited even before the completion of their courses.

Unity in Diversity

"Unity in Diversity" is the motto of the Institute. The diversity within the Institute is evident. The unity has been the unity of purpose - furthering of statistics. The Indian Statistical Institute has not only succeeded in aiding the birth of statistics, but has also succeeded in nurturing the baby well.