Statistical System of India: Some Reflections
Rakesh Mohan[*]

I am delighted and honoured to be at this auspicious occasion of the first Statistics Day and to inaugurate first Annual Conference on Financial Statistics. As a member of the statistics community, it is matter of great pride that June 29, birth anniversary of (late) Professor Prasanta Chandra Mahalanobis, has been declared by the Government of India as Statistics Day. I am particularly happy that Professor Parikh is here who began his professional life in the ISI Statistical Unit in the Planning Commission and had a great deal of interaction with Professor Mahalanobis.

Statistics in simple terms is defined as the study of the 'laws of chance'. On this Statistics Day, let me however not take a chance to talk about field statistics. In the preface to his book on "Statistics and Truth", C.R.Rao (1989) writes, which I thought is worth quoting at length,

> *"Statistics as a method of learning from experience and decision making under uncertainty must have been practiced from the beginning of mankind. But the inductive reasoning involved in these processes have never been codified due to the uncertain nature of the conclusions drawn from given data on formation. The breakthrough occurred only in the beginning of the present century with the realization that inductive reasoning can be made precise by specifying the amount of uncertainty involved in the conclusions drawn. This paved the way for working out an optimum course of action involving minimum risk, in any given uncertain situation, by a purely deductive process. Once this mechanism was made available, the floodgates opened and there was no end to the number of applications impatiently awaiting for methods which could really deliver the goods. From the time of Aristotle to the middle of the 19th century, chance was considered by scientists as well as philosophers to be an indication of our ignorance which makes predictions impossible. It is now regarded that chance is inherent in all natural phenomena, and the only way of understanding nature and making predictions (with minimum loss) is to study the laws (or the inner structure) of chance and formulate appropriate rules of action. Chance may appear as an obstructor and an irritant in our daily life but chance can also create. We have now learnt to put chance to work for the benefit of mankind. All knowledge is, in the final analysis, history. All sciences are, in the abstract, mathematics and all methods of acquiring knowledge are essentially statistics."*

What has been the historical development of the statistical system in India? Who have been its main architects? What has been the role of the Reserve Bank in the national statistical system? I thought these questions will be of interest to the audience assembled here today.

Historical developments

Let me go back in history. India has a long historical tradition of collection and use of various kinds of statistics. Kautilya's Arthasastra (321-296B.C.), one of the greatest treatise of economics, indicates a system of census and data collection relating to agriculture, population and other economic activities, covering villages and towns. In addition, the concept of cross-checking and validation by independent agents was very much part of the data collection system. Thus, early evidence established the coexistence of economics and statistics, and their application for the welfare of the states. Subsequent historical anecdotes based on Huen Tsang's writings (dated late seventh to early eighth century) give a detailed description of the plan of cities, construction of houses, and an account of common products of India and data on the area of kingdoms and the distances between them. During the *Moghul* period, evidence and application of statistical knowledge was prominent in *Ain-i-Akbari* by Abul Fazal. Documentary evidence includes the system of legalised measurements, land classification and crop yields by season, etc. The system of land tenure and land revenue, followed during the *Moghul* period, had enough empirical basis.

The statistical system was strengthened during the British period. During this period, the statistical development was geared towards administration, tax collection, revenue, trade and commerce and related activities as might be expected. With a view to rationalize and establish a sound system of revenue collection, the East India Company in 1807 emphasized the need of a statistical survey of the country. A small department of statistics was founded in the India House in 1847. In 1848, the first census relating to the area and revenue of each in North-West Provinces was released. In 1853, the department released the first series of statistical papers on India. Impressed by the trend in statistical activities, the Secretary of State ordered the Governor-General in Council to prepare a 'comprehensive and coordinated scheme of statistical survey' for each of the twelve great provinces of the then British India and Dr. W.W. Hunter was appointed as Director-General of Statistics in India in 1869, who can perhaps be regarded as the original precursor to the Chief Statistician of India today. The Statistical Account of Bengal (the present Bangladesh, West Bengal, Bihar and Orissa) was published in 20 volumes. For each district there were details on topographical data, ethnic divisions and creeds, agricultural situation, commerce, working of district administration and finally the sanitary and health aspects. Although censuses of Calcutta were undertaken in the year 1822 and in 1847, the operation of a decennial census for the whole country started in 1881 and is continuing ever since. The report on the Census of British India taken in 1881 was published in three volumes.

The need for timely and accurate collection of agricultural data was felt by the Indian Famine Commission and agricultural departments were organised in various provinces which

resulted in the publication of 'Agricultural Statistics of British India' in 1886. To scrutinise and summarise the data collected by the agricultural departments, a statistical Bureau was formed at the centre in 1895 to coordinate the agricultural, foreign trade, prices, wages and industrial statistics. During 1905, a separate body Directorate General of Commercial Intelligence and Statistics (DGCI & S) was constituted to collect/publish commercial and trade statistics and to help trade and business. The first issue of Indian Trade Journal was released in 1906 and first price statistics based on a survey was released in 1910. The Economic Enquiry Committee set up in 1925 under the Chairmanship of Dr. Visweswarayya and more importantly the Bowley-Robertson Committee set up later in 1934, were mainly responsible for the government's decision to set up an Inter-Departmental Committee with the Economic Adviser to the Government of India as the chairman. The Inter-Departmental Committee recommended the formation of a Central Statistical Office for coordination, institution of a statistical cadre, establishment of State Bureaus at State Head Quarters and maintenance of important statistics for the entire country.

Architect of Modern Statistical Methods in the Indian Subcontinent

The developments in statistics that took place between 1930 and 1960 are quite remarkable and in some sense unique. No other discipline in India recorded such growth and development during the same period in India. There were several important ingredients. In statistics, unlike other disciplines, India was not a late starter. Indeed, much of the development even in the United States came later. Only Britain had started earlier. This helped creation of an Indian school of statistics with its own mix of theory and applications. The architect of modern statistical methods in the Indian subcontinent was undoubtedly Professor Prasanta Chandra Mahalanobis. He was helped by a very distinguished group of scientists that included R.C. Bose, S.N. Roy C.R. Rao, S.S. Bose, K.R. Nair, D.B. Lahiri and many others. There were others like P.V. Sukhatme, and V.G. Panse who worked independently of Mahalanobis. The history of statistics is basically a history of some of these persons as well as a history of institutions and interactions between persons and institutions. The institute around which all these development took place is none other than the Indian Statistical Institute (ISI), Calcutta. Looking back at the history, one observed that 1950s was inarguably the golden period of ISI. Besides, Prof. Mahalanobis and C. R. Rao, the faculty of ISI included R.R. Bahadur, D. Basu, G. Kallianpur, D.B. Lahiri, M. Mukherjee, R. Mukherjee and many other distinguished luminaries. Some of them studied abroad and subsequently joined ISI as a faculty. D. Basu joined the ISI as a student and later became a Professor as well as the first Dean of Studies. D. B. Lahiri was a self-taught mathematician, contributed significantly on sample survey methods. Between them Rao, Bahadur, Basu and Kallianpur and a new group of brilliant students including K.R. Parthasarathy, R. Ranga Rao, V.S. Varadarajan, S.R.S. Varadhan made fundamental contributions to probability and classical inference during this period which were as important as the earlier contributions of

Bose and Roy to design of experiments and multivariate analysis. Among the other earlier students of the Institute who achieved international reputation are G.P. Patil, T.N.Srinivasan, R.G. Laha, J. Roy, Sujit Kumar Mitra, D.K. Roy Choudhury, and others. I may also mention that S.R.S. Varadhan, currently a professor of mathematics at New York University and only Indian ever, won the prestigious Abel prize (which is perhaps equivalent to a Nobel Prize) in mathematics this year.

Professor P. C. Mahalanobis and Statistics

As the Statistics Day is being celebrated in honour of the birth anniversary of (late) Professor Prasanta Chandra Mahalanobis, I thought a brief sketch of his life will be appropriate at this juncture. Born on June 29 1893 in a well-to-do progressive Brahmo family, he passed away on June 28, 1972. He graduated in physics from Presidency College, Kolkata and went on to study in Cambridge in 1913 and in 1915 finished his Tripos in Natural Science with a first class. His first encounter with Statistics was also a chance-event, when his tutor Macaulay drew his attention to some bound volumes of *Biometrika*. He got so interested that he bought a complete set of *Biometrika* volumes towards his journey back to India. Mahalanobis set up the Statistical Laboratory in the Presidency College sometime in the 1920s. His contribution to statistics is enormous. 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. His passion and conviction was truly guided for the solutions of applied problems. His further work on anthropological data resulted in new methodology for classifying or distinguishing populations characterized by such measurements called Mahalonobis D-square.[1] Another very important initiative undertaken by Professor Mahalonobis was the initiation of Crop Cutting Surveys to estimate agricultural production in India, which was a novel idea of that time. These surveys have continued till today and continue to be important in the estimation of agricultural production.

The Indian Statistical Institute was founded in a small room in the Presidency College as a society on 17 December, 1931. *Sankhya,* the Indian Journal of Statistics, was founded two years later. Mahalanobis' influence was so ubiquitous that even students of Physics began to take interest in statistics. Later, several talented young scholars joined to form an active group of statisticians. Mahalanobis continued to be the nucleus. Theoretical research in Statistics began to flourish in all the areas of statistics including design of experiments, statistical quality control, operations research, etc. Research on large scale sample surveys won Mahalanobis a Fellowship

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[1] He submitted the paper in Biometrika for publication. Pearson had expressed reservations about Mahalonobis D-square and thus did not publish it. However, Mahalanobis published it in other place.

of the Royal Society. Design and analysis of agricultural experiments also bloomed and led to some international contacts, notably with Sir Ronald A. Fisher. At the request of the Government of India, a draft of the second Five Year Plan was prepared at the Indian Statistical Institute in 1954 by Mahalanobis. The second plan pattern of industrial investment, with its marked shift in favour of capital good industries, was deeply influenced by the two-sector growth model developed by Mahalanobis. The substantial contributions of the Institute to theoretical and applied work, its training and promotional activities culminated in recognition by the Government of India. The Parliament passed the Indian Statistical Institute Act, 1959 which declared the Institute as an "Institution of National Importance" and empowered it to award degrees and diplomas in Statistics. The first computer of the country was installed in ISI in 1960. Subsequently, ISI made significant contributions to the development of advanced numerical algorithms.[2] Mahalanobis' mastery over empirics was exemplary as illustrated in using the method of fractal graphical analysis of consumption data, which was published in *Econometrica* (1960).[3] It is also understood that the concept of interpenetrative sub-sampling and pilot survey, pioneered by Mahalanobis, essentially form the basis of sequential analysis and modern bootstrap methods.

Evolution of the Statistical System after Independence

After independence in 1947, the country saw an urgent need for a statistical framework suitable for economic and social development. Mahalanobis was appointed as an Honorary Statistical Adviser in 1949 to the Government of India and Central Statistical Unit was setup under his technical guidance which was later named as Central Statistical Organization (CSO) in 1951.This organization was setup mainly to coordinate the statistical work done in various ministries and other government agencies and to advise them, to maintain standards with regard to definitions, concepts and procedures, to provide consultancy, to liaison with international statistical organizations, to prepare and publish a Monthly Statistical abstract and an Annual Statistical Abstract and to inform annual statistical information to public. In India, prior to 1947, the estimation of national income was attempted by individual economists and scholars for specific years. Among these, the most systematic work was that of V.K.R.V. Rao in his book *National Income in British India 1931-32* (London; MacMillan 1940), which formed the basis of national income estimation in the post-independence period. In 1949, the Government of India formed the National Income Committee (NIC) under the Chairmanship of P.C. Mahalanobis, with V.K.R.V. Rao and D.R. Gadgil as members. From then onwards the national income estimation has been steadily strengthened. NIC recommended the holding of an annual conference on national

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[2] It is also believed that the seed of computer and IT revolution in India was germinated in ISI.

[3] The editor of *Econometrica* published a shorter version of this paper what reportedly Mahalanobis did not like. As a result, he again published the full version of the paper in *Sankhya*.

income and wealth. The First Indian Conference on Research in National Income was organised by the Central Statistical Organisation (CSO) in early 1957. In 1964, this conference was converted into the Indian Association for Research in National Income and Wealth (IARNIW). Dr. V.K.R.V Rao was the first President of IARNIW. He is credited with the building of IARNIW as an independent research body under the aegis of the Central Statistical Organization.

In order to improve the quality and fill up the gaps in statistical information, it was decided to establish a National Sample Survey Organisation (NSSO). This organization had four divisions: Survey design and research, Field operations, Data processing, and Economic Analysis. The national sample survey (NSS) is the largest multi-purpose socio-economic survey.

The coverage and scope of data collection and dissemination of CSO has increased manifold in recent times. Its current activities include National Income Accounting, conduct of Annual Survey of Industries, Economic Censuses and its follow up surveys, compilation of Index of Industrial Production, as well as Consumer Price Indices for Urban Non-Manual Employees, Human Development Statistics, Gender Statistics, imparting training in Official Statistics, Five Year Plan work relating to Development of Statistics in the States and Union Territories; dissemination of statistical information, work relating to trade, energy, construction, and environment statistics, revision of National Industrial Classification, etc.

The National Statistical Commission (NSC) set up by the Government in January 2000 under the Chairmanship of Dr. C. Rangarajan reviewed the statistical system and the entire gamut of Official Statistics in the country. Core functions of NSC, inter alia, include identification the core statistics which are of national importance and are critical to the development of the economy, to evolve national policies and priorities relating to the statistical system and to evolve standard statistical concepts, definitions, classifications and methodologies in different areas in statistics and lay down national quality standards on core statistics. One of the key recommendations of this Commission was to establish a permanent National Commission on Statistics to serve as a nodal and empowered body for all core statistical activities of the country, evolve, monitor and enforce statistical priorities and standards and to ensure statistical co-ordination among the different agencies involved. In line with the above recommendations, the Government of India ordered the setting up of a permanent National Statistical Commission (NSC) on 1st June 2005. The present setup of NSC is a type of umbrella organization covering both CSO and NSSO.

National Statistical System and the Role of the Reserve Bank

Reserve Bank of India (RBI) collects and analyses statistics on various economic transactions of banking and other financial institutions in the process of implementing its policies towards achieving its implicit twin objectives of growth and price stability. A major part of the

statistics in RBI is collected through either statutory or control returns, which are exclusively used for monetary policy and supervision. In the field of information generation and analysis we adhere to international standards and practices. To collect supplementary statistics, RBI conducts surveys in the fields of credit to rural/urban households, industrial outlook, inflation expectations, different aspects of banking sector, external sector and the private corporate sector.

At present, the surveys conducted by RBI can be broadly classified into five categories:

(a) **external sector** including (1) survey of foreign liabilities and assets for corporate, insurance & mutual fund sectors, (2) coordinated portfolio investment survey, (3) survey on software export, (4) unclassified receipt survey used for BoP, (5) survey on balances in Nostro / Vostro account used in BoP, and (6) survey on non-resident deposits;

(b) **banking sector** including (1) survey on distribution of credit, deposits and employment in banks, (2) survey on composition and ownership of deposits with scheduled commercial banks, (3) survey on investment portfolio of scheduled commercial banks, (4) survey of debits to deposit accounts with scheduled commercial banks, (5) survey on international assets and liabilities of banks and (6) survey of small borrowal accounts;

(c) **corporate sector** including survey of performance of private corporate business sector, conducted since 1951-52;

(d) **monetary policy** including (1) industrial outlook Survey, (2) inflation expectation survey for households and (3) survey of inventories, order books and capacity utilization;

(e) **ad hoc**: Census of non-banking financial companies not accepting public deposits.

In addition to the abovementioned surveys, recently RBI has initiated steps to make use of survey methods for various operational purposes, e.g., to assess the extent of success and realities of implementation of financial inclusion. You may be aware that in India, Government as well as the central bank attach enormous importance towards financial empowerment of the rural poor and RBI has taken steps for financial inclusion and spread of Self Help Groups. In support of monetary policy, we propose to introduce survey of professional forecasters, as done in most of the central banks in developed countries. In addition, it may be necessary to collect necessary information for compiling housing starts, in view of the increasing importance of housing construction in the economy. However, in view of the current state of data availability with local authorities, this will need considerable additional work before any significant progress can be made. Other Central Banks conduct a number of other surveys, both ad hoc and regular ones, in order to help more informed monetary policy meeting, and other needs as they arise. As we improve the technical basis of our monetary policy apparatus we will need to keep innovating in this area.

Traditionally RBI is directly involved in national accounts compilation, especially in savings estimation and flow of fund compilation. Basic information on household and corporate

savings is provided to CSO for preparing the final estimates. Besides, data on output of banking system in GDP is imputed from the data supplied by us. RBI also has a long tradition of conducting important surveys in collaboration of NSSO.   The first comprehensive survey conducted by RBI is known as All-India Rural Credit Survey, with 1951-52 as the reference period. The objective of the survey was to collect such data/information as would assist the RBI and the Government of India in formulating an integrated credit policy for rural credit and to assess the extent of indebtedness of rural households to financial institutions in the organized and unorganized sectors. Findings of this landmark survey subsequently changed the entire landscape of Indian banking and culminated in introducing the world's biggest social banking experiments in the form of rural credit and priority sector lending. Such All-India surveys were conducted decennially and the latest survey pertained to the year 2002-03. While the 1951-52 and 1961-62 surveys covered only rural households, the subsequent surveys covered urban households also. The surveys of 1971-72 and 1981-82 were conducted jointly with NSSO, Government of India, whereas those of 1991-92 onwards were conducted entirely by NSSO.

The other area, which has direct consequence with RBI activities, relates to measurement of output and price. As member of the Technical Advisory Committee of National Accounts Statistics (NAS), Statistics on Prices and Cost of Living (SPCL), revision of WPI and CPI series, etc., RBI has been playing a critical role. Let me highlight a few recent initiatives. The procedure of converting current price estimate into constant price followed earlier, especially for estimating the output of financial sector, resulted in some kind of anomalies. In some cases, while estimate at current price was negative, constant price estimate was positive and increasing. However, in the last GDP revision (1999-00 series), this problem was corrected after a series academic discussion with CSO. Similarly, treatment of some of the financial intermediaries like mutual funds was not defined clearly in SNA 1993. And treating mutual funds similar to banks was conceptually not correct. Recently, CSO set up a committee in RBI to look into this matter and the recommendations of the committee has been accepted by TAC of NAS. Besides, RBI is also working in close collaboration with CSO for implementing the ensuing changes of SNA revision due this year.

Let me cite an example of RBI's recent involvement in price measurement issues. The need for integration CPIs is nothing new. The National Statistical Commission (2001) recommended, *inter alia*, that the current CPIs do not provide changes in the prices for the entire rural and urban population since they are designed to measure the changes in the prices of goods and services consumed by specific segments of the population and hence there is a need to compile the CPI separately for the entire rural and urban population. In this context, a Sub-Group set-up in RBI, recommended the compilation of separate CPIs for whole rural and urban population and provided a roadmap for compilation. I happy to note that TAC on SPCL has finally

accepted this and shortly we shall have CPI(U) and CPI(R). Needless to mention that these price indices will be very useful for monetary policy purposes.

Application of Statistical Methods in RBI: Need for Further Work

Before I conclude, let me outline a few areas of work in RBI where statisticians can contribute significantly. First, as monetary policy formulation largely depends on the forward-looking behaviour of the economy, the use of forecasting techniques automatically comes in the forefront. While traditional time series techniques are useful, we need to build up expertise on forecasting using calibrated models. Such models have definitive advantage of incorporating economic agents utility, requires less data and can be maneuvered easily with different alternatives. Second, RBI incurs a huge expenditure on management of currency through out the country. Operations research techniques could be utilized effectively in the areas of inventory, transportation, etc., so as to develop an efficient and cost effective currency management systems. Third, risk analysis under a statistical framework is a pre-requisite for implementing Basel II norms. Fourth, innovative sample surveys in the area of financial inclusion, development of leading indicators like house-start index, inflation expectation, etc., could be very useful tools. Fifth, we do not have an appropriate measure of potential output. It is not an easy task; however, efforts should be made to devise a suitable methodology for estimating potential output at the earliest.

Finally, let me conclude by saying that knowledge building is an ongoing activity. Frontiers are shifting upwards consistently and thus demanding a persistent catching up with the advanced knowledge. Central banking today is more challenging than ever and accurate information is the key to supplement policy decisions. I hope the Statistics Day and the conference on financial statistics pave the platform of knowledge sharing and understanding of advanced frontiers.