

INDIAN STATISTICAL INSTITUTE

FORTYNINTH ANNUAL REPORT

April 1980 - March 1981

CONTENTS

	Page
PART I : Teaching, Training, Research, Projects and Publications	
1. Teaching and Training	1
2.1 Theoretical Statistics and Mathematics	5
2.2 Applied Statistics, Surveys and Computing	5
2.3 Physical and Earth Sciences	8
2.4 Biological Sciences	13
2.5 Social Sciences	19
2.6 Statistical Quality Control and Operations Research	27
2.7 Library, Documentation and Information Sciences	29
3. Conferences, Seminars and Symposia	32
4. Publications	33
5. List of Scientific Papers and Publications :	34
5.1 List of Papers Published	34
5.2 Papers submitted accepted for publication	46
5.3 Papers read at Conferences	59
5.4 Books published	71
5.5 Articles published in Books	72
5.6 Technical Reports	74
PART II : Convocation, Visiting Scientists, Honours and Awards, Scientific Tours and Assignments	
6. Fifteenth Convocation : Indian Statistical Institute	82
Annual Review by B. P. Adhikari, Director	83
7. Visiting Scientists	86
8. Honours, Awards and Special Assignments	90
9. Scientific Tours and Assignments Abroad	93
10. Scientific Assignments in India	96
11. Eightyseventh Birth Anniversary of Late Professor P. C. Mahalanobis	102
PART III : Administration and Office-bearers	
12. General Administration	103
13. List of President, Chairman and Members of the Council, Members of the Committees of the Council and Academic Council	105
PART IV : Statement of Accounts and Auditors Report for the year 1980-81	115

INDIAN STATISTICAL INSTITUTE
FORTYNINTH ANNUAL REPORT

April 1980—March 1981

Part I. Teaching, Training, Research, Projects and Publications

I. TEACHING AND TRAINING

1.1 Degree and Training Courses

During the current term, 6603 candidates applied for admission to the B.Stat. and M.Stat. degree courses, post-M.A./M.Sc. Diploma Courses and research scholarships and took special admission tests at 12 centres in different parts of the country, and the successful candidates were called for interview for final selection. Admission tests were also held for admission to the (1) Evening Course in Statistics at Calcutta and Delhi, (2) One-year Certificate Course in Data Collection and Processing Methods, (3) Two-year Advance Diploma Course in Computer Science, (4) Two-year part time Postgraduate Diploma Course in SQC and OR at Bombay and Madras, and (5) One-year Course in Operation of Punched Card Machines. The annual examinations of the B.Stat. and M.Stat. courses were held in May/June 1980. The 1980-81 academic year commenced on 28 July 1980.

The fifteenth Convocation of the Institute was held on 31 March 1981 and 161 candidates received their degrees, diplomas and certificates.

During the period covered by this report several committees were set up to review the syllabi of some of the courses offered by the Institute. On the recommendations of the committees the syllabi of the M.Stat. Course and the Course on Operation of Punched Card Machines were revised, to be effective from the session 1981-82. The latter course was also renamed Course on Operation of Automatic Data Processing Equipment. The revision of the syllabi of the Evening Course in Statistical Methods Application and the Course in Documentation and Information Science was also under active consideration of the Academic Council. The proposal for offering a two-year M.Tech course in Computer Science from the session 1981-82 was approved by the Academic Council and the ISI Council and the Syllabus for the course was finalised.

The number of candidates admitted to different degree, diploma and training course during 1979-80 and 1980-81 and the results of examinations held during the period are given below.

<i>Courses</i>	<i>Number of students</i>		<i>Number passed in</i>
	<i>1979-80</i>	<i>1980-81</i>	<i>Annual Examination</i>
1. <i>Courses leading to a Degree in Statistics :</i>			1980
1.1 Bachelor of Statistics with Honours—			
B.Stat. (Hons.)			
1st year	20	18	21
2nd year	13	21	12
3rd year	13	12	13
4th year	15	14	14

INDIAN STATISTICAL INSTITUTE

Courses	Number of students		Number passed in
	1979-80	1980-81	Annual Examination 1980
1.2 Master of Statistics (M.Stat.)			
Previous year	7	6	6
Final year	35	22	33
1.3 Junior and Senior Research Fellows, Visiting Fellows	107	98	
1.4 Ph.D.	—	—	8*
2. Specialised Courses in Applied Statistics leading to Diplomas :			
2.1 Statistical Quality Control and Operations Research (One year)	21	12	14
3. Courses in Statistics for Persons in Employ- ment (jointly with the CSO) :			
3.1 Junior Certificate Course in Statistics	13	16	16
3.2 Indian Statistical Service Probationers' Training Course		19	19
4. Evening Courses :			
4.1 Statistical Methods and Applications (One year)			
(i) Calcutta	46	46	18
(ii) Delhi	12	10	9
4.2 Two-year Post-Graduate Diploma in Sta- tistical Quality Control and Operations Research (Bombay and Madras)			
4.2.1 (i) Bombay—1st year	16	6	6
(ii) Bombay—2nd year	6	6	6
4.2.2 (i) Madras—1st year	20	21	12
(ii) Madras—2nd year	14	9	9
4.3 Six-month Evening Course in Statistical Quality Control at Bangalore			
(i) July to December	31	30	23
(ii) January to June	—	—	—
5. Electronic Computer Courses :			
5.1 Two-year Advanced Diploma in Com- puter Science			
1st year	17	13	10
2nd year	12	13	8
5.2 One-year Certificate Course in Data Collection and Processing Methods	5	5	1

FORTYNINTH ANNUAL REPORT : 1980-81

Courses	Number of students		Number passed in
	1979-80	1980-81	Annual Examination 1980
5.3 Intensive Course on Programming and Applications	23	31	31
5.4 Course on Operation of Punched Card Machines	17	11	17
6. <i>Associateship in Documentation & Information Science</i> :	—	—	30
	472	430	336

*awarded Ph.D. at the
Fifteenth Convocation

1.2 *International Statistical Education Centre (ISEC), Calcutta*

The International Statistical Education Centre, started in 1950, is operated jointly by the International Statistical Institute and the Indian Statistical Institute under the auspices of the UNESCO and the Government of India. During the year the Centre functioned under a joint Board of Directors, consisting of : *Chairman* : Professor C. R. Rao, *Members* : E. Malinvaud, J. M. Gani and E. Lunenberg (ex-officio members, representing the International Statistical Institute), N. K. Mukherjee (Cabinet Secretary, representing the Government of India), B. P. Adhikari and N. Bhattacharyya (Member-Secretary), (representing the Indian Statistical Institute).

During the year, the Regular Course of the thirtyfourth term of the Centre was conducted with 22 trainees from 10 countries in South and South-East Asia, the Far East and Commonwealth Africa. The Government of India awarded 6 fellowships for the foreign trainees—5 under the Technical Cooperation Scheme (TCS) of the Colombo Plan and one under the Special Commonwealth African Assistance Plan (SCAAP). Three foreign trainees were awarded CFTC fellowship. Five Indian trainees, 3 trainees from Sri Lanka, 2 from Nigeria and 1 from Sudan were supported by their respective governments. Two trainees from Afghanistan are supported by U. N. fellowships.

The ten-month Regular Course started on 2 June 1980. From June to September the trainees stayed at Calcutta and studied theory and applications of statistics, besides mathematics and economics. During October—November, they underwent six-week training in Official Statistical Systems at New Delhi and other places. This part of the training was conducted by the CSO, Government of India. The general training in statistics was resumed at Calcutta around the middle of November, and was completed by the end of January 1981. The final examination for the Regular Course trainees was held during the first week of February 1981. Thereafter, the trainees entered the last phase of their programme, specializing in selected areas like sample surveys, data processing, economic planning, large scale sample surveys etc. It may be mentioned that some of the courses in statistics, mathematics and economics have been made optional with effect from the current term.

INDIAN STATISTICAL INSTITUTE

In addition to the above, 4 trainees attended three-month Special Courses during April-June 1980. Two were from Bangladesh, one of them studied National Income Statistics and the other, Price statistics. The third was from Gambia and studied External Trade Statistics. The fourth, from Western Samoa, studied Large Scale Sample Surveys. All these trainees enjoyed CFTC fellowship.

Mr. S. Yamada from the University of Fisheries, Tokyo, Japan, joined the 34th term in mid-November 1980 as Visiting Teacher and stayed till the end of February 1981.

1.3 Professional Examinations in Statistics

The holding of professional examinations in Statistics for external candidates on an all-India basis has been an important activity of the Institute since 1938. These examinations are based on well-organised syllabi to reach high professional standards and lead to certificates and diplomas.

During the year, examinations for the (i) Statistical Assistantship Certificate, (ii) Junior Diploma in Statistics and (iii) Senior Diploma in Statistics were held at the centres in Bangalore, Bombay, Calcutta, Delhi, Hyderabad, Lucknow and Madras in May and November 1980.

The number of candidates who registered, appeared and passed during the terms are shown below :

Examination	Number of candidates					
	Registered		Appeared		Passed*	
	May	Nov.	May	Nov.	May	Nov.
Statistical Assistantship Certificate	11	17	6	16	3	6
Junior Diploma in Statistics	24	31	14	21	4	7
Senior Diploma in Statistics	17	20	16	18	7	7

*Passed in one or more papers but may not have completed the examination.

The total number of candidates who have qualified for the award of Certificates and Diplomas in these professional examinations in statistics including the results of November, 1980 term are 460 and 232 respectively.

2. RESEARCH WORK

A brief account of the progress of research in different divisions and units of the Institute is given below.

FORTYNINTH ANNUAL REPORT : 1980-81

2.1 THEORETICAL STATISTICS AND MATHEMATICS

2.1.1 Calcutta

The list of scientific papers and publications including technical reports give a detailed idea of the work done on research problems in various disciplines of mathematics and statistics. During the period, members of the Division have been engaged in research in the following areas : Algebra, Algebraic topology, Asymptotic theory, Combinatorial mathematics and graph theory, Decision theory, Descriptive set theory, Design of experiments, Functional analysis, Harmonic analysis, Inference about stochastic processes, Measure theory, Multivariate analysis, Probabilistic number theory, Probability theory, Sampling theory, Sediment transport, Stochastic processes and topological automata.

2.1.2 Delhi

The list of scientific papers and publications including technical reports give a detailed idea of the work done on research problems in various disciplines of mathematics and statistics. These areas include Characterisation problems, Game theory, Linear methods, Mathematical physics and Stochastic processes.

2.2 APPLIED STATISTICS, SURVEYS AND COMPUTING

2.2.1 *Research* : Research activities in the division include both theoretical investigation of methodology and applications of the existing methods to the solution of practical real life problems with social relevance. During the year 1980-81, the following three broad areas of research work were covered.

(i) *Research Activities in Applied Statistics* : The research activities of the division cover topics in sampling theory, design of experiments, combinatorics, multivariate analysis and computer science. The main areas of work in sampling during the past one year are randomised response techniques, optimal sampling strategies under exchangeability and other conditions on variables, replicated and repeated sampling techniques. In design of experiments and combinatorics, the principal areas of research activities are orthogonal arrays, optimality considerations of block designs under mixed effects model, robustness of designs and characterisation problems in graphs. Optimality and robustness properties of estimation and testing procedures are being studied in the context of the general linear model set up. Research has also been carried out in cluster analysis and growth curve models.

(ii) *Research in Computer Science* : The main research activities of this Division in the area of Computer Science is in the field of Data-base management and fault tolerant computing studies on consecutive retrieval property in files, integrity in data bases and prevention of deadlocks are under close attention. Two custom tailored data base management systems for survey data and time series data are under development. The emphasis in fault tolerant computing is on the design of self diagnosable systems

INDIAN STATISTICAL INSTITUTE

under different constraints. In addition tools for diagnosis of sequential and combinatorial circuits are also being investigated. The Division has also taken up a computer system study for drawing contour maps, identify an effective test of antigen and to standardise the method for the survey of immunological profiles of Malaria infection. This is sponsored by the Indian Council for Medical Research, INIEST 1.

During 1980-81, the Division also took up a project entitled. A Programme Package for Analysis and Management of Statistical Data. The aim of the project is to give the statisticians a facility to define complicated data structure which is typically found in sample surveys carried out in this country. The project envisages the development of a data base management system which allows the users to define data structures similar to that used in survey data. Further, elaborate facilities for editing of data in this data base and for creating table of different types have also been envisaged. The language design has been completed last year. The overall theoretical design of the system has also been completed.

(iii) *Research in Biometry* : Three main aspects of research in Biometry are focused in :

(1) *Biology of Fish Population in relation to Environment, Conservation, Development, Growth and Reproduction* : The work covers the following five broad areas (a) Factors affecting survival and mortality of post-embryonic carps, (b) Factors affecting growth of post-embryonic carps, (c) Growth rates in ponds, (d) Species difference in blood biochemistry, and (e) Survival and growth phenomena in varying environment.

(2) *Macro-Micro Level Examination of Normal Human Health* : Objectives of the above projects, the details of methodological procedures and findings were reported for each group of experiments. The entire statistical and biological aspects will be reported by the end of the year.

(3) *A Comprehensive study of Immunological Profiles of Malaria Infested Area in Ajodhya Hills in Paralia District* : The objectives of this project sponsored by Indian Council for Medical Research are the following : (a) to examine the immunological, nutritional and socio-economic profiles of people living in endemic area ; (b) to study the causes of differences and similarity of biochemical, indices of blood and influences of other environmental indices in these areas ; (c) to examine the variability of profiles of normal state, disease state and the recovery status ; (d) to examine the range of family variability within the same environment-both intra and inter variability ; (e) to detect whether intra-individual variability are stable or transient in Ajodhya Hills ; (f) to study the effect of migration and the effect of density dependent factors ; (g) to assess the efficacy of public health measures and passive immunity ; and (h) to study the extent to which antibodies represent an additional weapon against rampaging parasites of infectious diseases.

2.2.2 *Surveys* : A Survey on the socio-economic conditions of some college students of Calcutta (with special emphasis on drug habits of students) was organised

FORTYNINTH ANNUAL REPORT : 1980-81

by the trainee officers of the Indian Statistical Services, during August-September 1980. A randomised response technique was used in the survey to elicit information on drug habits. A mimeographed report of the survey findings has been brought out.

2.2.3 *Seminars* : In addition to the seminar and talks given by visitors, ten different faculty members and research scholars of the Institute gave seminars on fourteen topics.

2.2.4 *In-House Computer System* : The Divisional Computer Centre maintains two computer systems : (i) EC-1033 system, and (ii) V-77/200 Varian Computer System.

2.2.5 *Projects* : (i) An enquiry into the nature of urban poverty, Calcutta : The project has been completed. (ii) Calcutta Health Survey, conducted by the Calcutta Metropolitan Development Authority. The project has been completed. (iii) Pavement Dwellers' Survey, Calcutta. The project has been completed. (iv) Household Survey on Distribution of Public Expenditure on Social Services in West Bengal. A draft report is under preparation which is expected to be completed by September 1981. (v) Survey of Farmers, field investigation was completed by December 1980. (vi) A Study of Immunological profiles of Malaria Infected Area. The first phase of data collection of this project sponsored by the Indian Council for Medical Research is in progress.

2.2.6 *Editorial Work* : As in the previous years, the Division was entrusted with the editorial work of *Sankhyā*, Series C, parts 1 and 2 (Sample Surveys Theory and Practice).

2.2.7 *Teaching and Training* : Besides participating in the regular teaching activities of the Institute, the following courses were organised by the Division.

(i) *Advanced Diploma in Computer Science*

First batch : 1978-80. Eight students have successfully completed the course and passed the oral examination. One student could not complete his dissertation in due time and was allowed extended time upto 30 July 1981.

Second batch : 1979-81. Twelve students were promoted to the 2nd year of the course after completing their 1st year course work and practical training.

Third batch : 1980-82. Nine students have been admitted to the first year of the course.

(ii) *Intensive Course on Programming and Application of Electronic Computers (16th Session : 27 October 1980—3 January 1981)*

The objective of this course is to impart training on the use of computer in solving problems. The course covered use of Unit Record Machines, fundamentals of computer

INDIAN STATISTICAL INSTITUTE

organisation, selected numerical techniques and application in some areas. There were 29 trainees from government departments, public sector enterprises, educational and research institutes. All of them were awarded certificates of merit.

(iii) *One-year Certificate Course in Data Collection and Processing Methods :*

Session : 1979-80. Two trainees have successfully completed the course.

Session : 1980-81. Five trainees have been admitted to the 1980-81 session of the course.

(iv) *Special Course on System Programming in OS/ES.* Six software experts from V/O Electronorgtechnica, U.S.S.R., conducted a course on Systems Programming OS/ES during the period 23 March 1981 to 6 June 1981. Seven and four scientific workers of Applied Statistics, Surveys and Computing Division and the Social Sciences Division respectively of the Institute participated in the course.

(v) *Course on Operation of punched card machines*

Session : 1979-80. Seventeen students have successfully completed the course. Twelve students have been admitted to the above course for the session 1980-81.

The Divisional Committee of the scientific workers of the Applied Statistics, Surveys and Computing Division held five meetings to formulate proposals for research and developmental programmes and the Technical Advisory Committee met once to finalize the programme of work for the year 1981-82.

2.3 PHYSICAL AND EARTH SCIENCES

2.3.1 *Chemistry*

The overbearing influence of organic matter on the soil property is universally acclaimed. Our soils are generally poor in humus and getting progressively depleted with the growing need of producing more, thus calling for an effective management. A systematic knowledge of not only the humus reserve but also the dynamics of the humus in soil under different geographical conditions and agricultural practices is essential for any long term planning. In this respect the existing informations are both scanty and inconclusive. The five distinct soil types of West Bengal that are also representative of similar soils in the rest of the country have been tested for their humus characteristics and humus dynamics. Suitable parameters indicative of the progress as well as the course of humification processes have been developed on the basis of the data so far obtained.

2.3.2 *Electronics*

The following research and development activities were pursued.

FORTYNINTH ANNUAL REPORT : 1980-81

2.3.2.1 Digital Electronics :

(i) *Development of Microcomputer Systems* : A general Microcomputer system with memory capacity 24K bytes has been developed around a 6800 Microprocessor chip. The peripherals connected to the system are keyboard, video display unit, paper tape reader, paper tape punch, matrix printer, dual drive floppy disc, audio cassette recorder and A/D, D/A subsystems for communication with the analog world. Various software packages, namely, assembler, basic interpreter, text editor have been developed for the system to enhance its flexibility.

(ii) *Design and Development of a Dedicated Signal Processing System using F.F.T.* : A 6800 micro-processor based on-line F.F.T. processor has been developed. On-line data can be fed to the processor through a A/D converter and the power spectrum of the Fourier transformed signal can be seen on oscilloscope screen via the D/A converter. This system can be used to study E.C.G. and E.E.G. signals for possible diagnosis of certain types of human diseases.

(iii) *Data Acquisition System* : A 6800 micro computer based data acquisition system is being developed which will be able to monitor eight analog variables, convert them to digital signals, process the information and then take on-line action if necessary. The aim is to develop an inexpensive, portable data acquisition system for on-line collection of data.

(iv) *Development of Special Purpose Software for the Micro-computer* : A test programme has been developed to check any memory block including the portion where test programme is loaded. A software routine has also been developed for dumping the contents of a block of main memory on the VDU or getting a hard copy. This programme will be very useful while debugging and developing any programme on the Micro-computer System.

(v) *Theoretical Computer Science* : Theoretical works are being carried out on the areas of (a) fault tolerant computing, (b) Microprogramming, (c) Computer architecture, (d) Logic Design. Several useful results have been obtained in these areas.

2.3.2.2 Theoretical Physics :

(i) *Elementary Particles* : Strong Interactions and multi-particle production phenomena in lepton-hadron and hadron-hadron collisions are being studied. Also investigations relating to grand unified theories have been taken up.

(ii) *Gravitation and Cosmology* : The cosmological implications of baryon number non-conservation are being studied.

(iii) *Solid State Physics* : Some aspects of superconductivity, with special reference to cooper pair formation are being studied from the point of view of Quantum Field Theory.

INDIAN STATISTICAL INSTITUTE

(iv) *Plasma Physics* : Problems relating to stability of a plasma are being investigated.

(v) *Measurement Problems* : The measurement problem of quantum mechanics is being systematically investigated from the point of view of relativistic Brownian Motion.

2.3.2.3 *Physics of Fluids*

(i) *Effect of Uniform Suction on the Flow in Hydrocyclone Separators* : Introducing a suitably defined parameter (suction parameter), the effects of uniform suction on the axisymmetric laminar boundary layer inside the conical surface and under the roof of cyclone have been studied. It is found that the boundary layer thickness and the total flow through the boundary layer along the cyclone wall and under the cyclone roof decreases as the value of the suction parameter increases from 0 to 1.5. Also the amount of fluid which is diverted towards the overflow through the solid body rotating core is considerably reduced due to suction. Experiments in regard to demonstrations of the above results are in progress.

(ii) *Statistical theory of Turbulence* : (a) In the case when turbulence is characterized by very large Reynolds number, it is shown that Von Kármán's equation admits of a class of self-similar solutions. Asymptotic behaviours of such solutions for small and large values of wave number are discussed ; (b) Longitudinal and transverse correlations are calculated using certain similarity spectra as obtained with Heisenberg's decay equation, in case of homogeneous turbulence ; (c) Studies on the interaction of mean and turbulent fields of temperature and wind velocity are in progress.

(iii) *Problem in Bio-Mathematics* : (a) A mathematical model has been constructed for the purpose of simulation of glucose, insulin and glucagon levels in human circulating blood during a prolonged and severe muscular exercise. Rate constants are evaluated suitably so that the simulation of other physiological conditions e.g. starvation and glucose feeding etc. may also be achieved ; (b) Considering blood as a non-newtonian fluid, an exact similar solution of the Navier-Stokes equation for unsteady flow in a semi-infinite contracting or expanding tube is obtained, in case where Reynolds number is low.

(iv) *Linear and Non-linear Stability Analysis* : Shown that when Reynolds number $R < R_c$ (critical), the magnetic buoyancy boundary layer is the unique solution of the Boussinesq equations in presence of transverse magnetic field, and is stable in a slightly weaker sense than asymptotically stable in the mean. Upper bound of R_c is found out from the admissible function which satisfies the Euler-Lagrange equation. (b) The effect of nonlinear temperature profile and rotation on the onset of convection is studied by the method of Weighted Residuals in the frame of linearised stability analysis. Galerkin method has been employed to solve the case when both the boundaries are rigid. (c) Steady sedimentation of a uniform distribution of particles in a liquid

FORTYNINTH ANNUAL REPORT : 1980-81

is modelled as two-phase flow problem. By considering the three-dimensional forms of equations with the constant drag coefficient, the effect of finite amplitude on the above problem is to be carried out.

(v) *Sediment Transport Mechanism* : A fluid-mechanical model regarding the possibility of transportation of sediments into suspension as caused by the solid body vortices generated from the laminar sublayer, has been constructed. The path of the solid body vortex whose circulation decreases due to viscous dissipation has also been calculated assuming the logarithmic profile for the distribution in channel flow.

2.3.3 Electronics and Communication Science

Research is being carried out dealing with the same undermentioned areas as was being done in the previous year.

(i) *Research in Bio-medical Signal Processing and Development of a Patient Monitoring System* : (a) Characteristics of biomedical signals have been studied. Statistical and stochastic nature of those signals are under investigation. The system can be utilized in rural areas, where experts are not available. (b) Some work on partitioned adaptive filtering for parameter estimation, using Kalman filters and its potential for parallel computation has been undertaken.

(ii) *Research in Digital and Optical Communication Area* : (a) In the field of optical communication extensive theoretical studies have been carried out with computer simulation on wave propagation through hollow rectangular and cylindrical anisotropic dielectric guides and also their sensitivity analysis was performed. (b) An important investigation is completed on the effect of phase jitter and intersymbol interference and their minimization. (c) A microprocessor based communication model has been developed which will be suitable for computer-communication network in developing countries. A microprocessor based PSK modulator has also been developed.

(iii) *Pattern Recognition and Artificial Intelligence Techniques* : (a) Varied type of statistical, syntactic, and fuzzy set theoretic algorithms for machine recognition of diverse type of patterns, mainly of biological origin such as speech, hand written characters, finger print EEG etc. have been developed and experimented with successfully. Work is in progress for development of algorithms to be used in satellite imagery patterns. A new area of work on 2-dimensional as well as 3-dimensional image analysis problems have been undertaken which include computer assisted tomography. (b) A new syntactic grammar for generation and recognition of some-handwritten scripts has been developed. (c) A generalized fuzzy set theoretic approach for the study of patterns generated from bio-social systems has been published. (d) An approach for application of possibility theory in Man-Machine System Reliability Analysis has been published. (e) A fast algorithm for Walsh-Hadamard Transform for feature extraction problems in Image processing by computers has also been published.

(iv) *Acoustic-Phonetic Studies of Speech Sound* : (a) Some studies have been performed on phoneme structure of some Indian Languages and their application in

INDIAN STATISTICAL INSTITUTE

ASR Techniques is under study. For this purpose linear predictive method (LPC Analysis) has also been experimented with.

(v) *Studies on the methodology for Image Analysis and Image Understanding System* : (a) Computer recognition of 3-D objects has been taken up. Also some algorithms have been tested. In the area of resources estimation project for classification of the geological rock samples from computer analysis of their microphotograph was undertaken. (b) A work on pattern recognition and image understanding system for Remota Sensing Applications was completed.

(vi) *Studies on Cybernetics and System Theory* : Several Studies in Generalized fuzzy set theoretic approach for bio-social systems, in man-machine systems and social implications of Pattern Recognition and Artificial Intelligence Research have been undertaken.

2.3.4 Geology

(i) *Integrated programme* of geological research in the Pranhita-Godavari Valley was continued. The main topics of research in stratigraphy and palaeontology of the Gondwanas were : (n) saurosid reptiles from the Yerrapalli formation (b) Excavation and exploration of therapsid reptiles from Yerrapalli formation, (c) Study of Permian vertebrate fauna, (d) Examination of the fauna of Late Upper Triassic Dharmaram formation, (e) Mesozoic Gondwana vertebrates of the Pranhita-Godavari valley, (f) Review of Lower Jurassic Kota fauna, (g) Examination of spirally coiled coprolites from Maleri, (h) Evolution of rhynchosaurs, (i) New eosuchian reptile from Late Triassic of India, (j) Braincase of a Late Cretaceous sauropod dinosaur from India, (k) Geology of an area around Yamanpalli-Lingal-Metpalli in Adilabad district, A.P., (l) Geology of the N.W. part of the Pranhita-Godavari valley, (m) Stratigraphic interrelationships between different Gondwana formation in and around Chinnor, A.P., (n) Studies on calcareous lithounits in Late Triassic Maleri formation (o) Studies on genesis and significance of Maleri red clay, (p) Gondwana stratigraphic classification by statistical method, and (q) Trace fossils from the Triassic continental Gondwana red beds, (r) Structural analysis of Delhi metasediments of a part of Central Rajasthan and Pakhal rocks in A.P. (s) Early diagenetic glauconitization of feldspar grains in Middle Proterozoic tidal flat complex, (t) Trace fossils from Proterozoic sediments of Godavari valley and (u) Studies on tidal flat siliciclastic sequence of Pakhal Group in the Ramagundam area.

(ii) *Sedimentological Studies of fluvial deposits around Giridih, Bihar*. Growth and accumulation patterns of the point bars of the Usri river and its tributary, the Patbri near Giridih, Bihar, have been worked out.

2.3.5 Physics

2.3.5.1 (i) *Studies in the Mechanical Properties of Human Tissues and Organs* : Both pathological and normal samples have been put to tensile and tearing tests to determine the tensile breaking load the ultimate tensile and tearing strength and the ultimate

FORTYNINTH ANNUAL REPORT : 1980-81

percentage elongation. The tissues and organs on which investigations have been carried out include 2000 hair strands, 25 gutt bladders 35 appendices, 16 skin specimens, 12 tendon, 8 muscles, 6 nerves and 12 miscellaneous specimens. Pathological hair samples include such hair disorders as diffuse alopecia, onitis, vitiligo, male pattern alopecia, alopecia areata, psoriasis and seborrheic capitis and interesting findings of forensic and anatomical importance have been reported. A technique of quantifying the damage of a pathological specimen (non-hair) has been evolved by an index called the damage index μ .

(ii) *Theoretical Study on the Application of the Control Theory to Electrical Mechanics and Power Systems* : The theory of de-coupling has been successfully applied to d.w.r. synchronous machine and investigations on non-linear de-coupling, data sensitivity and optimization are in progress.

(iii) *Interaction of Physics and Medicine* : The studies were continued.

2.3.5.2 *Teaching Activities* : The Unit was engaged in teaching Physics Elective in the Second Year B. Stat. Honours Course.

2.3.5 Flume Project

The study of sediment transportation problems was continued by a team consisting of a geologist, a statistician and a mathematician. The problems of generation of unimodality, symmetry and lognormality in the size distribution of particles suspended in flowing water were investigated experimentally and theoretically. Flume experiments were conducted to study the nature of grain size distributions of particles settled from suspension at decelerating water flow velocity.

2.4 BIOLOGICAL SCIENCES

2.4.1 Anthropometry and Human Genetics

(i) *Bioanthropological Study of a Migrant African Group, the Sidhis of India* : The project aims at understanding of the processes of biological and social adaptation among the Sidhis who came to India from Africa some 400 years back.

(ii) *Bioanthropological studies among the Nandiwallas and Dhangars* : The objective of this project is to determine the mode of inheritance of some quantitative dermatoglyphic variables, to examine extent of diversity within and between population, and to assess evolutionary implications of dermatoglyphic variables.

(iii) *Patterns of fertility and reproductive wastages by parity and social class* : With respect to national problems of high fertility and increasing population in the stratified society of India at large the project has been undertaken to study from the standpoint of reproductive biology differential fertility, reproductive wastages and casualties among the Bengali mothers.

INDIAN STATISTICAL INSTITUTE

(iv) *Study of physical growth of Bengali boys* : With respect to national problems of health and nutrition of the growing children of India in general the project has been undertaken from the standpoint of growth dynamics to study anthropometrically the norms and rates of growth and development of the pre-adolescents of the Bengali parvillage.

(v) *Impact of Altitude on Human Population* : The objective is to compare highland and lowland Sherpas, lowland Sherpas and lowland Lepchas, and socioeconomic subgroups of the lowland Lepchas, to evaluate the relative effects of physical environmental and socioeconomic stresses on health status, as judged by demographic, anthropometric, haematological and other clinical traits. The data show that socioeconomic stresses may be more important determinants of health than physical environmental ones. A recent ophthalmological survey shows relative infrequency of hereditary eye diseases.

(vi) *Biomedical study of Portuguese-descendants of Mirpur village, district Midnapore, West Bengal* : The objective is to compare the mixed Portuguese-Bengali population of Mirpur with a few neighbouring ones, as well as the latter themselves and their subgroups, to evaluate the relative effects of genetic and socioeconomic factors on health/disease. The data show that all the communities suffer from heavy intestinal parasitic infestations and anaemia, fertility is inversely related to socioeconomic condition, and Mirpur (an ethnic minority) is on the verge of extinction.

(vii) *A study on the relationship between socioeconomic condition, nutrition and health* : The objective is to compare high, medium and low economic subgroups of the same population, to evaluate the effects of socio-economic condition on nutrition and of nutrition on health/disease. The data show an inverse relationship between health parameters and economic condition.

*(viii) *A study on dietary intake pattern, body measurement, parasitic load and other health indicators among the inmates of two old-age homes in Calcutta city.*

*(ix) *Distribution of intestinal parasites in West Bengal.*

(x) *Study of Fertility, sex-ratio and biochemical genetic markers* : Between parental and offspring generations the study aims to examine the nature of variation in and association between biochemical genetic markers and reproductive wastages/sex-ratio in the children.

(xi) *Study of placental enzyme polymorphism in Indian Population* : Principal purpose is to study gene frequency of various placental enzymes like alk.ph, PGM₁, Ac.ph., Est-D & LDH in a number of ethnic groups of N.E. Indian in understanding the extent of Mongoloid admixture in the population groups.

* Projects 8 and 9 are described under Biochemistry Unit, items (v) and (vii).

INDIAN STATISTICAL INSTITUTE

(v) *A Study on Dietary Intake Pattern, Body Measurement, Parasitic Load and Other Health Indicators Among the Inmates of two Old-Age Homes in Calcutta City* : The purpose of the project is to assess the health status of the elderly population, and the effect of socioeconomic condition on old-age diseases. Collection of health related data on the elderly section of the people from various regions/communities, etc. and the results obtained should help formulate medical welfare programme(s) for this section of the Indian populations.

(vi) *Impact of Altitude on Human Population* : To compare high land and low land Sherpas and low land Lepchas, with regards to physiological and biochemical parameters to evaluate the relative effects, especially, of altitudinal stresses, vis-a-vis genetic constitution, on health/disease.

(vii) *Distribution of Intestinal Parasites in West Bengal* : Intestinal parasitic infestation is one of the major health problems in India. Some data on the distribution of intestinal parasites in different regions of West Bengal exist, but there are large gaps both in terms of spatial and ethnic coverages. Detailed survey of the types and prevalences of these infestations by region, ecological zone, ethnic group etc. should help formulate medical welfare programmes with appropriate emphasis on preventive and curative measures.

2.4.3 Botany

Research activity was primarily concentrated in the following areas :

(i) Breeding of rice with a view to evolve high-yielding rice varieties from indigenous germ plasm and performance trial of a dual-purpose high-yielding (joint yield of grain and straw) rice variety, developed by the Botany Research Unit and provisionally named 'Subarna', in the farmer's fields under different agro-climatic conditions. The results are encouraging which call for further extensive trial.

(ii) Performance trials of intervarietal mixtures of rice, wheat, oat etc., and inter-species mixtures of cereals and legumes like wheat and gram, wheat and pea, rice and pigeon pea, oat and gram, oat and lentil were conducted with a view to find out the nature of mixture effects. While some varietal and species mixture showed competitive disadvantage, a few mixtures showed mutually stimulated yield performance thus offering the possibility of harnessing this biological phenomenon for higher grain/seed yields.

(iii) The mechanisms involved in intervarietal and inter species competition and interactions are under investigation.

(iv) The effect of electromagnetic field on plants was studied. The study demonstrated certain disruption of the mitotic behaviour during nuclear division of the growing roots of *Allium cepa* following exposure to specific strength of electromagnetic field for a special period.

FORTYNINTH ANNUAL REPORT : 1980-81

(v) The investigation on the behaviour and ecology of field rodent was continued. It was observed that the structural components of nests consists of plant materials of mainly the grass family and also others available in the neighbourhood of the burrow.

(vi) Preliminary work for planning and execution of the project 'Deforestation : nature cause and consequences' was done.

2.4.4 Crop Science

(i) *Study of Asymmetry in Plants and Animals* : General problems of levo and dextro-rotatory situations present therein. Interest in the phenomenon of asymmetry in plants and animals is due to the fact that morphology does not end merely with the presentation of facts in the form of data. So it is to gain knowledge of the laws operative in structure and behaviour in the case of animals and the yield in the case of plants.

(ii) *Exploratory work on the Family Arecaceae (Palmae)* : The family Palmae comprises of a total of 212 genera, 2779 species and 45 major groups of palms. Uptil now very little attention has been paid to this family, particularly, to the seedling plants, both from the anatomical as well as from morphological points of view. To cope with this problem we have been studying the following aspects of the same. (a) Anatomy of the palm seedling : It includes—atomy of root, stem and leaf, ontogeny of apical meristem stomata, trichomes, vessels etc. ; (b) Developmental stages of fruits of several species till maturity, e.g. to gain knowledge about the development of endosperm and its different stages ; (c) Morphology and growth pattern of palm seedlings of several species. The above-mentioned studies are aimed to determine the laws of organic differentiation.

(iii) *Studies in the Field of Natural History* : It includes general behaviour and ecological studies of different animals, birds, insects etc. It may be noted that during all these studies in the above-mentioned fields, statistical and mathematical tools are applied extensively to explore the pathways of the selection process.

2.4.5 Embryology

(i) *Molecular Embryology of Molluscan eggs* : Experiments with Tunicamycin have continued. Scanning electron microscopy shows that not only does it very effectively loosen the cell cement of *Limnaea* morulae but also converts the cytoplasm into very regularly shaped globules. It also converts rabbit rbc into echinoid forms. This is the first known example of an antibiotic acting as such an agent.

(ii) *Ecological and Biochemical Study on Wildlife* : (a) Study of pheromones of leopards has continued. In the non-amine fraction a ketone of molecular weight 98 has been identified. Olfactory reaction of the cubs has been studied. Olfaction of free ranging lions has been studied in Kenya. (b) The ecological relationship of ants, moths and thorns of *Acacia jeyal* and *Acacia Elattor* has been studied in the remote bushland of Kora, Kenya.

INDIAN STATISTICAL INSTITUTE

(iii) *Biometathematical Study of Cellular Growth and Morphogenesis* : Stochastic and mathematical models of this fundamental process have been further developed. Mathematical studies in the problems of differentiation, based on these models have been initiated. Biological oscillations have been predicated and these have been considered to form the basic steps of differentiation.

2.4.6 Entomology

Investigations on the acoustic sensitivity of the filarial mosquito (*Culex pipiens fatigans*) with special reference to the formation of a swarm : Acoustic response/sensitivity of mosquitoes is an established fact. There are reasons to believe that the so called swarming of mosquitoes involves acoustically triggered mating process amongst a large assembly of mosquitoes. Swarming may also therefore be possible to be evoked by sounds of appropriate frequencies. It is the aim of the project to investigate the range of frequency (audible or ultrasonic), if any, most favourable for swarming process.

2.4.7 Leaf Protein

(i) *Screening* : Of a few species screened this year, *Allmania nodiflora* was found to be hopeful and produced 200 kg/ha leaf protein (LP) in 50 days. Studies are being carried out in winged bean, a newly introduced bean crop. The results indicate the immense potentialities of winged bean as a protein yielding crop for the humid tropics.

(ii) *Agronomic Aspects* : Studies on three root crops viz. radish, turnip and beet root have been completed in a series of long term experiments to establish the optimum of different aspects for producing maximum root yield as also protein yield from the by-product leaves in this region. The results are being analysed.

(iii) *Microbiological Aspects* : (a) *Screening of different micro-organisms from whey samples* : A number of fungi, bacteria and actinomycetes have been isolated and identified on the basis of careful microscopic slides and physiological/biochemical characteristics. (b) *Production of citric acid in different whey samples* : A citric acid producing mould, *Aspergillus niger* NL IM.594 has been found to propagate well in all the whey samples studied so far. 3.5g of citric acid per 100 ml of turnip whey was recovered when fortified with 10% sucrose. (c) *Production of penicillin in whey* : *Penicillium chrysogenum*, an antibiotic producing mold propagates in all the whey samples. Experiments are being continued for better production of antibiotic.

(iv) *Biochemical and Nutritional Aspects* : (a) Analytical studies on fibre, a by-product of leaf protein concentrates (LPU) are being continued with the object of utilising the component as an animal feed. (b) Studies on the role of lipids in affecting storage of LPC are in progress. (c) Laboratory evaluation of different heat fractionated LPC of various hopeful species are being studied. The objective is to carry out feeding trials with the hopeful samples in the next phase. (d) Utilization of water

FORTYNINTH ANNUAL REPORT : 1980-81

hyacinth : Work is in progress. Among many other factors, known and unknown, we are aiming to reduce i) high water content and ii) potassium and Chloride. Through minimizing these two factors, the crop may be made more acceptable as a cattle feed.

2.5 Social Sciences

2.5.1 Demography

2.5.1.1 Following studies were completed during the period 1980-81.

- (i) Education mobility of males and females in rural areas of districts around Calcutta : Education mobility in respect of birth cohort among males of scheduled castes (Hindus and Muslims, between mother and daughter over a period of 25 years in comparison with net upward education mobility between father and son over a period of 35 years : The study shows opposition of the weaker section of the village population to higher education of sons than their fathers, not true regarding that of females.
- (ii) Evaluation of rural health programme in districts around Calcutta.
- (iii) Extension education service in rural areas of West Bengal.
- (iv) Acceptance of sterilization programme in rural areas of Murshidabad, Nadia and Birbhum districts.
- (v) Marriage pattern among females in rural areas of districts around Calcutta.
- (vi) Out-migration of villagers of districts around Calcutta.
- (vii) Literacy among women in family life in rural areas of Murshidabad, Nadia and Birbhum.
- (viii) Study of differential response by male and female informants regarding contraceptive practice.
- (ix) Evaluation of widowhood data in Indian Censuses.
- (x) Effect of socio-economic development and of population control programme on fertility in India.
- (xi) Applications of model life tables to Indian mortality data.
- (xii) Population estimates of India.
- (xiii) Management of primary schools in rural areas of West Bengal.
- (xiv) Drop out reasons.

INDIAN STATISTICAL INSTITUTE

2.5.1.2 Teaching :

Besides teaching for the degree course and for International Statistical Education Centre students the staff of the Demography Unit imparted training on the following programme :

(i) Specialisation training on Vital Statistics and Demography was arranged for Statistical Officer Trainees during 2-13 June 1980. (ii) Four trainees of the International Statistical Education Centre (ISEC) underwent specialised training in Demography during 11 February to 21 March 1981.

2.5.2 Economics, Econometrics and Planning

2.5.2.1 Calcutta :

The research work of the Economic Research Unit has covered a wide range of theoretical and applied problems. There has also been the usual teaching at the graduate as well as undergraduate level, and research guidance of students.

(A) *Economic Theory* : (i) One stream of research in economic theory continues to span the broad contours of classical and post-classical theories of nature, distribution and accumulation, eschewing the current neoclassical orthodoxy of the subject. (a) Offering a reconstruction of the analytical core of the classical theory of nature and distribution together with an application of it to the 'pure' theory of international trade, starting from certain fundamental classical premises in the theory of capital and production. (b) Working out the logical structure of a number of central conceptions found in the *Wealth of Nations*. (c) Developing a broad analytical frame for studying the formation of marketed surplus and foodgrains prices in the context of 'backward agriculture' broadly concerned. (d) Evolving the broad idea of service versus commodity forms of production on a methodological plane with applications to the methodology of national income estimation and analysis of industrial organisation. A *workshop on Economic Theory* is held every working Saturday in the above background, being attended by economists from different universities and research organisations in Calcutta.

(ii) *Econometric Methods* : Studies in this area have analysed statistical problems in the estimation of single equation econometric models arising from (a) heteroskedastic disturbances, (b) transformation of variables, (c) errors in variables (d) omission of regressors and misspecification of the equation (e) Bayesian Inference, (f) Time series Analysis and Forecasting.

(iii) *Measurement of Poverty, Inequality and Income Distribution* : Some studies in progress in this area concern issues relating to measurement of poverty, inequality and tax progression. One study examined the procedure for measuring incidence of undernutrition advocated by Professor Sukhatma.

(iv) *Regional Planning* : Research work in progress in this area seeks to cover the following aspects: (a) manufacturing industrialisation and regional

FORTYNINTH ANNUAL REPORT : 1980-81

production functional analysis in India (b) monetization of agricultural products and regional surplus-deficit analysis in India (c) spatial linkage and growth centre analysis in Eastern Region of India (d) synthetic statistical analysis for regional planning in Nepal.

(B) *Applied Economic Problems* : (i) *Economic Planning* : One study in progress seeks to work out a plan outline, complete with a monetary, fiscal, price and production policy frame, from the objective of meeting basic human needs within a planning horizon. Preliminary discussions have been held in connection with another project of periodic review of the Indian economy.

(ii) *Problems of the Rural Economy* : In a study of the potentialities as well as institutional and other constraints of rural development, the report on the first phase of a survey of four villages in Bankura is in the final stages of preparation. The second phase to be taken up soon in Burdwan will include a study of the impact of the programmes initiated under the Integrated Rural Development Programme in the selected areas. A benchmark survey of the Integrated Rural Development Programme in two blocks in Coorbhehar has also been taken up. Socio-economic investigation of some 30,000 village households has been completed and sample tabulation of data for one mouza has also been worked out.

(iii) *Consumer Behaviour and Level of Living* : Interregional and intertemporal variation in the level of living is being studied on the basis of 25th Round NSS Household Budget Data. The processing of the data on the Institute computer is in progress. Another study of consumer expenditure pattern using NSS time series data (7th to 28th Round) has been undertaken. As a part of this study, a system of demand equations based on Muellbauer's concept of price-independent generalised linearity is being used.

(iv) *Agriculture* : As part of a broader study of Government policy in respect of pricing, production, procurement and distribution of agricultural commodities, acreage response functions are being estimated for particular crops from state-level time-series data.

(v) *Industry* : A study on the measurement of productivity in selected manufacturing using Annual Survey of Industries data since the mid-sixties is in progress. Another study seeks to analyse trends in the mark-up factor for manufactured products during the Plan period for major individual industries as well as for output of manufactures as a whole.

(vi) *Labour* : Data collected in the ICSSR-sponsored survey of unorganised transport workers in Calcutta is under scrutiny and tabulation in the Institute computer in Calcutta.

(vii) *Energy policy* : One study has analysed the relation between investment on capacity for manufacturing sector and expansion of capacity for power generation. Another study has compared the cost of nuclear power and thermal power under Indian conditions, utilising data provided by the American Physical Society in their special report on nuclear power.

INDIAN STATISTICAL INSTITUTE

(viii) *Social Forestry* : A study on social forestry was prepared using data, on utilisation of forest products by households in four villages in Bankura surveyed under the Rural Survey project of the Unit.

(ix) *Money and Banking* : One study has sought to develop an econometric model for forecasting demand for bank credit of the commercial sector in India ; A related study aims at analysing the changing seasonal pattern of such demand.

(x) *Foreign Trade* : An econometric study of the behaviour of India's import—both total imports and imports of various groups of commodities, over the period 1950-51 to 1977-78 is being carried on. Another empirical study is being made of trends in India's exports during the period 1964-65 to 1975-76, with particular emphasis on changing direction and commodity composition of export trade. One note prepared during this period discussed alternative export policy options for the country taking a perspective view of the eighties.

2.5.2.2 *Delhi, Planning* :

(i) Impact of the Metropolitan City of Bombay on the surrounding region ; (ii) Integrated Development—Case study of North Kanara ; (iii) Theory of decentralized resource allocation Medianism and Nonlinear input-output models ; (iv) Effect of price and quantity controls on the Sugar Industry ; (v) Social choice theory and income distribution in India ; (vi) Specification of the pattern of income distribution ; (vii) Dynamics of deforestation ; (viii) Employment and earnings in the handicrafts sector (ix) Export strategies and development ; (x) Impact of social services in rural areas ; (xi) Input-output tables for the Indian economy ; (xii) Agricultural development and its impact on the less privileged, including field studies ; (xiii) Study to estimate the requirements of fertilizers, componentwise, for Punjab, keeping in view the changing cropping pattern. The time series data on production of major crops, fertiliser consumed, area under different crops, irrigated area etc. is being collected ; (xiv) Rural agricultural market centres and spatial development ; (xv) Commodity trade and employment.

2.5.3 *Linguistic Research*

The programme of fundamental and applied research is grouped under three broad headings :

(i) *Study of the Phonetic Structures of major Indian Languages and Application of the Results in the following areas* ; (a) Speech Pathology : Speech and language habilitation of hearing impaired children. (b) Second language teaching (c) Cultivation of mother-tongue.

(a) *Bengali Phonetics* :

Fundamental research : *Suprasegmentals of the Bengali language* (a) Spectrographic recordings have been made of Bengali monosyllabic words in the first phase

PORTYNININTH ANNUAL REPORT : 1980-81

of this research. Similar data is being collected for disyllabic words, with the purpose of measuring the duration of vowels in Bengali words. (b) Studies are in progress on allophonic varieties of Bengali speech sounds resulting from interaction of speech sounds.

Applied research : Speech Pathology : (a) Studies on articulatory norms in school going children from four to ten years of age. (b) Educational problems of hearing impaired children attending schools for children with normal hearing.

(b) *Hindi Phonetics*

Fundamental research : Suprasegmentals of the Hindi language : A project has been initiated in collaboration with experts on the Hindi language to carry out a number of studies on the suprasegmentals (prosodic features) of the Hindi language. It is planned to study vowel duration, stress and intonation patterns in monosyllabic, disyllabic and trisyllabic words in the first phase. This is a continuing scheme.

Applied research in Speech Pathology : A methodology for speech habilitation of hearing impaired children having Hindi as their mother tongue is being prepared.

(c) *Telugu Phonetics*

Fundamental research : Suprasegmentals of the Telugu language : Studies are in progress on the suprasegmentals (prosodic features) of the Telugu language, in collaboration with the Department of Linguistics, Osmania University, Hyderabad.

Applied research : Speech Pathology : Methodological units for speech and language habilitation of hearing impaired children with Telugu as their mother tongue will be prepared in collaboration with Department of Linguistics, Osmania University, Hyderabad.

(d) *Punjabi Phonetics*

Fundamental research : The articulatory and acoustic phonetic structure of the Punjabi language has been studied and a book has been finalized for publication.

(ii) *Investigation of Problems Relating to the Structure of Meaning*

(iii) *A Statistical Approach to Linguistic Problems :* Some statistical studies are in progress and further studies planned on quantitative linguistic and phonetic data from the following languages : Bengali, Hindi, Telugu, Punjabi, Serbo-Croat and English.

(a) *Serbo-Croat :* Data provided by Professor Djordje Kostic on the distribution of grammatical forms and categories according to their frequencies is being processed statistically. It is planned to measure the distance among the areas of linguistic performance in the Serbo-Croat language and individual authors. The work is

INDIAN STATISTICAL INSTITUTE

being carried out under the linguistic guidance of Visiting Professor Kostic and the statistical guidance of Professor N. Bhattacharyya.

(b) *Bengali* : A considerable amount of data has been collected over the years on the vocabularies of Bankim Chandra Chatterjee and Rabindranath Tagore and is ready for statistical processing.

(c) *Comparative studies* : A number of technical papers are planned, based on a substantial amount of data collected on the Bengali, Hindi, Telugu and Punjabi languages, as well as on Serbo-Croat and English.

2.5.4. *National Income Research*

Studies on the Distribution of Income : Studies are continuing regarding investigations covering both private and public sectors subject matters being occupational wage-differentials and distributions of income within Central Government Services and West Bengal State Government Services in the public sector and agriculture, manufacturing industries, mining and plantation in the private sector.

(ii) *Studies on National Accounts* : The work on the estimation of state domestic product of West Bengal by districts is continuing. This is a part of the studies on national accounts. Data required for estimating capital formation and capital-stock for West Bengal are also being collected.

(iii) *Studies on Level of Living* : Studies on disparities in level of living in India are being carried out on the research work done during the previous year. Some investigation was also made of the effect of different methods of numerical integration for computing the Lorenz ratios.

(iv) *Studies on Disparities in Purchasing Power between Different States of India* : This study is now being followed up by applying the Khemis-Gary methodology. In another study, the construction of a composite consumer price index number is attempted from the available consumer price index numbers of different states and in rural and urban areas and a comparison of this with the national income deflator.

(v) *Studies on Social Indicators and Economic Development* : An attempt is made to form a correlation matrix for 13 indicators based on data from 84 selected countries, find out the relative weights for different indicators and construct an index for each country combining all the indicators. The simple correlation between per capita G. N. P. and these indicators will also be examined.

(vi) *Studies in Progress* : (a) The variation between different states in shares of monetized and non-monetized components in the total consumption expenditure. (b) Consumer durable (c) Urbanization in India.

(vii) *Preparation of series of estimates of capital formation and national income in India from the year 1857 to 1900 (in progress)*

FORTYNINTH ANNUAL REPORT : 1980-81

2.5.5 *Pre-Census Population Studies*

The undermentioned research projects dealing with historical studies based on quantitative data were continued during the year.

(i) *Pre-Census Population Project* : The purpose of the project sponsored by the Registrar General India is primarily to collect materials bearing on population and allied socio-economic variables prior to the first Census of India in 1872. The third pre-census volume covering the period 1811-1830 for the whole of India except the Eastern Zone is getting ready for the press. Compilation and editing of the volumes relating to the period 1801-1910 and 1831-1840 are going on. Twelve maps prepared for publications.

(ii) *Analysis of Socio-Economic Trends in Bengali Writings, 1818-1947* : Proceedings of Seminar on Economic Writings in Bengali, 1818-1947 held at Calcutta in 1978 are being released from the press. As a part of compilation of a socio-economic bibliography on India, a volume of materials in Bengali were examined with a view to surveying the trends. A monograph on the subject has been sent to the press.

(iii) *Economy of Bengal, 1750-1800* : The object is to construct estimates of production and population of the period. Two papers were circulated. Collection of data is almost complete.

(iv) *Editing of Manuscripts of Statistical Survey of Bengal by Francis Buchanan* : Compilation work on Gorakhpur has been completed. An analytical introduction is being prepared in collaboration with other scholars. Compilation work on the district of Rungpore is in progress.

(v) *Economic Changes in Rural India* : The purpose of these studies is to bring out trends of socio-economic changes in a historical perspective. Reports on the study of 20 villages of Aligarh district 1825-1975 and on the village of Ballavpur, 1925-1976, are nearing completion.

2.5.6. *Psychometry*

(i) *Development of Intelligence Tests for Deaf Children for Diagnostic Purposes* : On the basis of a pilot study and the results obtained from the experimental version of the test battery has been revised and the printing of the same is also over. This test is now planned to be administered at five different schools at Calcutta.

(ii) *Usefulness of Aptitude, Achievement and Personality Variables in Industrial and Educational Selection* : This is an on-going project, and aims at testing the hypothesis that the candidates so selected are more suitable to the organisation than those who are selected otherwise.

(iii) *Isolation of Common Patterns of some Personality Traits and its Significance for Vocational Fields* : On the basis of this study a paper has been sent for publication.

INDIAN STATISTICAL INSTITUTE

(iv) *Popular Conceptions of Mental Health* : A preliminary report was prepared and circulated amongst the experts for their comments, and they were consulted for devising a suitable methodology for further surveys.

(v) *Study of Internal Locus of Control* : The object was to measure the attitudinal dimension named 'internal locus of control or subjective efficacy' (defined as a belief that the environment or the outer world could be transformed through personal effort) and to relate it to other psycho-social variables. The study is being carried on from previous year and some preliminary data were obtained.

(vi) *Development of a Scale for Measuring Managerial Potentiality/Skill* : Work is going on to know the personal desirability and social desirability of the managers regarding the items written in five different areas of managerial skill.

(vii) *Statistical Analysis of Multiple Choice Test Score* : Some analysis is being programmed with accumulated data in connection with psychometric testing. Different theoretical models and their suitability are being considered in investigation. Analysis of data is in progress.

(viii) *Analysis of Educational flow Data* : A stochastic model is assumed to characterise the progress of students in schools through an educational system. Data will be collected and analysed.

(ix) *Rorschach Psychogram through Computer Programming* : A standard machine scoring procedure has been achieved. The other portion of the study i.e. the interpretation manual is going on. A paper in this connection is in progress and is expected to be published very soon.

2.5.7 Sociology

(i) *Social Science Research Project and Problems : an inventory/study* : Data collected from several research organization/institutions/universities are being analysed. Related survey in the North Bengal region has just been completed.

(ii) *The Study of 'Registry Marriage' and Impact of Legislation in West Bengal* : Collated information on the 'registry marriage' are being tabulated and analysed.

(iii) *Content analysis of views on an aspect of societal change in India : the Hindu-Muslim Relations in the 18th Century Bengal* : Analysis of the materials so far collected, is being done. A technical paper has been prepared and sent for publication.

(iv) *Study of pilgrim centre* : Project completed.

(v) *Variations in Family Structures in India* : Processing and analysis of data relating to urban and rural sectors of eastern India are in progress.

FORTYNINTH ANNUAL REPORT : 1980-81

(vi) A study on Socio-economic structure and change in some selected villages of West Bengal has been completed. Survey report entitled, *Mahalanobis survey revisited : prospects of agrarian change in West-central Bengal*, has been prepared and sent for publication.

(vii) *Field research in various (e.g. socio-religious-economic) aspects of societal problems of two States* : Sample survey in Patna district of Bihar has been completed and data have been scrutinized. Tabulations are being done, together with the processing of primary data, collation of secondary data is also continuing.

(viii) *A study of the Nepalese system of Panchayat Democracy* : One book has been published.

(ix) *Law, society and change—a case study of the Indian situation in the period between 1947-1961, that is, the Nehru Era of Indian politics—one aspect of which : study of the socialist movement in India, and the concept of Total Revolution as propounded by Jayaprakash Narayan* : Two books have already been published. Concluding work on the third volume, which would complete the project, is in progress.

(x) *Problems of deforestation in India (under socio-cultural and biological adaptation in contrasting eco-system)* : To identify and to quantify the factors influencing the process of deforestation and its consequences on man and environment, a study of domestic consumption of minor forest products as a part of the programme, has been taken up.

(xi) *Village re-survey* : Follow up studies are being carried out on the previous years research work.

(xii) *Problems of Adjustment of the Retired Persons in their Family Life* : Study has begun by canvassing structured questionnaire.

(xiii) *Conflict, Structure and Change* : Theoretical frame-work and design of the project have been formulated. Awaiting pilot study for finalisation of research design.

(xiv) *Preparation of report on Bihar Movement is in progress* :

(xv) A research project to compare network and structure of power relations in different areas is under preparation.

(xvi) *The conditions of rural progress in India : Report Completed.*

2.6 Statistical Quality Control and Operations Research

2.6.1 *General* : Statistical Quality Control and Operations Research Division was set up by the Government of India in 1952 under the technical guidance of the Indian

INDIAN STATISTICAL INSTITUTE

Statistical Institute. The Division continued with its objectives of promoting applications of Statistical Quality Control (SQC) and Operations Research (OR) methods, training and education of executives, inspectors, trainers, operators, consultative services to industrial establishments and research in SQC & OR and allied services. The activities of the Division are organised through comprehensive programme under the broad classification of (i) promotion, (ii) training, (iii) plant services and (iv) research.

Promotional activities during the year were conducted in public and private sectors through participation in and organising of seminars, conferences, pilot surveys and inplant demonstrative project and serving on expert bodies in the field. Inplant training of technologists, trainees, inspectors and operatives including operative programme in local languages and services continued to have support from a number of public and private sector organisations. The units of Bharat Heavy Electricals Ltd., Hyderabad, Bhopal and Jhansi continued as servicing plants of the Division besides a number of other plants both in public and private sectors. Several organisations were added to the list of servicing plants during the year.

The Division undertook new project assignments during the year, apart from rendering consultative services to factories already on its rolls. The Division has so far trained about 29,000 managers and technologists etc. from various factories and organisations, produced about 650 specialists and prepared over 500 research and application papers in the field of SQC & OR.

The Division continued liaison with various academic and technical institutions, Productivity Councils, societies, association and several other national and international bodies by way of its academic, technical and promotional activities.

2.6.2 *The Consultative Services* : During the period under review 14 plants joined the SQC services scheme. 179 technical reports were sent to factories and 15 factories discontinued. A total of 55 factories are taking consultative services as on March 1981.

Special studies involving SQC & OR methods were taken up in the areas : Optimal process parameters for spiral welding, recovery of bushing, wave soldering process for printed circuit board of electronic industries, lowest SFC in diesel engine manufacture, quality improvement in heavy machine shop of turbines and generators, productivity improvement in assembly of energy meters, cycle tube manufacture, evaluation of sampling plan IS 2486 for testing insulator caps, technological improvement in manufacture of solid core insulator, evaluation of performance of V T pumps, simulation test using OA techniques for study of motor burn-outs in compressor, vendor quality assurance, application of fibrograph for process control at textiles, optimum strategy for efficiency of a mill under restricted power supply, optimum slicing of wooden sleepers for packing cases, scientific inventory management, quality of conductors and sampling and testing error in its testing, control of rejection at a foundry, lampworks and MICA Vee rings in high voltage tests, sampling scheme for verification of stocks of food

FORTYNINTH ANNUAL REPORT : 1980-81

items, factors influencing thickness of pressed magnet, effect of magnetic current on properties of sintered magnets.

2.6.3 Education and training

Implant training programme of various factories continued. A series of training programmes for senior executives of Bharat Heavy Electricals Ltd. continued on regular basis besides regular programme for executives at various level. One-year special programme for executives at fairly advanced level blended with practical applications continued for third batch of trainees at Delhi and later at Madras. The Division organised short-term specialisation training programme in the area of SQC and OR for Indian Statistical Services (ISS) probationers, ISEC trainees and participants from various organisations like RITES, NPC, IIM, polytechnics and a large number of industrial establishments.

During the period under review 2901 managers and technologists etc. were trained in various implant general and other courses, 121 trainees underwent professional training in SQC & OR at a Post-graduate level and in part-time courses in Calcutta, Bombay, Madras and Bangalore. The Division organized training courses, namely, 7 general courses for 118 participants, 54 implant courses for 2901 participants and 20 other courses for 393 participants at its units at Bangalore, Baroda, Bombay, Calcutta, Coimbatore, Delhi, Hyderabad, Madras, Pune, Trivandrum, T & P, Calcutta and SQC & OR Division, Calcutta.

2.6.4. *Applied research* : During the period under review 9 papers were published, 19 sent for publication and presented at Conference Seminars etc., 40 manuals and technical reports etc., prepared by the specialists of the division. Some of the areas in which applied research work is carried out include unified theory for phase type renewal process using the properties of Erlangian mixtures, the uniqueness of the optimal solution for pseudo monotonic problem and some non-linear programming problem, combinatorial optimisation in flow-shop scheduling problem, Bayesian three-decision sampling plans, optimal parameters and optimal sampling interval of control chart, acceptance sampling by variables using gauging method etc. explicit expression for fundamental matrix using group generalised inverse, control of ovality using bi-variata gamma distribution.

2.6.5 *Promotional Activities* : The specialists from the division delivered 190 lectures and talks to various institutions and organisations. The division also arranged 26 seminars and the specialist from various units attended 44 seminars and symposia.

Introductory visits were paid to 41 factories. Twelve survey and pilot projects were carried out and 15 reports sent.

2.7 Library, Documentation and Information Sciences

2.7.1 Central Library :

(i) With the addition of 2863 new books and 1293 bound volumes of journals, the total collection of the Central Library at Baranagar rose to 1,65,239 at the close

INDIAN STATISTICAL INSTITUTE

of the year. The library has a collection of 34, 023 reprints, 3,75,000 maps and a large collection of microfilms, microfiches and photoprints. The services of the branch libraries at Bangalore, Bombay, Giridih and Delhi are co-ordinated with those of the Central Library to serve researchers, students and staff of the Institute.

(ii) *Acquisitions*: A total of 2863 titles were acquired of which 1888 were purchased, 964 were received as gifts and 14 were received on exchange. The Library received a total of about 7800 titles "On inspection/approval and purchase" basis. Of these about 1200 were selected and purchased while 688 were purchased against orders placed on request.

(iii) *Technical Processing*: The Library classified 1901 and catalogued 3024 books and other documents, processed 49 titles for Text Book Collection. 4614 and 1868 cards to alphabetical and classified catalogues respectively were added. 23 issues (some combined) of weekly lists of additions to the library and 3 issues of Quarterly Library Bulletin: a classified list of additions to the library were brought out with a view to facilitating the use of the classified catalogue. A project work on 'Subject Index to classified Catalogue' has been undertaken.

(iv) *Periodicals*: Altogether 2311 periodicals were received in the library of which 733 were received against subscription, 959 on complimentary basis and 619 on exchange arrangements with national and foreign organisations. The library subscribed to 97 new journals during this period. The library also acquired 276 back volumes of journals. Technical processing including accessioning of 1293 bound volumes of journals was completed. It also brought out 50 issues of weekly list of current journals. A project on 'Identification of lacunae in periodical holdings' was also completed.

(v) *Membership and Circulation*: The total membership of the Library during the period was 3688 including students, research scholars, staff as well as members of the Institute and students members of other institutions. On loans and reference 707994 books and journals were issued. Special permission was given to 746 readers to use the Library for a short period. The Library borrowed 42 books and journals and issued 47 books and journals under inter-library lending arrangements.

(vi) *Documentation*: During the period the Library completed compilation of 2 Bibliographies "Population Studies—A Bibliography of Research Papers and Publications" and "Bibliography on Energy" of which the former has been published. Compilation of 4 other Bibliographies is taken up: (1) Bibliography on Statistics and Mathematics, (2) Rural Development and Reconstruction and Social and Political Mobilisation, (3) Scanning of Articles on the Application of Stochastic Processes and Management Sciences and Economics and (4) Bibliographical Resources on Demography and Family Planning, available in the Institute Library. Institute also provides with short lists of documents in specialised subjects on request.

(vii) *Reprographic and Photographic Services*: The library provided with 1,16,967 xerox prints, 5140 bromide enlargements, 2040 photocopies from microfilm, 148

FORTYNINTH ANNUAL REPORT : 1980-81

photocopies of large maps and drawings, 730 frames of scientific photographs etc., 403 contact prints, 1463 frames of microfilms of books, journals etc., 572 frames of microfiche of books, journals etc., and 434 slides.

(viii) *Reports and Records* : The Library processed 1268 accessioned 554 and issued 1619 official reports and other documents. The Library also sorted and collated 497 official publications for binding. A catalogue of U. N. publications available in the Library was compiled. The Library completed a list of foreign official publications after making entries in the cards. Reference services to the readers are regularly provided.

(ix) *Translation* : Four documents were translated from German into English. Two other documents were translated from English into French for the participants of one national and one international conferences. Several documents in Russian also were translated into English. Checking of the translation and transliteration of 360 titles (in Russian) in the cataloguing cards was carried out for the Special Materials Collection.

(x) *Special Materials* : (a) Microfilms : 617 processed and 610 accessioned. (b) Russian titles : 221 accessioned, 200 transliterated, 130 translated into English, 130 classified and catalogued and 570 catalogue cards prepared. A catalogue of Russian language publications available in the Institute Library was also brought out.

(xi) *Circulating Library* : The Workers Circulating Library acquired 704 new books bringing the total collection to 30,302. It issued 27496 books to the members. This library was shifted from its temporary shed to the 3rd floor of the new library building in October, 1980.

2.7.2 Delhi Centre Library

(i) With the addition of 862 new books and 641 bound volumes, the total collection of the Delhi Centre Library rose to 17962 volumes at the close of the year. The Library has also a large collection of Reprints and Technical Reports etc.

(ii) *Acquisition* : 862 books and 641 bound volumes were accessioned during the year.

(iii) *Technical Processing* : The Library classified and catalogued 700 books. Five issues of Bi-monthly list of additions were published.

(iv) *Periodicals* : The Library received 280 periodicals, of which 270 were received on subscription, one on exchange and 9 on a complimentary basis. Five new periodical titles have been subscribed for.

In addition to the exchange programme already being undertaken with the Institute of Statistical Mathematics, Tokyo, Japan, similar programme with the following

INDIAN STATISTICAL INSTITUTE

has been undertaken : (1) Université de Paris-Sud, Centre D'orsay, Cedex, Paris, 2, Mathematics Research Centre, University of Wisconsin-Madison.

In exchange the Institute will send Discussion Papers and Copies of the Journal *Sankhya*. 641 sets of the Periodicals has been bound and added to the stock.

(v) *Membership and Circulation* : The total membership rose to 474 (including staff, research scholars, students and guests) of which student members (outside) numbered 15 and Institute members were 116. Altogether 180 persons used the reading room with special permission. 7400 books and periodicals were issued to members. The Library borrowed 182 publications from local libraries and lent 52 publications to other libraries under the Inter-library lending arrangements.

(vi) *Xeroxing* : Services of providing photocopies of about 109 articles consisting of 2450 pages were given during the period.

(vii) *Library Trainees* : Training was given for four months to 6 students of the Library and Information Science Course on request from the University of Delhi and the Directorate of Training and Technical Education.

2.7.3 Documentation Research and Training Centre (DRTC), Bangalore

(i) *Research* : (a) General theory of subject indexing language. (b) POPSI (Postulate-based permuted subject indexing). (c) Classification schemes/classauri/thesauri. (d) Comparative study of schemes for classification. (e) Information systems and services. (f) Data Accessibility and dissemination. (g) Information analysis and consolidation (h) Library networks and library legislation. (i) Computer-based information systems. (j) Bibliometrics.

(ii) *Training* : The 1980-82 session of the DRTC Course leading to the award Associateship in Documentation and Information Science commenced on 1 August 1980. In all, 13 candidates were admitted to the course. There were three deputed candidates. One candidate joined on study leave. One candidate discontinued the course from October 1980.

(iii) *Seminars* : About 30 seminars were organised.

3. CONFERENCES, SEMINARS AND SYMPOSIA

Among different conferences, symposia, seminar and workshops organised by the Indian Statistical Institute mention may be made of the following :

(i) A conference in honour of Professor C. R. Rao on the occasion of his sixtieth birthday : The conference was held at the Delhi Centre from 8 to 13 December 1980. Professor C. R. Rao was the principal invited speaker.

FORTYNINTH ANNUAL REPORT : 1980-81

The invited participants from Australia, Czechoslovakia, German Democratic Republic, Japan, U.S.A. and India gave lectures mainly on the following topics : (i) characterization problems, (ii) design and analysis of experiments, (iii) inference, (iv) limit theorems, (v) multivariate analysis, (vi) sampling techniques, and (vii) stochastic differential equations.

(ii) Sixth Annual Conference of the Indian Association for the Study of Population : The Institute collaborated with the Indian Association for the Study of Population in holding its sixth Annual Conference on Population Distribution and Development at the Institute campus, Calcutta during 29-31 December 1980. About 100 economists, demographers and social scientists including six from abroad participated in the deliberations of the conference which was organised in three parallel sessions. Units of the Institute particularly Demographic Research Unit actively participated in the organisation and deliberations of the conference.

(iii) Documentation Research & Training Centre, Bangalore, Annual Seminar : Information analysis and consolidation : principles, procedures and products. About 80 participants from all over India attended and 21 papers were presented. 23-27 February 1981.

(iv) On 30 January 1981 a Round Table was organised to discuss the Special Bearer Bond Ordinance to mop up black money. Several academic and professional organisations of Bangalore City had participated.

(v) Workshop on Statistical Methods in Human Population Genetics : It was organised at the Institute in collaboration with Indian Society of Human Genetics and Indian Council of Medical Research. Eight faculty members from the Institute, Cancer Research Institute, Bombay, University Department of Statistics, Poona, Indian Agricultural Statistics Research Institute, New Delhi, Department of Bio-statistics, Christian Medical College, Vellore, and Bose Institute conducted the Workshop. Forty participants from several University Departments, Anthropological Survey of India and colleagues attended the Workshop on 6 October and 4 November 1980.

4. PUBLICATIONS

The following were published during the year 1980-81.

(i) *Sankhya** : The Indian Journal of Statistics, the official organ of the Indian Statistical Institute.

Series A : Volume 42, Parts 1 & 2.

Series B : Volume 42, Parts 1 & 2.

Series C : Volume 41, Part 2 (in Press).

Series D : Volume 40, Part 1.

INDIAN STATISTICAL INSTITUTE

It has been decided that from Volume 43 (1981) *Sankhya* will be published in two series: A and B. Series A will be devoted to probability and mathematical statistics. Instead of Series B, C and D there will be a single Series B containing all papers on methodology and applications which are of use to practising statisticians and econometricians.

Work is now progressing on the basis of a publication schedule that includes printing of all the back issues of Vol. 42 and bring out the 6 issues of Vol. 43 of the reorganised Series A and B before November 1981.

A project to publish Cumulative Index of *Sankhya* from Vol. 1-42 (total 70 volumes of all Series) has been taken up. An editorial working group has been formed and the work is progressing with necessary computer aid. The Cumulative Index is scheduled to be printed before December 1981.

(ii) *Technical Reports* : Twenty Seven technical reports from the Statistics-Mathematics group have been issued.

5. LIST OF SCIENTIFIC PAPERS AND PUBLICATIONS

5.1 List of Papers Published

A. Theoretical Statistics and Mathematics

1. Bhattacharya, C. G. (1980) : Estimation of a common mean and recovery of in-block information. *Ann. Statist.* 8, 205-211.
2. Chattopadhyay, A. K. (1981) : Selecting the normal population with the largest (smallest) value of Mahalanobis distance from the origin. *Commun. Statist. Theor. Methods*, A10, (1), A10, (10).
3. Gangopadhyay, T. (1980) : Paths in r -partite self-complementary graphs. *Discrete Math.* 32, 3, 229-249.
4. — (1980) : r -partite self-complementary graphs. *Discrete Math.*, 32, 3, 245-265.
5. — (1980) : Bigraceful graphs—I. *Utilitas Mathematica*, 17, 271-275.
6. Ghosh, J. K. (with Mukhopadhyay, N.) (1980) : Sequential procedures in identification. *Commun. Statist. Theor. Methods*, A9 (15), 1625-1639.
7. — (with Sinha, B. K. and Wisand, H. S.) (1980) : Second order efficiency of the MLE with respect to any bounded bowl-shaped loss function. *Ann. Statist.* 8, 3, 506-521.

FORTYNINTH ANNUAL REPORT : 1980-81

8. — (with Sinha, B. K. and Subramanyam, K.) (1979) : Edgeworth expansions for Fisher-consistent estimators and second order efficiency. *Calcutta Statist. Assoc. Bull.*, 28, 1-18.
9. — (with Basu, A. P.) (1980) : Identifiability of distributions under competing risks and complementary risks model. *Commun. Statist. Theor. Methods*. A9 (14), 1515-1525.
10. — (with Basu, A. P.) (1980) : Asymptotic properties of a solution to the likelihood equation for the independent not identically distributed case with life testing applications. *J. Amer. Statist. Assoc.*
11. — (with Le Cam, L. Pflanzagl, Johann, Rao, C. Radhakrishna and Elfron, B.) (1980) : Discussion of Professor Berkson's paper. *Ann. Statist.* 8, 3, 469-485.
12. Parthasarathy, K. R. (with Plymen, R.) (1980) : On the outer and inner invariants of Connes, *J. Functional Analysis*, 38, 1-15.
13. Ramkrishnan, S. (with Rao, B. V.) (1980) : D-spaces are standard Borel. *Ann. Prob.*
14. Rana, I. K. (1980) : Determination of probability measures through group action. *Z. Wahr. Theorie*, 197-206.
15. Rao, B. L. S. Prakasa. (1980) : On a characterization of the geometric distribution. *Skand. Actuar. J.* 139-140.
16. — (with Basawa, J.) (1980) :—Asymptotic inference stochastic processes. *Stoch. Proc.* 10, 1, 221-254.
17. Saha, G. M. (with Das, A. D.) (1980) : A note on duals of some T_m -type P BIB designs. *CSA Bull.* 29.1 15-116, 179-183.
18. Sarma, Y. R. K. (with Bell, C. B.) (1980) : A characterization of exponential distributions based on order statistics. *Metrika* 27, 263-269.
19. Sestry, N. S. Narasimha. (1980) : On minimal non PN-groups. *J. Algebra*, 65, 104-109.
20. Sikder, K. (1980) : On quasi-transitive semigroup actions. *Semigroup Forum*, 20, 269-280.
21. Sinha, Bikas Kumar (with Mukhopadhyay, B. B.) (1980) :—A note on a result of Ghosh and Sinha. *CSA Bull.* 29, 169-171.
22. Sinha, K. B. (with Gustafson) : On the Eisenbud Wigner formula for time delay. *Letters. Math. Phys.*

INDIAN STATISTICAL INSTITUTE

23. Sitaram, A. (1980) : An analogue of the Wiener-Tauberian theorem for spherical transforms on semi-simple Lie groups. *Pacific J. Mathematics*, 89, 439-445.
24. Srivastava, S. M. (with H. Sarbadhikari) (1980) : Parametrizations of G_r -valued multifunctions. *Trans. Amer. Math. Soc.* 258, 459-466.
25. — (1980) : A representation theorem for G_r -valued multifunctions. *Amer. J. Math.* 102, 165-178.

B. Anthropometry and Human Genetics

1. Basu, A. (with Gupta, R. and Bhattacharya, K. K.) (1980) : A demographic study of Mirpur : a village in coastal Midnapore District, West Bengal. *J. Biosocial Science* (Cambridge) 12, 2, 227-234.
2. — (with Gupta, R. and Bharati, P.) (1980) : Environmental studies in Indian anthropology : perspective, premise and strategy. *Collegium Anthropologicum*. (Zagreb), 4, 2, 130-149.
3. Bhattacharyya, S. K. (with Ghosh, A. K., Bharati, P. and Dey, B.) (1980) : Red cell enzyme study among some migrant tribal populations in the Andaman Islands. *Zeitschrift für Anthropologie and Morphologie* (Stuttgart) 71, 3, 136-140.
4. Ghosh, A. K. (with Dey, B., Bharati, P. and Blake, M. N.) (1980) : A new variant of carbolic anhydrase. *Acta Anthropogenetica*. 31, 71-73.
5. Gupta, R. (1980) : Selection intensity in the Sherpa. *Current Anthropology* (Chicago) 21, 10, 136-137.
6. — (1980) : Altitude and demography among the Sherpas. *J. Biosocial Science* (Cambridge) 12, 103-114.
7. — (1980) : A study on bilateral asymmetry in skinfold thickness measurements. *Collegium Anthropologicum* (Zagreb) 4, 1, 33-35.
8. Malhotra, K. C. (1979) : Excommunication as a process leading to the formation of new groups. *Eastern Anthropologist*, 32, 49-53.
8. — (1980) : Marriage distance among the four Dhanger castes of Maharashtra, India : differences among districts. *South Asian Anthropologist* 1, 25-34.
9. — (1980) : Gene dispersion in man—the Indian case. *Current Anthropology*, (Chicago) 21, 135-136.
10. — (with B. Karmakar) (1980) : Finger dermatoglyphics in Schizo-phrenia. *J. Indian Anthropol. Soc.* 14, 259-264.

FORTYNINTH ANNUAL REPORT : 1980-81

14. — (with Sarkar, A.) : Genetics of Cartilagenous lump at the back of the human ear. *Indian J. Heredity*, 18, 21-23.
12. — (with Chakraborty, P and Pal, I.) (1980) : Puri pilgrim study : I area of origin and some socio-economic characteristics of the pilgrims. *Bull. Cult. Res. Inst.* 14, 73-79.
13. — (with Khoms, S. B.) (1980) : Fire-walk ceremony at Takli Dhokaswar. *Eastern Anthropologist*, 33, 83-88.
14. — (with Gadgil, M.) (1980) : The fundamentals of environmental protection. *World Wild Life Fund*, India, 1-3.
15. Malhotra, K. C. (with Chakraborty, P. and Pal, I.) (1980) : Socioeconomic condition of Puri pilgrims. *Eastern Anthropologist*, 33, 231-240.
16. — (with Gadgil, M.) (1980) : What price is development. *Science Today* XV : 19-24.
17. — (with Kanhere, G. M.) (1980) : On the distribution of some cephalo-facial characters. *Indian J. Phys. Anthropol. Hum. Genet.* 6, 87-108.
18. — (with Karmakar, B.) (1981) : The correlations between ridgecounts on different palmar interdigital areas of the Tbellari Dhangars of Maharashtra, India. (*Spectra of Anthropological Progress*), 3, 19-22.
19. Mukherjee, B. N. (with Reddy, A. P. and Ranchandrish, T.) (1980) : Distribution of ABO and Ph(D) blood groups among four endogamous groups of Andhra Pradesh. *Human Heredity* (Denmark) 30, 331-333.
20. — (1979) : Enzyme polymorphism : variation in Indian population : *Acta Anthropogenetica*, 3, 167-192.
21. — (with Reddy, A. P.) (1980) : Glucose-6-phosphate dehydrogenase deficiency and colour vision defect in six endogamous group of Maharashtra. *Ind. J. Phys. Anthropol. Hum. Genet.* 6, 29-32.
22. Pakrasi, Kanti (with Malhotra, K. C., Mukherjee, B. N. and Kala, S. L.) (1980) : Inbreeding, village endogamy, marriage distance, spatial, temporal and social variation. *HOMO* (W. Germany) 31, 21-38.

C. Applied Statistics, Surveys and Computing

1. Adhikari, Ajoy K. (with Roy, J. and Sengupta, S.) (1980) : Estimates of parameters of grain-size distributions from weight frequencies. *Mathematical Geology*, 12, 247-265.

INDIAN STATISTICAL INSTITUTE

2. Arnab, Raghunath (1980) : Two stage sampling over two occasions. *Aust. J. Statist.*, 22, 349-357.
3. --- (with Chaudhuri, Arijit) (1979) : On estimating the mean of a finite population on two occasions with varying probabilities. *Aust. J. Statist.*, 21, 162-165.
4. --- (1979) : On the relative efficiencies of sampling strategies under a super-population model. *Sankhya*, C, 41, 40-43.
5. Bandyopadhyay, S. (with Sengupta, A., De, N. and Srimani, P. K.) (1980) : Checking p-t diagnosability of a system. *Computers and Electrical Engineering*, 7, 157-162.
6. (1980) : A new method to test system diagnosability. *Information Science*, 22, 130-138.
7. --- (1981) : Some studies of p-t diagnosable systems. *Proc. IEEE*.
8. Basu, Anirban (1980) : ROMs, PROMs and EPROMs. *Electronics for you*, September.
9. Bhimasankaram, P. (with Majumdar, D.) Hermitian and non-negative definite solutions of some matrix equations connected with distribution of quadratic forms. *Sankhya*, A, 42, 155-170.
10. Chakravarti, S. R. (1980) : On some tests in MANCOVA model with unequal covariance matrices. *Communications in Statistics*, A, 9, 291.
11. Chaudhuri, A. (with Arnab, Raghunath) (1981) : On non-negative variance estimation. *Metrika*, 28, 1-12.
12. Das, B. C. (1980) : Population, energy, environment, science and technology. *Man and His Environment*, 2-xth, ICAES, 2, 29-47.
13. --- (1980) : Micro-level basis and composite model approach in rural development is envisaged for Indian scene. (a new strategy for rural development). *Man and Development*, 11, 1, 121-131.
14. Mukhopadhyay, A. C. (1980) : On the property of balanced asymmetrical factorial plans. *ARS Combinatorica*, 9.
15. Mukhopadhyay, P. (1980) : On the estimation of some confidential characters from survey data. *Calcutta Statist. Ass. Bull.*

D. Chemistry

4. Ghosal, D. N. (with Haque, S.) (1981) : Anihocryms in *Salvia* : their species relationship evolution. *Proc. Indian National Science Academy*. B 47, 2, 204-209.

FORTYNINTH ANNUAL REPORT : 1980-81

E. Digital Electronics

1. Dattagupta, Jaysree (with Sinha, B. P. and Srimani, P. K.) (1980) : Hardware implementation of assembler using associative memories. *Proc. I.E.E.F. Symposium, Circuits and Systems, U.S.A., October.*
2. — (with Srimani, P. K.) (1980) : Fault graphs and single fault equivalence classes in combinational networks. *Proc. International Computer Symposium, Taipei, December.*
3. — (with Dasgupta, A. R., Dattagupta, R.) (1981) : Detection of short circuit faults in combinational networks *Proc. CSI-81, New Delhi 1, 100-103.*
4. — (with Dattagupta, R.) (1981) : An on-line information retrieval system using an associative parallel processor, *Proc. CSI-81, New Delhi.*
5. Pal, A (with Srimani, P. K., Sinha, B. P.) (1980) : Fail-safe realization of sequential machines with a new two level MOS module. *Computers and Electrical Engineering, 7, 163-173.*
6. — (with Chakrabarti, B., Misra, A.) (1981) : Microprocessor based line frequency monitoring system, *Proc. CSI-81, 137-144.*
7. — (with Chakrabarti, B. and Misra, A.) (1981) : Microprocessor based line voltage monitoring system, *Proc. CSI-81, New Delhi 1, 79-87.*
8. Sen, A (with Chakrabarti, M. K., Dattagupta, Jaysree, Pal, A., Dasgupta, A. R., Sinha, B. P., Srimani, P. K.) (1981) : Microprocessor based special purpose F.F.T. Processor, *Proc. CSI-81, New Delhi, 1, 129-136.*
9. Srimani, P. K. (1980) : Enumeration of all minimum feedback edge sets in a directed graph. *Int. J. Systems Sci., 11, 2, 239-246.*
10. Srimani, P. K. (with De, N., Seugupta, A., Bandyopadhyay, S.) (1980) : On certain investigations on self-diagnosable systems. *Int. J. Systems Scie., 2, 3, 363-375.*
11. Sinha, B. P. (with Srimani, P. K., Choudhury, A. K.) (1980) : A. address generation scheme which minimizes the control memory requirements in microprogrammed digital computers. *Int. J., Electronics, 48, 457-470.*

F. Demography

1. Chakraborty, U. (1981) : Family planning programme impact on birth rate in West Bengal : a preliminary and initial assessment. *J. Institute Economic Research, 16, 1, 34.*

INDIAN STATISTICAL INSTITUTE

2. Guha Roy, S. (1980) : Path analysis of areal fertility in rural India, *Proc. Workshop on Behavioral Dynamics of Fertility Transition*. Hawaii, 10-19.
3. Malakar, C. R. (1980) : Communications in development, *Capital Annual*, 104-105.
4. Sarkar, B. N. (1980) : Non enrolment of children in schools and reporting error in data collection, *Proc. Symposium on Advances in Methods of Data Collection, Validation, Storage, Retrieval and Analysis*, Indian Statistical Institute, Calcutta, 145-161.
5. — (1981) : Two generation education mobility of males in villages of districts around Calcutta, *Margin*, National Council of Applied Economic Research, New Delhi 13, 2, 44-52.
6. — (1980) : School enrolment of girls in West Bengal villages. *Sectional Abstracts*, Fifth Indian Social Science Congress, Indian Academy of Social Sciences, Allahabad, 3.
7. — (1980) : Household in villages of West Bengal. *Population Dynamics and Rural Development*, Fifth Annual Conference, Indian Association, *Study of Population*, Delhi 74.
8. — (1980) : Vasectomy and tubectomy operations in India. *Population Dynamics and Rural Development*, Fifth Annual Conference, Indian Association for the Study of Population, Delhi, 69.

G. Documentation and Library Science

1. Bhattacharyya, G. (1970) : Development of professional manpower for information service : A model. *Library and Information Science* 4, 2, 128-143.
2. — (1980) : IASLIC, 1955-1980. *IASLIC Bull. Silver Jubilee Commemorative Volume*. 28-34.
3. — (1981) : Some significant results of current classification research in India. *International Forum on Infn and Doc.* 6, 1.
4. Devadason, F. J. (with Balasubramanian, V.) (1981) : Automated system for generating thesaurus from subject representations. *Annals. Lib. Sci. and Doc.* 25, 79-85.
5. — (with Balasubramanian, V.) (1981) : Computer generation of thesaurus from structured subject propositions. *Infn. Process. Mgt.* 17; 1, 1-11.

FORTYNINTH ANNUAL REPORT : 1980-81

6. — (1980) : Standardisation of computer readable bibliographic record : a proposal for common exchange/communication form. *Lib. Sci. Stand. Doc.* 16 : 91-100.

H. Electronics and Communication Science

1. Chaudhuri, B. B. (1980) : Guided waves in anisotropic slabs. *J. Inst. Elec. & Telecom. Engrs.*, May.
2. — (with Dutta Majumder, D.) (1980) : Recognition and fuzzy description of sides and symmetries of figures by computer. *Int. J. Systems Sci.* 12, 1435-1445.
3. Dutta, A. K. (with Ganguli, N. R. and Dutta Majumder, D.) (1980) : Acoustic features of consonants : A study based on Telugu speech sounds. *Acoustics*, 44.
4. Dutta Majumder, D. (with Chatterjee, N. and Das, J.) (1981) : On adaptive quantization of speech like signals. *IETE J.*, 26, 7.

I. Embryology

1. Brahmachary, R. L. (with Guha, T.) (1981) : Ultrastructure of early embryonic cells of limnaea. *Experimental Cell Biology*, 49, 278-282.
2. Tapaswi, P. K. (with Bhattacharya, P.) (1981) : An extended mathematical model of transcription and translation during embryogenesis. *Cybernetica*, 24, 1, 61-84. International Association for Cybernetics, Belgium.

J. Geology

1. Adhikari, A. K. (with Roy, J., and Sengupta, S.) (1980) : Estimates of parameters of grain-size distribution from weight frequencies. *Math. Geology*, 12, (5), 247-265.
2. Chatterjee, S. (1980) : *Malerisaurus*, a new eusuchian from the Late Triassic of India. *Philosophical Transactions of the Royal Society, London*. D. 291, 1048, 163-200.
3. — (1980) : The evolution of rhynchosaurs. *Ecosystemes continentaux du Mesozoique*. *Memoirs Societe Geologic France, New Series*, 57-65.
4. Sengupta, S. (1980) : Some statistical methods for sedimentological research. *Bhavidya, J. Geological Institute*, 37, 11-10.

INDIAN STATISTICAL INSTITUTE

K. Leaf Protein

1. Bagchi, D. K. (with Chanda, S.) (1980) : Note on the effect of age at harvest on root yield and extracted protein in two varieties of beetroot. *Indian J. Agric. Sci.* Oct., 50 (10), 794-795.
2. Chanda, S. (with Chakrabarty, S. and Bagchi, D. K.) (1980) : Propagation of yeast in whey, a by-product from leaf protein production plant. *Current Science* 49,20, 793-794. Also presented at 21st Annual Conference, Association of Microbiologists of India, Bombay.
3. Matal, S. (with Bagchi, D. K.) (1980) : Water Hyacinth, a plant with prolific bio-productivity and photo synthesis. *Proc. International Symposium on Biological Application of Solar Energy* Ed. A Gnanam, Krishnaswami and Joseph. S. Khan. 144-148.

L. Linguistic Research

1. Kostic, Djordje (with Viadisavljevic, Spasenija, Knafic, Vladislava and Bhattacharya, Nikhilesh) (1980) : Linguistic habilitation for hearing impaired children-an experimental study. Calcutta.
2. Mitter, Alokanda (1980) : Evaluation of speech sounds in hearing-impaired children. Calcutta.
3. — (1980) : Deviant speech in school-going children, Calcutta.
4. — (1980) : Suprasegmental and their role in language acquisition in hearing impaired children. Calcutta.

M. Physics

1. Gupta, A. B. (with Ghosh, K. G.) (1980) : Tensile breaking strength of human scalp hair in diffuse alopecia. *Calcutta Medical J.* 77, 9 & 10, 129-134.
2. — (with Ghosh, K. G.) (1980) : Role of male pattern alopecia and diffuse alopecia in females on the strength of human scalp hair. *Indian J. Dermatology.* 25, 2, 5-9.
3. — (with Ghosh, K. G.) (1980) : Elastic properties of scalp hair in alopecia areata. *Indian J. Dermatology.* 25, 3, 13-17.
4. — (1980) : Saha's contribution to astrophysics in thirties. *J. Ind. Astronomical Society.*

FORTYNINTH ANNUAL REPORT : 1980-81

N. Planning, Economic Statistics and Econometrics

1. Bose, D. K. (1980) : Roots of the power gap. *Business Standard, Annual*, 95-97.
2. Chakrabarti, S. K. (1980) : Without an analytical frame. Review of *Price Levels and Economic Activity*, by M. L. Trivedi. *Economic and Political Weekly*, 15, 17, April 26, 778-779.
3. — (1980) : Payment problem : need for labour intensive exports. *Economic Times*, July 2.
4. — (with Banerjee, Bidyut) (1980) : Estimation of quarterly agricultural income in India. *Indian Economic Journal*, April-June 4, WC 27 27, 53-60.
5. Dasgupta, D. (with Chetty, V. K.) (1980) : Efficiency of temporary equilibria. *J. Mathematical Economics*, July.
6. Roy, Biswanath. (1980) : Distribution of income and wage-differentials in some industries. *Indian J. Labour Economics*, XXIII, 1 and 2, 66-87 April-July.
7. Saradamoni, K. (1980) : Women : a critical assessment of their status of the post-independence period. *Malayalam Yojana*, September.
8. — (1980) : Changing land relations and women : a case study of Palghat. Three popular articles. *Malayalam Malathrubhumi*, 28, 30 and 31 December.
9. Sharma, A. N. : Road network planning for rural development. *Proc. International Conference on Transportation*, 1, WL, 77-94.

O. Pre-Census Population Studies

1. Bhattacharyya, Durgaprasad (with Deb Roy, Rama) (1980) : A document on agrarian structure in a village in Rohlak District (1826-27). *Proc. Indian Historical Records Commission*, XLVI, 27-38.
2. — (with Deb Roy, Rama) (1980) : Minimum needs programme and the rural poor (abstract). Population Dynamics and Rural Development—Summary Report, *Proc. and Papers*, Annual Conference of IASP 1979. 92-93.
3. — (1980) : Some social aspects of the impact of Western science and technology in the 19th Century Bengal (abstract). *Proc. Seminar, Science and Technology in India, 18-19th Century*, 53-54.
4. Chattopadhyay, Kunal (1980) : Credit planning and small farming in Indian agriculture—a study. *Indian Economic J.* 194.

INDIAN STATISTICAL INSTITUTE

5. — (1980) : Central parks and planning aspect of Calcutta. *Calcutta Municipal Gazette*, XCVIII, 1, March 22, 1497-1502.
6. — (1980) : Calcutta—its place in National Tourism. *Calcutta Municipal Gazette*, XCVIII, 6, July 5, 1671-1674.
7. — (1980) : In search of India. *Travel World*, November—December, 13-14.
8. Deb Roy, Rama (1980) : An outline survey of some aspects of technology in India, 1750-1900 and its legacy (abstract). *Proc. Seminar, Science and Technology in India, 18-19th Century*. 10-11.

P. Psychometry

1. Chatterjee, S. (with Mukherjee, Manjula and Maitra, Subir) (1978) : Higher secondary science achievement as related to scientific interest and aptitude. *Ind. J. Psycho.* 53, 3, 125-129.
2. — (with Mukherjee, Manjula, Chakraborty, S. N. and Hassan, M. K.) (1980) : Some correlates of social prejudice among Hindu female. *Ind. J. Social Research*, 48, 2 — 3.

O. Sociology

1. Biswas, S. K. (1980) : Resource utilisation and social planning. *Calcutta, J. Indian Anthropol. Soc.* 14, 3, 215-224.
2. — (1980) : Is anthropology dead/dying. *J. Indian Anthropol. Soc.* 15, 1.
3. Chakrabarti, P. (with Malhotra, K. C. and Pal, Ila) (1980) : Puri pilgrim study I : area of origin and some socio-economic characteristics of the pilgrims. *Calcutta, Bull. Cultural Research Inst.* XIV, 3 4, 73-79.
4. — (1980) : Socio-economic characteristics of the Puri pilgrims. *Eastern Anthropologist*, Lucknow, 33, 3, 231-20
5. Chatterjee, Bhola (1980) : (i) In favour of enthusiasm (ii) King Birendra must fulfil his pledge, (iii) Behind the growing unrest in Nepal, (iv) Secularism : enough is not enough, (v) Nepal's royal way to no-democracy. *Amrita Bazar Patrika* : (i) 20 January (ii) 22 August (iii) 1 November (iv) 22 November (v) 23 December (vi) Did JP clear the Rsa. (vii) Nepal : Re-enters democracy, *Sunday* (vi) 16 March, 7, 37, 18, (vii) 27 April 7, 43, 36-39.
6. Chattopadhyay, K. (1980) : Policies and research : need for coordination. *Bull. Cultural Research Instit.* Calcutta, XIV, 3 4, 48-52.

FORTYNINTH ANNUAL REPORT : 1980-81

7. De, D. (with Chattopadhyay, K.) (1980) : Urbanization and urban studies in India : a review with the example from Giridih, Bull. Cultural Research Institute, Calcutta, XIV, 1 - 2, 96-108.
8. Mukherjee, P. N. (1980) : Disciplined Electicism, *Seminars*, 254, October 38-43.

R. Statistical Quality Control

1. Anand, K. N. (with Balakrishna, C. V.) (1980) : Development of optimum process parameters for a gear box casting. *Souvenir on Systems Approach to QC - Experiment in Foundry*. June.
2. Chowdhury, A. K. (with Anantha Rao, R., Setty, C. A.) (1980) : Automobile quality customer feedback and quality management. *QR* (Special issue on Automobile Industries) 7, 3, September.
3. Chowdhury, K. K. (1980) : Import substitution through quality improvement. *QR J.* 7, 2, May.
4. Iyer, V. Narayana (1980) : Quality control and reliability techniques—much preaching little practice. *IAQR News Letter*, Trivandrum Branch, June.
5. Narayana, V. (with Sreenivasan, N. S.) (1981) : Maturity evaluation in management of quality. *QR J.* 8, 1, January. 19-24.
6. Pal, B. K. (with Anantha Rao, R.) (1980) : Increasing profitability of Foundry operations through experimental approach. *Souvenir on Systems Approach to QC - Experimentation in Foundry*. Bangalore, June.
7. — (1980) : Development of optimum process parameters for quality and cost of an insulator. *QR J.* 8, 1, January.
8. Setty, C. A. (with Anand, K. N.) (1980) : Systems approach to foundry and quality control. *Souvenir on Systems Approach to QC - Experimentation in Foundry*. Bangalore, June.
9. — (1980) : Prosperity through quality control and operations research. *March of Karnataka*. September.

S. Theoretical Physics

1. Bandyopadhyay, P. (with Roy Choudhury, R. K. and Dhattacharyya, S.) (1980) : Status of scaling-in-the-mean hypothesis in inclusive processes. *Phys. Review*, D, USA, 21, 1861.

INDIAN STATISTICAL INSTITUTE

2. Raju, C. K. (1980): Classical time-symmetric electrodynamics. *J. Phys. A*, UK, 13.
3. Roy Choudhury, R. K. (with Dey, S., Khan, T. P. and Roy, T.) (1980): Explosive instabilities in nonlinear perturbation. *J. Phys. A*, UK.
4. — (1980): Exponential potential and mass dependence of wave functions. *J. Phys. A*, UK, 13.
5. — (with Roy, S.) (1980): Stochastic space-time and the concept of potential. *Phys. Review*, D, USA, 22.

5.2 Papers submitted/accepted for publication

(The Journal to which the paper is submitted for publication is mentioned within brackets)

A. Theoretical Statistics and Mathematics

1. Bhattacharyya, C. G.: Estimation of a common location (*Comm. Statist.*).
2. Chattopadhyay, A. K.: Note on gammaization of dependent quadratic forms. (Communication in Statistics).
3. Das, Prabir: Characterization of unigraphic and unigraphic integerpair sequences (*Discrete Mathematics*).
4. —: Eulerian trails with prescribed degrees in tournaments (*Ars Combinatorica*).
5. —: Characterization of unigraphic and unigraphic degree sequences. (*Discrete Mathematics*).
6. —: Characterization of potentially self-complementary, self converse degreepair sequences for digraphs. (*Proc. Symp. Comb. and Graph Theory*, Lecture Notes in Mathematics, Springer-Verlag).
7. Dasgupta, Ratan: Some further results on non-uniform rates of convergence to normality. (*Sankhya*) A (1980).
8. Gangopadhyay, T: Characterization of forcibly bipartite self-complementary bipartitioned sequences. (*Proc. Symp. Comb. and Graph Theory*, Lecture Notes in Mathematics, Springer-Verlag).
9. Ghosh, D. T.: Tolerance limit for normal Distribution (*Sankhya*).
10. Jaiswal, N. K. (with Karmeshu): A non-linear stochastic model with mechanic interference problem. (*Intl. J. System Science*).

FORTYNINTH ANNUAL REPORT : 1980-81

11. — (with Karmeshu and Rangaswamy): A semi-Markovian model for cell survival after irradiation (*Biom. J.*).
12. Jaiswal, N. K. (with Karmeshu): A machine interference model with threshold effect (*J. Appl. Prob.*)
13. Karandikar, R. L.: Pathwise solutions of stochastic differential equations (*Sankhya*).
14. —: Approximation results for multiplicative stochastic integrals. (*Proc. Seminaire de Probabilites*).
15. —: On quadratic variation process of a continuous Martingales. (*Illinois J. Math.*).
16. —: A remark on paths of continuous Martingales. (*Expositioes Mathematicae*).
17. Mazumder, B. S. (with Ghosh, J. K. and Sengupta, S.): Methods of computation of suspended load from bed materials and flow parameters. (*Sedimentology*).
18. — (with Ghosh, J. K.): Size distribution of suspended particles—unimodality, symmetry and lognormality. (*International Summer School on Statistical Distributions in Scientific Work*). Trieste, Italy.
19. —: Taylor diffusion for natural convective flow through a vertical channel. (*Int. J. Engg. Sci.*).
20. Mukherjee, Amiya: On alternative definitions of homology groups. (*J. Indian Math. Soc.*).
21. —: Embedding complex projective spaces in Euclidean space. (*Bull. London Math. Soc.*).
22. Parthasarathy, K. R. (with Hudson, R. and Ion, P. D. F.): Timeorthogonal unitary dilations and non-commutative Feynman-Kac formulae. (*Comm. Math. Phys.*).
23. Parthasarathy, T.: Existence of equilibrium stationary strategies in discounted stochastic games. (*Sankhya*).
24. Raha, A. B.: Lindelof spaces and closed projections. (*J. Indian Math. Soc.*).
25. — (with Srivastava, S. M.): Spaces for which Dini's theorem holds. (*Bull. Polish Academy of Sciences*).

INDIAN STATISTICAL INSTITUTE

26. Rao, B. L. S. Prakaso : Asymptotic theory for non-linear least squares estimators for diffusion processes. (*J. Math Anal.*).
27. — : A non-uniform estimate of the rate of convergence in the CLT for independent random fields. (*Z. W. G.*).
28. — (with Shreehari, M.) : Rate of convergence in the invariance principle for random sums. (*Sankhya*).
29. — : Asymptotic behaviour of M-estimators for the linear model with dependent errors. (*Bull. Inst. Math. Acad. Sinica*).
30. — : The Bernstein-von Mises theorem for a class of diffusion processes. (*The Random Proc.*) (in Russian).
31. — : Convergence of smoothed empirical processes for independent random variables. (*Aligarh J. Statistics*).
32. — (with Rubin, H.) : Asymptotic theory of estimation in non-linear SDE's. (*Sankhya*).
33. — (with Shreehari, M.) : On some properties of the geometric distribution. (*Sankhya*).
34. Rao, K. P. S. B. (with Barone, E.) : Poincare recurrence theorem for finitely additive measures. (*Rendiconti di Matematica*).
35. — (with Barone, E.) : Existence of finitely additive invariant measures. (*Italian, Supplemento Bolletino UNI*) (GNAFA).
36. — : On generalized inverse of Boolean matrices II. (*Linear Algebra and its Application*).
37. Rao, N. T. V. Ranga : Empirical Moiles for ovality problems. (*Sankhya*).
38. Roy, A. K. (with Ellis, A. J., Rao, T. S. B. R. K. and Uttersund, U.) Facial characterizations of complex Linderstraus spaces. (*Trans. Amer. Math. Soc.*).
39. — : A short proof of a theorem on complex Linderstraus spaces. (*Israel J. Mathematics*).
40. Saha, G. M. : Balanced arrays from association schemes and some related results. (*Proc. "Symp. Combinatorics — Graph Theory"*).
41. Sarbhadhikari, H. (with Mauldin, R. D.) : Continuous one-to-one parametrizations. (*Bull. des Sciences Mathematiques*).

FORTYNINTH ANNUAL REPORT : 1980-81

42. Sastry, N. S. Narasimha : Finite groups admitting the extensions of the automorphisms of a maximal elementary abelian 2-subgroup. (*J. Algebra*).
43. Sitaram, A. (with Bachi, S. C.) : Determining sets for measures on DR*. (Illinois J. Math.).
44. Srivastava, S. M. (with Mauldin, R. D.) : Parametrization des ensembles coanalytiques a coupes relativement non maigres. (*C. R. Acad. Sci.*, Paris).
45. Tripathi, T. P. (with Maity, Pulakesh) : Some T2-class of estimators better than H-T estimator. (*Aligarh J. Stat.*).
46. Venkatesappaiah, J. : Quality and Cost improvement through Multiple Regression Application. (*Sankhya*).

B. Anthropometry and Human Genetics

1. Basu, A. (with Mukhopadhyay, B.) : Physical, environmental and sociocultural correlates of demographic characteristics among the Sherpas, an indigenous high altitude population of the eastern Himalayas. (*Archivos del Instituto de Biologia Andiana*) (Peru).
2. Bharati, P. : Economic condition and demography among the Mahishyas of Chakpoin village, Howrah District, West Bengal. (*J. Biosocial Science*) (Cambridge).
3. Bhattacharya, K. K. (with Bharati, P., Gupta, R. and Basu, A.) : A study on diet and nutritional anthropometry of the population of Mirpur, Midnapore District, West Bengal. (*Collegium Anthropologicum*) (Zagreb).
4. Bhattacharyya, S. K. (with Mukhopadhyay, J. and Basu, A.) : The nutritive value of chhang, the indigenous millet-beer of the Sherpas. (*Applied Nutrition. J. Indian Dietic Association*). Calcutta.
5. Gupta, R. (with Basu, A.) : Variations in body dimensions in relation to altitude among the Sherpas of the eastern Himalayas. (*Annals of Human Biology*) (London).
6. Malhotra, K. C. (with Karmakar, B.) : Palmar dermatoglyphics in Schizophrenia. (Dermatoglyphics).
7. --- (with Vijayakumar, M., Khomna, S. B. and Karmakar, B.) : Palmar dermatoglyphics of 3 Mendelian isolates, the Nandiwallas of Maharashtra. (*Man In India*).
8. --- (with Chakraborty, R. and Tateno, Y.) : Variations on dermal ridges in nine population groups of Maharashtra, India, II. asymmetry and interdigital diversity. (*Amer. J. Phys. Anthropol.*).

INDIAN STATISTICAL INSTITUTE

9. — (with Chakraborty, R.): Variations in asymmetry and inter-digital diversity for three ridge-count measures among the Dhanger caste cluster of Maharashtra, India. (*J. Human Evolution*).
10. — (with Chakraborty, R.): Dermatoglyphic asymmetry: Is it an indicator of Canalization? (*Annals of Human Biology*).
11. — (with Others): Ulnar triradius (u), border triradius (lb) and astralimital triradius (*ast*): the neglected triradii on human palm. (*Collegium Anthropologicum*) (Zagreb).
12. —: Relationship between types of axial triradii and the true hypothelar patterns. (*Dermatoglyphics*).
13. — (with Bondopadhyay, Sibdas and Kate, S. L.): Effects of the types and G-6-PD deficiency on the height, weight and skinfolds of various persons of age groups of three endogamous population of Maharashtra. (*Human Heredity*).
14. — (with Reddy, A. P.): Gene diversity among the tribes of South Western India. (*Zeitschrift für Morphologie und Anthropologie*).
15. — (with Dhanu, B. V. and Kate, S. L.): Study of twelve genetic markers in the blood of the Santals of West Bengal and The Motias of Maharashtra, India. (*L' Anthropologie*).
16. Malhotra, K. C. (with Pingle, Urmila and Das, S. K.): A genetical study of the five tribal groups of Andhra Pradesh, India. (*Zeitschrift für Morphologie und Anthropologie*).
17. — (with Das, S. R.): Haptoglobins: Genetics and variation in Indian populations. (*Proc. Seminar on Human Variation*, 1978) Anthropological Survey of India, Calcutta.
18. — (with Roychoudhury, Blake, N. M. and Kate, S. L.): Red cell enzyme polymorphism: gen differentiation in three populations of Maharashtra. (*Amer. J. Phys. Anthropol.*).
19. Mukherjee, B. N. (with Joshi, S. H., Baxi, A. J., Malhotra, K. C. and Kate, S. L.): Incidence of hepatitis B (Australia) antigen among three communities in Malaria Western Maharashtra, India (*Human Heredity*).
20. Mukhopadhyay, B. (198): A comparative microdemographic study of two communities in coastal Midnapore District, West Bengal. (*J. Biosocial Science*) (Cambridge).
21. Pakrasi, Kanti (with Dasgupta, P.): A study of anthropometry and some genetic markers in two sub-populations of Kanras of West Bengal (*Indian J. Phys Anthropol. and Hum. Genet.*).

FORTYNINTH ANNUAL REPORT : 1980-81

22. — (with Dasgupta, P.): A study of population composition (*Bull. Cultural Research Institute*), Government of West Bengal.
23. — (with Halder, Ajit): Fertility in contemporary Calcutta : a biosocial profile. (*Genus*) (Italy).

C. Applied Statistics, Surveys and Computing

1. Arbab, Raghunath : On strategies of sampling of finite population on successive occasions with varying probabilities. (*Sankhya*).
2. —: Sampling on two occasions with varying probabilities. (*Aust. J. Statist.*).
3. —: An addendum to Singh and Singh's paper on random non-response in unequal probability sampling. (*Sankhya*).
4. Arbab, Raghunath : (with Chaudhuri, Arijit): On unbiased product type estimator (*J. Indian Soc. Agric. Statist.*).
5. — (with Chaudhuri, Arijit): Some results concerning strategies of sampling on two occasions. (*J. Indian Soc. Agric. Statist.*).
6. — (with Chaudhuri, Arijit): On unbiased variance estimation with various multistage sampling strategies. (*Sankhya*).
7. — (with Chaudhuri, Arijit): On strategies for sampling on two occasions using initial sample to stratify a finite population. (*J. Statist. Planning and Inference*).
8. Basu, T. K. (with Ghosh, A.): Modelling the dynamics of glucose, insulin and glucagon levels in human circulating blood in the face of a severe physical exercise and against a glucose challenge using the same constraints. (*Bull. Math. Biology*).
9. Bhimasankaram, P.: An extension of a result of Mitra on non-negative definite matrices. (*Utilitas Mathematica*).
10. — (with Mathew, Thomas): Optimality of BLUE's in a general linear model with incorrect design matrix. (*J. Statist. Planning and Inference*).
11. Bhimasankaram, P.: On the robustness of LRT with respect to specification errors in a linear model. (*J. Multivariate Analysis*).
12. Chakravarti, S. R. (with Clement, B., Giri, N. C. and Sinha, B. K.): Tests for the mean vector of multinormal population under intra-Class structure. (*Computer Simulation J.*).

INDIAN STATISTICAL INSTITUTE

13. — (with Clement, B., Giri, N. C. and Sinha, B. K.) : On some optimum invariant test for intra-class structured covariance matrix against circular symmetry. *Technical Report* 81-18, University of Montreal, Department of Mathematics and Statistics.
14. — (with Giri, N. C.) : Optimum invariant test on means of multinormal distribution with additional information. *Technical Report* 81-3, Department of Mathematics and Statistics, University of Montreal.
15. Chakravarti, S. R., : Optimum invariant tests on discriminant coefficients with additional information. *Technical Report* 81-6, University of Montreal, Department of Mathematics and Statistics.
16. Chaudhuri, Arijit : Non-negative unbiased variance estimation. *(Proc.) Symposium on Survey Sampling*, Carleton University, Ottawa, Canada, May 2-9, 1980.
17. — (with Adhikari, Arun, K.) : A study of the effect of variate-transformations on strategies of sampling finite populations. *(Canadian J. Statist.)*
18. — : On the relative efficiencies of several strategies for estimating a finite population mean. *(J. Indian Soc. Agric. Stat.)*.
19. — : On non-negative variance-estimation in Midzuno-strategy. *(J. Indian Soc. Agric. Statist.)*.
20. Chaudhuri, Arijit (with Adhikari, Arun Kumar) : On the relative efficiencies of several strategies for estimating.
21. — (with Adhikari, Arun Kumar) : Improving on the efficiencies of standard sampling strategies through variance transformations in estimators for finite population means. *(Canadian J. Statist.)*.
22. — (with Adhikari, Arun Kumar) : A study of the efficiency of Midzuno-Sen strategy relative to ratio and ratio-type estimators under a linear regression model. *(Biometrika)*.
23. Das, B. C. : Role of non-economic and economic obstacles to regionwise growth, development and conservation. *(Man and Development)*.
24. — : Need for food balanced sheet budget surveys, empirical experiments and intervention studies for alleviation of rural poverty. *(Man and Development)*.
25. — : Future prospects of regionwise rural development. *(Man and Development)*.
26. Gupta, Sanjib K. : The influence of carbohydrate in the storage and synthesis of chlester *(Indian J. Nutrition and Dietetics)*.

FORTYNINTH ANNUAL REPORT : 1980-81

27. Mukhopadhyay, A. C.: Orthogonal main effect plans with variable number levels for factors. (*Proc. International Symposium in Graph Theory and Combinatorics*).
28. —: Using resolvability and non resolvability in the construction of Block Designs. (*J. Statist. Planning and Inference*).
29. —: Construction of some series of orthogonal arrays. (*Sankhyā*).
30. Mukhopadhyay, P.: *rps*-designs reconstructed.
31. —: On the structure of a matrix and some related results in survey sampling.
32. —: On the estimation of some confidential characters from survey data. (*Calcutta Statist. Ass. Bull.*).
33. —: (with Padmawar, V. R.): Estimation of symmetric functions of a finite population.
34. —: Estimation under two stage random permutation models.
35. Roy, J. (with Ghosh, Subir): Optimality in presence of damaged observations. (*J. Statist. Planning and Inference*).
36. — (with Majumdar, P. P.): Distribution of A-B-O blood groups in the Indian subcontinent: a cluster-analytic approach.
37. Sengupta, A.: Realization of fault tolerant machine in linear code applications. (*IEEE Transac. Comput.*).
38. — (with Bandyopadhyay, S., De, N. and Srimani, P. K.): Non-real time realization of fault tolerant machine. (*IEEE Trans. Computers*).
39. —: Linear time varying machines—identification procedure.
40. Vijayan, K. S.: A characterisation of the simplex. (*J. Aequationes Mathematicae*).

D. Biochemistry

1. Bhattacharya, S. K. (with Mukherjee, J. and Basu, A.): The nutritive value of Chhang, the indigenous millet beer of the Sherpas. (*J. Ind. Dietetic Assoc.*).
2. — (with Mukhopadhyay, H., Hiranji, P., Dey, B., Basu, A.): Interstitial parasitic infestations in populations inhabiting similar and contrasting ecological zones. (*Human Ecology*) (New York).

INDIAN STATISTICAL INSTITUTE

3. Mukherjee, J. J. (with Pal, P. R.): Inorganic pyrophosphatase in leaves of *Cynodon dactylon* Pers. (*Current Science*).
4. — (with Pal, P. R.): Studies on inorganic pyrophosphatase from *Amaranthus blitum* L. leaf. Magnesium requirement and anionic inhibition. (*Proc. 68th Indian Science Congress*, III. 103).

E. Chemistry

1. Das, T. (with Ghosal, D. N.): Studies on the humus dynamics in arable soils. (*J. Indian Soc. Agricultural Chemists*).
2. — (with Ghosal, D. N.): Chemistry and distribution of organic matter in the soils of Himalayan and sub-Himalayan West Bengal. (*J. Indian Soc. Soil Science*).
3. Ghosal, D. N. (with Bhattacharya, S. K. and Das, T.): Cation exchange capacity of the soils of West Bengal: contribution of the organic and inorganic components. (*Indian Agriculturists*).

F. Demography

1. Chakraborty, B.: Rural-urban mortality differentials in States. (*Social Biology*).
2. —: Determinants of child education in India. (*Artha Vijyan*).
3. —: Demographic effect consequent upon changes in age-pattern of marriage: An Indian example. (*Genus*).
4. Guha Roy, S.: Population estimates for India. (*Population*) National D'etudes Demographiques, Paris.
5. Malakar, C. R.: Evaluation of widowhood data in Indian Causes—a life table investigation. (*Genus*).
6. —: A Note on age redistribution method. (*Asia and Pacific Census Forum*).
7. Raman, M. V.: Differential response by husbands and wives regarding contraceptive practice. (*J. Institute of Economic Research*) (Dharwar).

G. Digital Electronics

1. Datta Gupta, Jayasree (with Choudhury, A. K.): Fault graphs a new tool in test set generation and complete minimal test set generation. (*I.E.E.E Trans Computers*).

FORTYNINTII ANNUAL REPORT : 1980-81

2. Pal, A. : An interactive algorithm for testing 2-assumability of Boolean functions. (*Proc. I.E.E.E.*).

H. Documentation and Library Science

1. Bhattacharyya, G. : Professional strategies relating to information services to industries. (*IASLIC Bull.*).
2. Gopinath, M. A. : Colon classification schedule for BX Astronomy. (Library Science with a slant to Documentation).
3. Mishra, J. : A case for rural information system in developing societies (*Economic and Political Weekly*).
4. Ravichandra Rao, I. K. : A brief communication on highly cited old papers. (*J. American Society for Information Science*).
5. Seethartha, S. : Information generation and utilization in hospitals ; an analytical study. (*Lib. Sci. Slant to Doc.*).

I. Electronics and Communication Science

1. Chandhuri, B. B. (with De, A. K. and Dutta Majumder, D.) : On fast Walsh-Hadamard transform for image processing. (*IEEE Trans. Acoust. Speech and Signal Processing*).
2. Dutta Majumder, D. (with Das, J. and Chatterjee, N.) : On minimisation of intersymbol interference in magnetic record reproduction systems. (*International J. Electronics*).
3. Dutta Majumder, D. (with Pal, S. K.) (1980) : Fuzzy set theoretic approach : a tool for automatic speech recognition. (*IEEE Trans. Acoust. Speech and Signal Processing*).

J. Embryology

1. Tapaswai, P. K. : Time lags in the extended model of transcription and translation during embryogenesis. (*Cybernetica*).

K. Geology

1. Ghosh, J. K. (with Saha, M. R. and Sengupta, S.) : Gondwana stratigraphic classification by Statistical method. (*Charles Lyell Commemoration Volume-150 years of Application of Statistics to Geology*), Ed. D. F. Merriam.

INDIAN STATISTICAL INSTITUTE

2. Jain, S. L. : A critical examination of some spirally coiled "Composites" from the Upper Triassic Maleri Formation, India. (*Paleobiology*).

L. Physics

1. Gupta, A. B. (with Ghosh, H. G.) : Tensile study of scalp hair in diffuse alopecia (revised). (*Ind. J. Physical Anthropol. Hum. Genet.*).

M. Planning, Economic Statistics and Econometrics

1. Bhattacharya, N. (with Kostic, D., Vladisavljevic, S. and Knaflic, V.) : Linguistic Habilitation for Hearing-Impaired Children.
2. Chakrabarti, S. K. (with Panda, M. K.) : Measurement of incidence of under-nutrition : a discussion of Professor Sukhelme's approach. (*Economic and Political Weekly*).
3. Chander, Prakash : Informational requirements of efficient resource allocation processes. (*Econometrica*).
4. Chatterjee, G. S. : A note on measures of disparity in level of living in India. (*Arthaniti*).
5. Datta, Bhaskar : Intersectoral disparities in India : 1960-61 to 1973-74 (*Indian Economic Review*).
6. — : Multilevel social choice functions and strategic manipulations under counter threats. (*Mathematical Social Sciences*).
7. — : Further result on voting with veto. (*Proc. Symposium on Social Choice Theory*), University of Caen, France.
8. — : Strategic sponsoring and strategic voting : a unified approach. (*Review of Economic Studies*).
9. Jain, L. R. : On specification of the pattern of income redistribution in demand projection exercise. (*Artha Vijnana*).
10. Majumdar, Krishna : Relationships between labour force structure and degree of urbanization in India. (*Economic and Political Weekly*).
11. Pal, M. N. (with Saha, V.) : An optimal truncation for the group of non-conformal top factories in the localisation pattern by industries in India. (*Indian J. Regional Science*).

FORTYNINTH ANNUAL REPORT : 1980-81

12. Rao, S. (with Griffiths, W. F.): Bayesian estimation and models comparison of some heteroscedastic error models. (*J. Econometrics*).
13. — (with Griffiths, W. E.): A Monte Carlo evaluation of a class of classical and bayes estimators for two heteroscedastic models. (*J. Amer. Statist. Assoc.*).
14. Roy, Bina: Wage-differentials and inequalities in distribution of income in India. (*Proc.* National Seminar on Wages, Income and Process).
15. — (with Roy, Biswanath, Chowdhury, Bharati): Distributions of income in West Bengal State Government Services. (*Arthniti*).
16. Saluja, M. R.: Component-wise capital output-ratios for the Indian economy. (*Sankhya*).
17. Saradamoni, K.: From matriliney to private property and subordination of women. (*Gyan Chand Commemorative Volume*).

N. Physics of Fluids

1. Dandapat, B. S.: Non-linear stability of the buoyancy boundary-layer in the presence of transverse magnetic field. (*J. Appl. Mech. Trans. ASME*).
2. — (with Gupta, A. S.): Thermal instability in a porous medium with random vibrations. (*Acta Mechanica*).
3. Guha, M. K. (with Mazumder, H. P.): On the self-similar solution of Von-Karman's equation in homogeneous and isotropic turbulence. (*J. Math. Phys. Sciences*).

O. Pre-Census Population Studies

1. Bhattacharya, Durgaprasad (with Bhattacharya, Archana): Economic Writings In Bengali, 1818-1947 with a foreword by Bhabalosh Datta. Socio-Economic Research Institute, Calcutta.
2. — (with Deb Roy, Rama): Evaluation of Land Reforms in West Bengal with special reference to Operation Barga—a preliminary study. Land Reforms Commissioner, West Bengal.
3. Bhattacharya, Durgaprasad (with Deb Roy, Rama, Bhattacharya, Benoy and Majumdar, Alak): Agrarian relations in a village in West Bengal—a case study. Indian Council of Social Science Research, New Delhi.
4. Chattopadhyay, Kunal: Urbanisation and Unhealthy Snowballing. (*Societal Perspective*).

INDIAN STATISTICAL INSTITUTE

P. Psychometry

1. Chatterji, S. (with Mukherjee, Manjula) : A comparative study of the inmates of detention home and slum children with respect of neuroticism, environmental and certain biographical factors. (*Japanese Psychological Research*).
2. — (with Mukherjee, Manjula) : Selection of trainee pilots through objective tests and techniques. (*Scandinavian, J. Psychology*).
3. — (with Mukherjee, Manjula) : Isolation of personality pattern and success in training course. (*New Zealand Psychologists*).
4. Ghosh, Anjali : A comparative study of management potential possessed by a group of managers and non-managers (*Productivity*).

O. Sociology

1. Biswas, S. K. : Developmental policy and impermanent cultivation, (*Social Scientist*) Trivandrum.
2. Chattopadhyay, K. (with De, D.) : Ward as a unit of sub-area analysis in the study of urban sociology. (*Indian J. Social Research*). Meerut.
3. Chattopadhyay, M. : Changes in levels of living : a case study in a rural society of Birbhum, (*Economic and Political Weekly*) Bombay.
4. Chattopadhyay, M. : Role of female labour in Indian agriculture. (*World Development*) Oxford.
5. — : Modes of production under changing conditions of Indian agriculture, (*Economic and Political Weekly*) Bombay.
6. Dasgupta, A. : A note on the Fakir and Sannyasi rebellion, (*Social Scientist*) Trivandrum.
7. Mukherji, P.N. (with Chattopadhyay, M.) : Agrarian structure, proletarianization and social mobilisation, (*J. Peasant Studies*), London.

R. Statistical Quality Control

1. Mujumdar, A. : Simple formulae for AOQL calculations for single sampling plans. (*J. Quality Technology*), U.S.A.
2. Mohan, S. R. : Degenerate complementary cones induced by K_* matrix. (*Mathematical Programming*).

FORTYNINTH ANNUAL REPORT : 1980-81

3. Prasad, R. Rajendra : $2 \times n$ flow-shop sequencing problem with random processing times. (*OPSEARCH*).
4. Mukherjee, S. P. : On the decision criteria regarding the intensity of boreholes in geological prospecting with reference to minimising investment. (*Indian J. Earth Sciences*).
5. Sengupta, S. : Goal programming approach to Quality Control. (*Operational Research*) UK.
6. — : Linear programming in budgeting. (*J. Institute of Chartered Accounts of India*).
7. Setty, C. A. (with Anantha Rao, R.) : Quality through Design. (*Quality*).

S. Theoretical Physics

1. Bandyopadhyay, P. (with Bhattacharyya, S.) : Some observation on $v_{\alpha}^{\mu} - v_{\alpha}^{\nu}$ scattering and the photon-neutrino weak coupling theory. (*Fizika*).
 2. Raju, C. K. : Interpretation of quantum mechanics as a theory of extended particles. (*International J. Theoretical Phys.*) USA.
 3. — : Products and compositions with Dirac Delta function. (*J. Phys.*) U. K.
 4. Roy Choudhury, R. K. (with Khan, T. P. and Dey, S.) : Stabilization of explosive instabilities on presence of third order terms. (*J. Phys.*) U.K.
 5. — : Mass dependence of Schrodinger wave function for an exponential (*J. Math. Phys.*), U.S.A.
- 5.3 Papers read at conferences and/or to be published in conference proceedings

A. Theoretical Statistics and Mathematics

1. Parthasarathy, K. R. (with Hudson, R. and Ion, P.D.F.) : The Feynman-Kac formula for Boson Wiener processes. Special Session on Mathematical Physics, American Mathematical Society, Boulder, Colorado April 1980 *Proc. Amer. Math. Soc.*
2. Parthasarathy, T. : Stochastic games. Conference on the Theory of Probability and its applications. S. V. University, Tirupati, July 8-10, 1980.
3. Sinha, K. B. : Time delay and resource in simple scattering. Special Session on Mathematical Physics, American Mathematical Society, Boulder, Colorado, April 1980. *Proc. Math. Soc.*

INDIAN STATISTICAL INSTITUTE

B. Anthropometry and Human Genetics

1. Basu, A. : The role of anthropological population studies in national development. Invited lecture, South Asia Regional Symposium of the International Association of Human Biologists, Ranchi, 25-29 December 1980.
2. Malhotra, K. C. : Future prospects of a pastoralism in India. Conference, Protecting our Environment : the Key to sustainable Development. Ahmednagar 4-6 August 1980.
3. — : Population structure of the Dhangers of Maharashtra. 9th Wisconsin Conference, Madison Wisconsin USA. 7-9 November 1980.
4. — (with others) : (i) Relationship between types of triradii and the true hypotenar patterns. (ii) Ulnar triradius (U^*) border triradius (B^*) and extralimital triradius (U^{*B}). (iii) Genetic of palmar pattern ridge counts. I. Frequency distribution. (iv) Genetic of palmar pattern ridge counts. II. Correlation between different configurational areas. (v) Australian antigen among three communities of western Maharashtra. (vi) Haemoglobin variants and G-6-PD deficiency among Maharashtrais. Seventh Annual Conference of the Indian Society of Human Genetics, Ranchi, 26-28 December 1980.
5. — : Impact of Hydro-Projects on the Gavli Dhangers, a pastoral community of Karnataka. Seminar on Implications of Hydroelectric projects in Uttara Kanada, Sirsi. 17-19 January 1980.
6. Mukherjee, B. N. (with Kate, S. L., Phalke, M. A. Sainani, G. S. and Mutalik C. S.) : Distribution of plasma cholinesterase variants at E₁ locus among different population groups of Maharashtra, India. All India Seminar on Human Variations, Patiala, 18-19 February, 1980.
7. — (with Reddi, A. P.) : Gene diversity among the tribes of South Western India. Seventh Annual Conference of the Indian Society of Human Genetics, Ranchi, 26-28 December 1980.
8. — (with Roychoudhury, A. K., Blako, N. M. and Kate, S. L.) : Red cell enzyme polymorphism : gene differentiation in the population of Maharashtra. Seventh Annual Conference of the Indian Society of Human Genetics, Ranchi, 26-28 December 1980.
9. — (with Joshi, S. H., Boxi, A. J., Malhotra, K. C. and Kate, S. L.) : Incidence of hepatitis B (Australia) antigen among three communities in Malarial Western Maharashtra, India. Seventh Annual Conference of the Society of the Human Genetics, Ranchi, 26-28 December, 1980.

FORTYNINTH ANNUAL REPORT : 1980-81

10. — (with Das, S. K., Banerjee, S. K. and Kate S. L.): Serological and biochemical investigation on three population groups in three locations of Maharashtra. Seventh Annual Conference of the Indian Society of Human Genetics, Ranchi, 26-28 December 1980.

C. Biochemistry

1. Bhattacharyya, S. K. (with Mukhopadhyay, B., Bharati, P., Gupta, R., Day, B. and Basu, A.): Intestinal parasitic infestations in populations inhabiting contrasting ecozones. Annual Conference of the Indian Anthropological Society, Calcutta, April 1980.

D. Chemistry

1. Das, T.: Humus reserve of some entisols and their classification. 45th Annual Convention of the Indian Society of Soil Science, (IARI) Karnal, 27-28 November, 1980.
2. — (with Ghosal D. N.): Characteristics of the organic matter in the soils of the Gangetic alluvial plains of West Bengal. Proc. Symposium, Recent Development in the Research on Soil Science, Central Soil Salinity Research Institute, Karnal, 27-28 November 1980.

E. Crop Science

1. Ghose, M.: Vessels in roots of young palms : *J. Ind. Bot. Soc.* 59 Suppl. : 59-60.
2. — : On the stomatal frequency in leaves of young and adult palms : Proc. 68th Indian Science Congress, 111, 97, 40.
3. Ghosh, S. S. (with De, S. K. and Davis, T. A.): Morphological study in juvenile palms of four species of Phoenix (*P. sylvestris*, *P. dactylifera*, *P. zeylanica*, and *P. rupicola*). Proc. 68th Indian Science congress, 111, 106, 41.

F. Demography

1. Chakraborty, B.: Psychological perspectives of family planning policy determinants. Sixth Annual Conference of the Indian Association for the Study of Population, Calcutta, 29-31 December 1980.
2. Das, Chittaranjan (with Sarkar, B. N.): Management of primary schools in rural areas of districts around Calcutta. Sixth Annual Conference of the Indian Association for the Study of Population, Calcutta, 29-31 December 1980.
3. Dey, Satyendralal: Acceptance of surgical contraception in forty four villages of West Bengal. Sixth Annual Conference of the Indian Association for the Study of Population, Calcutta, 29-31 December, 1980.

INDIAN STATISTICAL INSTITUTE

4. Ghosal, A. K. : Intergenerational fertility differentials. Sixth Annual Conference of the Indian Association for the Study of Population. Calcutta, 29-31 December 1980.
5. Guha Roy, S. : The Demographic Feasibility of Malthusian Thought. The Congress International de Demographic Historique. Paris, May 27-30, 1980.
6. — : Path Analysis of Areal Fertility in Rural India, Workshop in Behavioral Dynamics of Fertility Transition, Hawaii, 31 May—28 June, 1980.
7. — : Data collection for programme evaluation : problems and issues. Sixth Annual Conference of the Indian Association for the Study of Population, Calcutta 29-31 December 1980.
8. Malakar, C. R. : Health service research in family planning. Task Force Meeting of ICMR, New Delhi, 28-29 May 1980.
9. — : Use of statistical quality control in population census. Seminar on use of Sampling in Population Census and Demographic Surveys, Registrar General of India, New Delhi. 18-29 August 1980.
10. — : On some special features and methodology of the census of India. Seminar on Special Features and Significance of the Census of India, 1981. Kalyani University, West Bengal, 4 October 1980.
11. — : Regional variation on population distribution and development in India during 1961-71. Sixth Annual Conference of the Indian Association for the Study of Population, Calcutta, 29-31 December 1980.
112. Raman, M. V. : Significance of new household information in the 1981 Census for social planning, Seminar on Special Features and Significance of the Census of India, 1981. Kalyani University, West Bengal, 4 October 1980.
113. Sarkar, B. N. : School enrolment of girls in Bengal villages, Fifth Social Science Congress. Udaipur, 5-8 July 1980.
14. — : Some observations on the 1981 Census. Seminar on Special Features and Significance of the Census of India, 1981. Kalyani University, West Bengal, 4 October 1980.
15. — : Marriage-age pattern of females in rural areas of districts around Calcutta, Sixth Annual Conference of the Indian Association for the Study of Population. Calcutta 29-31 December, 1980.
16. — : Two-generation education mobility of males and females in rural areas of districts around Calcutta. Seminar on the Role of Sample Surveys in Education, 13-15 October 1980. NCERT, New Delhi.

FORTYNINTH ANNUAL REPORT : 1980-81

G. Documentation and Library Science

1. Bhattacharyya, G. : Academic programme for information systems and services for development planning. International Seminar on Training for Development Planning, Berlin (West), 4-6 August 1980.
2. --- : (i) Data activities ; an overview ; (ii) Data categories. DRTC Refresher Seminar—12 on Data Accessibility and Dissemination, Bangalore, 25-29 August 1980.
3. --- : Information analysis for consolidation : Some basic considerations, DRTC Annual Seminar—18 ; 23-27 February 1981 ; Paper AA.
4. --- : POPSI : A purpose oriented subject indexing language. ILO-RCTT (ESCAP) Regional consultation on Documentation and Information Systems on Technological Alternatives, Hyderabad, 8-12 September 1980.
5. --- : Use of POPSI for indexing official correspondences. Seminar on Indexing of Official Correspondences, Bangalore, 27 June 1980.
6. Devadason, F. J. : Data and data base systems : computers in data handling, DRTC Refresher Seminar—12 on Data Accessibility and Dissemination, Bangalore, 25-29 August 1980.
7. --- : Generation of thesaurus in different languages : A computer based system. COLING-80, 8th International Conference on Computational Linguistics, Tokyo, September 29—October 4 1980.
8. Gopinath, M. A. : (i) Data compilation in science and technology ; (ii) Data evaluation in science and technology ; (iii) Data generation in science and technology. DRTC Refresher Seminar—12 on Data Accessibility and Dissemination, Bangalore, 25-29 August 1980.
9. --- : Information flow in technology transfer : a study of the human interfaces. IASLIC Seminar—9, Nagpur, 22-26 October 1980.
10. --- : Library networks and library legislations : a comparative study of state library legislations in India. All India Library Conference—27, Hyderabad, 9-12 January 1981.
11. --- : Typology of structural relations of information analysis and consolidation process. DRTC Annual Seminar—18. 23-27 February 1981.
12. --- : Universe of subjects : structure and developments and the design of general schemes for classification. Seminar organised by the Department of Library and Information Sciences, Andhra University, 14-19 July 1980.

INDIAN STATISTICAL INSTITUTE

13. Mishra, J.: Socio-economic data : its generation, collection, organisation and services. DRTC Refresher Seminar—12 on Data Accessibility and Dissemination, Bangalore, 25-29 August 1980.
14. Neelamoghan, A. (with Seetharma, S.): (i) Reference framework : an aid to information analysis and consolidation. Paper BD.
— (with Seetharma, S.): (ii) Specialist groups in the preparation and production of information analysis and consolidation products. DRTC Annual Seminar—18, 23-27 February 1981 ; Paper CA.
15. Revichandra Rao, I. K.: Data structures and guidelines for data representation in numerical data bases. DRTC Refresher Seminar—12, 25-29 August 1980.
16. —: Use of computer and sampling techniques for stock verification. All India Library Conference 27, Hyderabad, 9-12 January 1981.
17. Seetharama, S.: Continuing medical education and health information system, Seminar organised by the National Tuberculosis Institute, 1 October 1980.
18. Seetharama, S.: (i) Data centres in India : an overview. (ii) Data services : evaluation, dissemination and referral services. (iii) Data users : their characteristics and requirements. (iv) Demographic data for developmental planning. DRTC Refresher Seminar—12 on Data Accessibility and Dissemination, Bangalore, 25-29 August 1980.
19. —: Information service support for technology transfer. IASLIC Seminar—9, Nagpur, 22-26 October 1980.
20. —: Planning of information analysis centres : Some general considerations. DRTC Annual Seminar—18, 1981.

H. Electronics and Communication Science

1. Chaudhury, B. B.: A review and some new results. IETE Symposium on Optical Communication and Integrated Optics, Calcutta, 23-24 May 1980.
2. Chowdhury, B. B. (with Dutta Majumder, D. and Das, J.): An Industrial data link system using microprocessor. IETE Technical Convention, Bombay, 31 January 1981.
3. — (with Dutta Majumder, D. and Das, J.): Programmable signal generator for biomedical signal generation. ICMATIC -81, Jadavpur University, 14 February 1981.

FORTYNINTH ANNUAL REPORT : 1980-81

4. Dutta, A. K. : Statistical approach in ASR research. International Symposium on Speech, TIFR Bombay, 23-26 July 1980.
5. Dutta, A. K. (with Ganguli, N. R.) : Acoustic in man-machine communication. International Conference in Acoustics, Sydney, Australia, July.
6. Dutta Majumder, D. : Mathematical tools and techniques in pattern recognition and artificial intelligence. VIIIth CASM-Cu National Research Symposium on Applications of Mathematics to Science and Society 26-27 March 1981.
7. — (with Chaudhuri, B. B.) : 3-D Image processing—methods and applications. IFIP Symposium, Informatics—81 and CSI—81 Conveation, New Delhi, February 27—March 4, 1981.
8. — : Fuzzy set theoretic approach in ASR research. International Symposium on Speech, TIFR Bombay, 23-26 July 1980.
9. Ganguli, N. R. (with Dutta, A. K.) : A Statistical approach to vowel recognition. International Conference on Pattern Recognition. Florida, USA, December, 1980.
10. Majumder, S. (with Biswas, S. and Dutta Majumder, D.) : Personal Computer with fuzzy instruction. IETE National Symposium on Microprocessors Calcutta May, 1981.
11. Paul, D. K. (with Chaudhuri, B. B.) : Properties of anisotropic dielectric tubes waveguides. *IEEE/Aps-S-International* Symposium, Quebec, Canada, 2-6 June, 198.
12. Shevganonkar, R. K. (with Paul, D. K. and Chowdhury, B. B.) : Effect of dielectric anisotropy of the bending loss in optical waveguides. 82 Annual Meeting and Special Conference on the Physics of Fiber Optics, American Ceramic Society, Chicago, 28-30, April 1980.

I. Geology

1. Chatterjee, S. (with Jain, S. L., Kutty, T. S. and Roychowdhury, T.) Mesozoic Gondwana vertebrates of the Pranhita Godavari Valley, Deccan—review. Symposium on Three Decades of Developments in Palaeontology and Stratigraphy in India, Hyderabad, 10-12 December 1980.
2. Chaudhuri, A. K. : Trace fossils from Proterozoic sediments of the Godavari Valley, South India (*Abstract*). AAPG-SEPM Annual Meeting, Denver, U.S.A. 9-11 June 1980.

INDIAN STATISTICAL INSTITUTE

3. — : Early diagenetic gluconitization of feldspar grains in a middle Proterozoic tidal flat complex (Abstract). AAPG-SEPM Annual Meeting, Denver, U.S.A. 9-11 June 1980.
4. Jain, S. L. : A critical examination of some Upper Triassic spirally coiled 'coprolites' from Maleri formation. Fifth All-India Congress of Zoology, Bhopal, 1-3 November 1980.

J. Leaf Protein

1. Banerjee, A. (with Dasgchi, D.) Leaf protein from (*Alimania Nodiflora* R. Br.) a common weed in West Bengal. 13th Annual Convention. The Indian Society of Agricultural Chemists, Bidhan Chandra Krishi Visva Vidyalay Kalyani, 28-29 November 1980.
2. Chanda, S. (with Chakravarty, S., and Malai, S.) : Microbial utilization of whey, a by-product of leaf protein production plant. 13th Annual Convention, the Indian Society of Agricultural Chemists, Bidhan Chandra Krishi Visva Vidyalay Kalyani, 28-29 November 1980.
3. Malai, S. : Optimum conditions to get maximum yields of extracted protein from a few crops of West Bengal. 13th Annual Convention. The Indian Society of Agricultural Chemists, Bidhan Chandra Krishi Visva Vidyalay Kalyani, 28-29 November 1980.

K. Physics

1. Gupta, A. B. : Some disorders in human scalp hair : a tensiomechanical study. IXth Annual Conference, Indian Association of Dermatologists, Indore, January 8-10, 1981.

L. Planning, Economic Statistics and Econometrics

1. Bhat, L. S. : Regional disparities and the problems of economic integration of States. All India Conference on Centre-State Relations, Society for the Study of Regional Disparities in Development, New Delhi, 1980.
2. — : Geographers' understanding of the development process. Second Annual Conference of the National Association of Geographers, India. Sri Venkateswara University, Tirupati, 9-12 January 1981.
3. — : North Kanara District—illustration of ecological economic imbalances in development. Seminar on Impact of Hydroprojects on North Kanara District, Conference on Environment and Hydro-Electricity development, Sirsi, January, 1981.

FORTYNINTH ANNUAL REPORT : 1980-81

4. — : Regional disparities in Uttar Pradesh. UGC sponsored Symposium on Urban and Regional Development. Geography Department, Bombay University, Bombay, February 1981.
5. — : Conceptual and analytical framework for rural development in India. National Symposium on Regional Planning and Rural Development, C. B. Pant Social Science Institute, Allahabad, March 1981.
6. Bose, D. K. : Declining traffic at Calcutta Port, an analysis. Seminar on the Problems of the Calcutta Port and Suggested Remedies. Indian Institute of Port Management, 5 July 1980.
7. — : Inter-state variation in employment and labour absorption in agriculture. Annual Conference on Population Distribution and Development, Indian Statistical Institute, Calcutta, 29-31 December 1980.
8. Chakrabarti, S. K. : A single equation model for forecasting demand for bank credit. Seminar on Forecasting Methodology in the Banking industry, National Institute of Bank Management, Bombay, 6-8 December, 1981.
- 9.— : Saving, investment economic growth and public policy—an exploratory note. Seminar on public policy issues relating to the Indian economy, Centre for Economy, Centre for Economic Studies, Presidency College, Calcutta 14-15 March, 1981.
10. Chakravarty, S. R. : New indices for the measurement of poverty. Fourth World Congress, Econometric Society, Aix-en-Provence, France. 28 August—2 September 1980.
11. Chander, Prakash : Informational requirements for resource allocation processes. Fourth World Congress, Econometric Society, Aix-en-Provence, France, 28 August —2 September 1980.
12. Chatterjee, G.S. : A note on measures of disparity in level of living in India. 19th Annual Conference, Indian Econometric Society, Pune, December 1980.
13. Chetty, V. K. : Effectiveness of monetary and fiscal policies in a Keynesian model. Fourth World Congress, Econometric Society, Aix-en-Provence, France, 28 August —2 September 1980.
14. Das, B. N. (with Pandala, M. S.) : A study on provision of basic social services in rural India : Alwar District (Rajasthan)—a case study. Second Annual Conference of the National Association of Geographers, India, Sri Venkateswara University, Tirupati, 9-12 January 1981.

INDIAN STATISTICAL INSTITUTE

15. Dutta, Bhaskar : Multivalued social choice function and strategic manipulation under counter threats. Fourth World Congress, Econometric Society, Aix-en-Provence, France, 28 August—2 September 1980.
16. Mazumdar, Krishna : Relationships between labour force structure and degree of urbanization in India. Conference on Urbanization in West Bengal, the Centre for Urban Economic Studies, University of Calcutta, Department of Economics 6-7 December 1980.
17. Pal, M. N. (with Saha, V.) : The construction of indices on regional production efficiency and manufacturing industrialisation for spatial association analysis in India : 1975-76. Thirteenth Regional Science Seminar, Bangalore, 22-23 December 1980. An Abstract Proceedings Volume is published by the IIM, Bangalore, 1980.
18. — (with Saha, V.) : Regional disparities in manufacturing industrialisation and production efficiency in India : 1975-76. Annual Conference on Population Distribution and Development, Indian Association for the Study of Population, Indian Statistical Institute, Calcutta, 29-31 December 1980.
19. Pal, M. N. (with Saha V.) : The effect of the location factor of energy use on the regional production technology and the localisation economy in India, 1975-76. U.G.C. sponsored seminar on The Economics of Energy, Rabindra Bharati University, Calcutta, 18-19 February, 1981.
20. Roy, Bina : Wage-differentials and inequalities in the distributions of income in India. The National Seminar on Wages, Income and Prices, Chandigarh, 10-11 October 1980.
21. — : Comparative study in growth between different regions of India. The Biennial Seminar of the Indian Association for Research in National Income and Wealth, Gokhale Institute fo Politics and Economics, Pune. 30 December 1980—1 January 1981.
22. — (with Roy, Biswanath, Chowdhury, Bharati) : Distribution of income in West Bengal State Government Services. 19th Annual Conference, Indian Econometric Society, Pune, December 1980.
23. Saradmoni, K. : Socialist countries and strength to the new international economic order. XIX Annual Conference of TIES, Pune.
24. — : Wages of inherited discrimination. Bi-National seminar on sex discrimination in gainful employment organised by USEFI and Indian Institute of Education, Pune, 1-5 January 1981.

FORTYNINTH ANNUAL REPORT : 1980-81

25. Sharma, A. N. : Road network planning for rural development. Road Transport Section of the International Conference of Transportation, New Delhi, 28-29 November, 1980.
26. — : Utility of connectivity indices for Road Network Planning for Rural Development, Second Annual Conference of the National Association of Geographers, India, Sri Venkateswara University, Tirupati, 9-12 January, 1981.

M. Pre-census Population Studies

1. Bhattacharya, Durgaprasad (with Deb Roy, Rama and Chattopadhyay, Kunal) : A note on population and cultivation in fifteen villages of Aligarh, 1922-1972. Sixth Annual conference of the Indian Association for the Study of Population on Population Distribution and Development, Indian Statistical Institute, Calcutta, 29-31 December 1980.
2. Chattopadhyay, Kunal : Credit planning and small farming in Indian agriculture. Sixty-third annual conference of the Ind. Econom. Association. Gokhale Institute of Politics and Economics, Pune. 26-28 December 1980.
3. Deb Roy, Rama : Evolution of Economics Concepts in the Census of India (1872-1971). First Annual Conference Bangiya Arthaniti Parishad, Calcutta. 25-26 January 1981.

N. Physics of Fluids

1. Basu, T. K. (with Ghosh, A.) : Mathematical simulation of insulin, glucagon and glucose levels in human circulatory blood in the face of severe muscular exercise. Eighth Centre of Advanced Studies in Applied Mathematics—Calcutta University—National Research Symposium, Science College, Calcutta University 26-27 March 1981.
2. Dandapat, B. S. : On the non-linear stability of the buoyancy boundary layer with magnetic field. First Asian Congress of Fluid Mechanics, Indian Institute of Science, Bangalore, 8-13 December 1980.
3. — : (with Dandapat, S.) : Unsteady flows of a non-Newtonian fluid in a semi-infinite contracting or expanding pipe. Centre of Advanced Studies in Applied Mathematics—Calcutta University Eighth National Research Symposium, Science College, Calcutta University, 26-27 March 1981.
4. — (with Mazumdar, H. P.) : On the onset of transient convective instability. Proc. International Symposium Non-Linear Continuum Mechanics, IIT, Kharagpur. 25-27 December 1980, 17-20.

INDIAN STATISTICAL INSTITUTE

5. Ghosh, A. (with Bagchi, B.): On the effect of uniform suction on laminar boundary layer in a hydrocyclone. Silver Jubilee Congress of Indian Society of Theoretical and Applied Mechanics, 34-36. 17-20, December 1980.
6. Guba, M. K. (with Mazumder, H. P.): On the self-similar solution of Von Karman's equation in homogeneous and isotropic turbulence. Centre of Advanced Studies in Applied Mathematics—Calcutta University Eighth National Research Symposium. Science College, Calcutta University March 26-27, 1981.
7. Mazumder, H. P. (with Bhattacharyya, P.): Some aspects of large Reynolds number phenomena in homogeneous and isotropic turbulence. International Symposium, Non-linear Continuum Mechanism 58-70. 17-20 December 1980. I.I.T. Kharagpur.

O. Sociology

1. Biswas, S. K.: A short note on bio-cultural approach to the problems of ethnicity. Symposium organized by the Indian Anthropological Society, Calcutta, 11 May 1980.
2. Chatterji, Bhola: Social change: why and how of it. National seminar on dynamics of social change, Nehru Memorial Museum and Library, organized by Jayaprakash Academy. New Delhi, 8-10 October 1980.
3. Chattopadhyay, K.: Education for motivation: their and our (Key note address), Plenary Session in the National Symposium on Education and Mobilization of Human Factors for Agriculture and Community Development, Seva-Bharati, 21-22 February 1981.
4. Mukherji, P. N. (with Chattopadhyay, M.): Agrarian structure and the rural proletarian Third Damodaran Memorial Symposium on peasantry and struggle for new India, Jawaharlal Nehru University, April 12-13, 1980.

P. Statistical Quality Control

1. Chakraborty, T. K. (with Malaker, C. R.): Use of statistical quality control in population census. Seminar on Use of Sampling in Population Census, Registrar General of India, Ministry of Home Affairs Delhi, 18-27 August 1980.
2. Handa, S. S.: Quality programme for oxyacetylene cutting. Seminar on Welding Technology, Indian Institute of Welding, Madras, 26-28 February 1981.
3. Iyer, V. Narayana: Vendor quality assurance. Seminar of Improvements through Quality & Reliability. IAQR, Trivandrum. 28 June 1980.

FORTYNINTH ANNUAL REPORT : 1980-81

4. Majumdar, B. (with Dashapande, N. S.): Optimum combination of different tin plates for manufacture of tin containers. All-India Seminar on OR and Decision Making. Delhi. 28-30 March 1981.
5. Nankana, A. N.: Analysis of failure data for improvement of quality. All-India Seminar of Reliability of Heavy Electrical Equipments.
6. Ramamurthy K. G. (with Jaiswal, N. K.): Some results for pseudo semi-markov process. (*Mathematische Operations for Sching and Statistik Series Optimization*).

5.4 BOOKS PUBLISHED

A. Theoretical Statistics and Mathematics

1. Rao, B. L. S. Prakasa (with Basawa, I): *Statistical Inference for Stochastic Processes*, Academic Press, London.

B. Anthropometry and Human Genetics

1. Malhotra, K. C. (with Abdushelishvili, M. G.): *Biology of the People of India. I Results of 1971 Expedition in the Union Territory of Delhi*. Academy of Sciences, USSR, Moscow : 1-308.

C. Documentation and Library Sciences

1. Bhattacharyya, G (with Gopinath, M. A., and Seetharam, S.): *Ed. Data Accessibility and Dissemination : the Working Document prepared for the DRTC Refresher Seminar-12, 1980.*
2. — (With Gopinath, M. A.): *Ed. Information Analysis and Consolidation : the Working Document prepared for the DRTC Annual Seminar—18, 1981.*

D. Linguistic Research

1. Kostic, Djordje : *The Lexicon of Brancko Radicovic—Frequency of Words and Grammatical Forms*. Mimeographed, pp. 1-400, Indian Statistical Institute, Calcutta, February 1981.

E. Physics

1. Gupta, A. B. : *Ananya Einstein (in Bengali)*. Book Home, Calcutta, pp. 1-400, 1981.

INDIAN STATISTICAL INSTITUTE

F. Planning, Economic Statistics and Econometrics.

1. Bhat, L. S. (Co-author) (1980) : *Impact of Metropolitan City on the Surrounding Region*, Concept Publishing Company, New Delhi.
2. Saluja, M. R. (1980) : *Input-output Tables for India, Concepts Construction and Applications*, Wiley Eastern Ltd., New Delhi.
3. Sharma, A. N. (1981) : *Spatial Approach for District Planning*, Concept Publishing Company, New Delhi, pp. 1-140.

Q. Sociology

1. Chatterji, Bhola : *Palace, People and Politics : Nepal in Perspective*, I-VI IX 1-203, with a foreword by the former Nepalese Prime Minister, B.P. Koirala, Ankur Publishing House, New Delhi, April 1980.
2. Chattopadhyay, K. : *Field Studies in the Sociology of Education* (The Report on West Bengal), New Delhi, National Council of Educational Research and Training.
3. Chattopadhyay, M. : *Mahalanobish Survey Revisited : Prospects of Agrarian Change in West-Central Bengal*.
4. Mukherji, P. N. : *Left Extremism and Electoral Politics Nazalite Participation in Election*. Manohar Publishers.

5.5 ARTICLES PUBLISHED IN BOOKS

A. Theoretical Statistics and Mathematics

1. Rao, B.L.S. Prakasa : Absolute stability of a stochastic integro-differential system-II. Proc. 5th Seminar on Stability Problems (In Russian).

B. Anthropometry and Human Genetics

1. Basu, A. (with Majumder, P.P., Ghosh, A. K. and Biswas, S. K.) (1980) : Human biological variations in Asia, with special reference to India. *Human Biological Diversity*, Ed., Hiernoux, Masson et cie., Paris and University of Montreal.
2. Malhotra, K. C. (1979) : Qualitative finger dermatoglyphic variation among 21 endogamous Dhangar Caster of Maharashtra. Dermatoglyphic 50 years later. Eds. W. Wertolecki and C. C. Plato : *Birth Defects : Original Article Series* 15, 335-345.
3. — (with Abdushelishvili, M. G.) (1980) : Introduction. *Biological Anthropology of the People of India*. Academy of Sciences, USSR, Moscow, 5-10.

FORTYNINTH ANNUAL REPORT : 1980-81

4. — (1980) : Somatoscopic characters of the people of the Union territory of Delhi. *Biological Anthropology of the people of India*. Academy of Sciences, USSR, Moscow, 64-77.
5. — (with Arstianov, S. A.) (1980) : Ethnographic characteristics of the populations of Delhi area. *Biological Anthropology of the People of India*. Academy of Sciences, USSR, Moscow, 11-16.
6. — (with Mazumder, P. P.) (1980) : Anthropometric variation among the five populations of Delhi. *Biological Anthropology of the People of India*. Academy of Sciences, USSR, Moscow, 111-130.
7. — (with Majumdar, P. P.) (1980) : Genetic distance analysis. *Biological Anthropology of the People of India*. Academy of Sciences, USSR, Moscow, 175-176.
8. Mulhotra, K. C. (with Abdusgelishvili, M. G.) (1980) : Conclusion. *Biological Anthropology of the People of India*. Academy of Sciences USSR, Moscow, 177-182.
9. — (1980) : Prehistoric skeletal remains from Deccan : further analysis. *Biological Anthropology of the People of India*. Academy of Sciences, USSR, Moscow 218-230.

C. Biochemistry

1. Bhattacharyya, S. K. (1980) : Intestinal parasitic infestation : a study of two populations inhabiting contrasting ecosystems. *Man and His Environment*, Eds. I. P. Singh and S. C. Tiwari. Concept Publishing Company, New Delhi, 177-185.

D. Botany

1. Roy, S. K. (1980) : The burrows, grain stores, movements and runs of the Indian mole rat *Bandicota bengalensis*. *Studies on Rodents and their Control*. The Meghalaya Science Society, Shillong, 1-19.

E. Demography.

1. Demography Research Unit : Some Aspects of Family Welfare Planning (based on data from the Female Schedule), Indian Statistical Institute, Calcutta, 1-181.

F. Electronics and Communication Science

1. Dutta Majumdar, D. : A fuzzy set theoretic approach for recognition of pattern generated from bio-social systems : *Proc. 5th European Meeting on Cybernetics and Systems*, Vienna, Hemisphere Publishing Corporation, Washington, 1980

INDIAN STATISTICAL INSTITUTE

2. Dutta Majumder, D (with Dutta, A. K. and Pal, S. K.) : Self-supervised vowel recognition system. *Pattern Recognition*.
3. — (with Chaudhuri, B. B.) : Fuzzy sets and possibility theory in reliability studies of man-machine system. *Fuzzy Sets : Theory and Applications to Policy Analysis and Information Systems*, Eds., P. P. Wang, and L. S. K. Chang, Plenum Press, New York, 1979.
4. — (with Pauri, S. K. and Chaudhuri, B. B.) : A new grammar for generation and recognition of scripts *Proc. 5th European Meeting on Cybernetics and Systems*, Vienna, Hemisphere Publishing Corporation, Washington 1980.

G. Embryology

1. Brahmachary, R. L. : Molluscan Development. *Reproductive Biology of Invertebrates*. John Wiley, London.

H. Geology

1. Jain, S. L. (1980) : The continental Lower Jurassic fauna from the Kota Formation, India. *Aspects of Vertebrate History* Ed. Louis L. Jacobs, Museum of Northern Arizona Press, Flagstaff, U.S.A., 99-123.
2. — (1980) : The Kota Formation : A member of the Indian Gondwanas. *Mesozoic Vertebrate Life No. 1 : New Mesozoic Faunas*, Ed. George Olshevsky, George Olshevsky, San Diego, California, 61-65.

I. Planning, Economic Statistics and Econometrics

1. Bose, D. K. (1980) : Nuclear power in India. *International Energy Studies* Ed. R. K. Pachauri, Wiley Eastern Ltd., New Delhi, 469-476.

J. Sociology

1. Chatterji Bhola : Social Change : why and how of it. *Total Revolution and Social Change*, 36-39, Jayaprakash Academy, New Delhi, October 1980.

5.6 A. TECHNICAL REPORTS

A. Theoretical Statistics and Mathematics

1. Parthasarathy, K. R. (with Sinha, K. B. and Krishna, M.) : Lectures on Quantum Mechanics.

FORTYNINTH ANNUAL REPORT : 1980-81

2. — : A first course in stochastic processes.
3. Sastry, N. S. Narasimha (with Bhattacharyya, P.): Algebraic Coding Theory.
4. — : Association scheme and the related combinatorial structure.

B. Anthropometry and Human Genetics

1. Bhattacharya, S. K. (with Mukhopadhyay, B. Bbarati, P., Gupta, P. and Basu, A.) Intestinal parasitic infestations in populations inhabiting similar and contrasting ecological zones. *Anthrop* 8:81.
2. — : (with Das, S. K., Dutta Swati, and Basu, A.): Variations in differential leukocyte count in relation to age and intestinal parasitic infection. *Biochem* 2:81.
3. Malhotra, K. C. (with Gadgil, M.) (1980) : Report of the field study conducted on behalf of the Committee on Legislative Measures and Administrative Machinery for Environmental Protection, Government of India. 1-44.
4. — (with Karmakar, B. and Kumar, M. Vijaya) (1980) : Genetics of palmar pattern ridge count. *Anthrop*, 11, 1-112.

C. Applied Statistics, Surveys and computing

1. Banthopadhyay, Sibdas (with Adhikari, Ajay Kumar) : Growth curves using longitudinal data.
2. Basu, T. K. (with Ghosh, A.): Mathematical simulation of glucose, insulin and glucagon levels in human circulating blood during a prolonged and severe muscular exercise.
3. Bhimasankaram, P. : An extension of a result of Mitra on non-negative definite matrices.
4. Chanduri, Arjil : On Optimality and related strategies for sampling on two occasions with varying probabilities.
5. — (with Adhikari, Arun Kumar) : A study of efficiency of Midzuno-Sen strategy relative to ratio and ratio-type estimators under a linear regression model.
6. — (with Adhikari, Arun Kumar) : On the Optimality of the Sampling strategies with varying probabilities.
7. Ghosh, S. (with Rao, S. B. and Singh, M. M.): On a robustness property of PMBD.

INDIAN STATISTICAL INSTITUTE

8. Majumdar, P. P. (with Roy, J.): Distribution of A-B-O Blood groups in the Indian Subcontinent—A cluster analysis approach.
9. Mathew, Thomas (with Bhimasankaram, P.): Optimality of BLUES in a general linear model with incorrect design matrix.
10. Mukhopadhyay, A. C.: Orthogonal main effect plans with variable number of levels for factors.
11. Mukhopadhyay, P. (with Halper, A. K.): Bayesian tables for Warner's randomized response probabilities.
12. — : *rps* design reconstructed.
13. Mukhopadhyay, P.: Ranking of PBIBDs with regard to A-optimality criterion under mixed effect model.
14. Mukhopadhyay, Sunanda: On the optimality of block design under mixed effect model.
15. — : Mixture experiment with bounds on variables.
16. Roy, J.: 'A stepwise procedure for chasing a subject of variables for discrimination.
17. Sengupta, A.: On regular expression of linear time varying machines.
18. Sinha, S. K.: Reliability estimation with type I censoring of a mixture Weibull distribution.

D. Biochemistry

1. Bhattacharya, S. K. (with Mukhopadhyay, B., Bharati, P., Gupta, R., Dey, B and Basu, A.) (1980): Intestinal parasitic infestations in populations inhabiting contrasting ecozones, *Biochem* 3:81.
2. — (with Mukherjee, J. J. and Basu, A.) (1980): The nutritive value of *Chhang*, the indigenous millet beer of the Sherpas. *Biochem* 4:80.
3. Mukherjee, J. J. (with Pal, P. R.): Inorganic pyrophosphatase level in germinating *Plasmodium aureis*. *Biochem* 1:81, 7.

E. Demography

1. Chakravorty, B.: Psychological perspectives in family planning policy determinants. (DRU/23).

FORTYNINTH ANNUAL REPORT : 1980-81

2. — : Population and environment, (DRU/23).
3. Das, Chitaranjan (with Sarkar, B. N.) : Management of primary schools in rural areas of districts around Calcutta. (DIU/21).
4. Dutt, Tink Kumar (with Sarkar, R. N.) : Role of transport in rural development, (DIU/22).
5. Guha Ray, S. : Path analysis of areal fertility in rural India, (DIU/16).
6. Malakar, C. R. : Regional variation in population distribution and development in India during 1961-71, (DIU 25).
7. Mukherjee, Baran (with Sarkar, B. N.) : Two-generation education mobility of males and females in villages of districts around Calcutta, (DIU 17).
8. Rajai, M. V. : differential response by husbands by wives regarding contraceptive practice, (DIU 6).
9. Sarkar, B. N. : Evaluation of rural health programme in West Bengal, 1977-79 (DRU/14).
10. — : Marriage pattern among females in Rural areas of districts around Calcutta, (DRU/18).
11. Sarkar, B. N. : A pilot investigation on school dropout (DIU 20).
12. — : Literacy development among females in family life in rural areas of Murshidabad, Nadia and Birbhum, (DIU/27).

P. Documentation and Library Science

1. Seetharama, S. : Collection development and manpower plan for the ISI Bangalore Centre Library. April 1980.
2. — : Plant based information services workshop : A proposal. June 1980.
3. — : State Technological Information Library and Documentation Centre (U.P.) Plan : An evaluation. May 1981.
4. — : Water and Power information system (SAPIS) : A manpower plan, September 1980.

G. Geology

1. Sarkar, Sonman (1981) : A preliminary study of the calcareous units within Upper Triassic Maleri Formation, Pranrita-Godavari Valley, Andhra Pradesh, P & E/G-02-80, 1-35.

INDIAN STATISTICAL INSTITUTE

H. Physics

1. Gupta, A. B. (with Ghosh, K. G.): Elastic properties of hair in alopecia areata P & E/Phys/81-91/Cyclostyled.

I. Physics of Fluids

1. Basu, T. K. (with Ghosh, A.): Mathematical simulation of glucose, insulin and glucagon levels in human circulating blood during a prolonged and severe muscular Exercise. P. & E/Ep-10-80.
2. Dandapat, B. S.: Non-linear stability of the buoyancy boundary-layer in the presence of transverse magnetic field. P & E/F-16-80.
3. Guha, M. K. (with Mazumder, H. P.): On the self-similar solution of von Karman's equation in homogenous and isotropic turbulence. P & E/E/17-80.
4. Mazumder, H. P. (with Bhattacharyya, P.): Some aspects of larger Reynolds number phenomena in homogeneous and isotropic turbulence. P & E/E/11-80.

J. Planning, Economic Statistics and Econometrics

1. Bhattacharya, N. (with Chatterjee, G. S.): A further note on between states variation in level of living in rural India. NIRU/4/80, December 1980.
2. Bose, D. K.: Policy for Science and technology in developing economy—A case study of India. ERU/D/1/80, 1-50, June 1980.
3. — (with Mohan, S.): The cost of nuclear power in India. ERU/3/80, 1-17, October, 1980.
4. Chakrabarti, S. K. (with Panda, N. K.): Measurement of incidence of under-nutrition critique of Professor Shukhatme's approach. ERU/5 80, 1-16, November 1980.
5. Chakravarty, S. R.: Inequality measurement: Some theoretic results. ERU/2/80, 1-14, June 1980.
6. —: Censored income distribution, representative income and measure of fertility. ERU/4/80, 1-18. November 1980.
7. Chander, Prakash: Dimension of Euclidean message spaces, ISI Discussion Paper No. 8016.
8. —: Capacity constraints in Geontief models, ISI Discussion Paper No. 8014.

FORTYNINTH ANNUAL REPORT : 1980-81

9. Chetty, V. K. : Economics of price and distribution controls—sugar industry, ISI Discussion Paper No. 8101.
10. Coondoo, D and (with Mitra, Amita) : A system of demand equations based on price independent generalised linearity. ERU/6/80, 1-13, December 1980.
11. Jain, I. R. : Extension of Iyengar's method of estimation of Engle Curves from grouped Data, ISI, Discussion Paper No. 7938.
12. Mazumdar, Krishna : Relationships between labour force structure and degree of urbanization in India. NIRU/3/80, November 1980.
13. Panda, K. Monoj : Wages in food for work programme—the productivity aspect. ERU/D/81, 1-9, March 1981.
14. Roy, Bina : Wage-differentials and inequalities in the distribution of income in India. NRU/28/0, October 1980.
15. — : Comparative study in growth between different regions of India. NIRU 3.80, November 1980.
16. — (with Roy, Biswanath, Chowdhury, Bharati) : Distribution of income in West Bengal State Government Services. NIRU/6/80 March 1981.
17. Sarkar, Nityannala : Study of autocorrelated linear regression model with decomposed error terms. ERU/1/81, 1-29, February 1981.
18. — : Study of a linear regression model with decomposed error term : a likelihood approach, ERU/3-81, 1-36, March 1981.
19. Saradannoni, K. : Changing land relations and women—a case study of Palghat.
20. Sil, Sidhu (with Bhawmik, Mrinal and Pai, Monoranjan) : A note on optimum grouping estimation in an Heteroscedastic Model, ERU/2/81, 1-12, February, 1981.

K. Psychometry

1. Dasumallik, T (with Bhattacharyya, K. P.) : Views on mental health : a preliminary study. August, 1980 1-14.

L. Sociology

1. Biswas, S. K. : March of anthropology in India.
2. Chakrabarti, P. : A study of some aspect of family organisations in Calcutta.