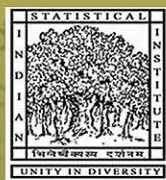


Annual Report

2013-2014



Indian Statistical Institute

PRESIDENT OF THE INSTITUTE, CHAIRMAN AND OTHER MEMBERS OF THE COUNCIL AS ON MARCH 31, 2014

President: Dr. C. Rangarajan
Chairman, Economic Advisory Council to the Prime Minister

1. Chairman: Shri A.K. Antony, Hon'ble Minister of Defence, Government of India.
2. Director: Prof. Bimal K. Roy.

Representatives of the Government of India

3. Shri P.K. Pujari, Additional Secretary and Financial Advisor, Government of India, Ministry of Statistics and Programme Implementation, New Delhi.
4. Smt. S. Jeyalakshmi, Additional Director General (SSD), CSO, Ministry of Statistics & P.I., New Delhi.
5. Shri Rajiv Kumar, Joint Secretary, Department of Expenditure, Ministry of Finance, New Delhi.
6. Dr. Sibaji Raha, Director, Bose Institute, Kolkata.
7. Shri Deepak K. Mohanty, Executive Director, Reserve Bank of India, Mumbai.
8. Mrs. Amita Sharma, Additional Secretary, Government of India, Ministry of Human Resource Development, New Delhi.

Representative of the ICSSR

9. Prof. Ramesh Dadhich, Member-Secretary, Indian Council of Social Science Research, New Delhi.

Representatives of INSA

10. Prof. Ajit Iqbal Singh, FNA, INSA Senior Scientist, Indian Statistical Institute, New Delhi.
11. Prof. R.L. Karandikar, FNA, Director, Chennai Mathematical Institute, Tamil Nadu.
12. Prof. Alok Bhattacharya, FNA, School of Life Science, Jawaharlal Nehru University, New Delhi.
13. Prof. N.K. Gupta, FNA, Department of Applied Mechanics, Indian Institute of Technology, New Delhi.

Representative of the Planning Commission

14. Dr. Savita Sharma, Adviser, Perspective Planning Division, Planning Commission, New Delhi.

Representative of the University Grants Commission

15. Prof. Debasis Kundu, Department of Statistics, Indian Institute of Technology, Kanpur.

Scientists co-opted by the Council

16. Prof. R. Balasubramanian, Director, Institute of Mathematical Sciences, Chennai.
17. Prof. N. Balakrishnan, Associate Director, Indian Institute of Science, Bangalore.

Elected representatives of the Institute members not employed in the Institute

18. Prof. D. Dutta Majumder, FNA, Emeritus Professor, Indian Statistical Institute, Kolkata.
19. Shri Ajay Kumar Ghosh, Kolkata.
20. Prof. Siddani Bhaskara Rao, C.R. Rao Advanced Institute of Mathematics, Statistics and Computer Science, Hyderabad.

Elected representatives of the employees of the Institute

21. Shri Rajat Kanti Chatterjee, Representative of the Scientific Workers.
22. Shri Gouri Sankar Acharya, Representative of the Non-scientific Workers.

Officers of the Institute

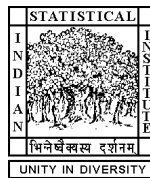
23. Prof. T.S.S.R.K. Rao, Professor-in-Charge, Theoretical Statistics and Mathematics Division.
24. Prof. Mausumi Bose, Professor-in-Charge, Applied Statistics Division.
25. Prof. Prabal Roy Chowdhury, Professor-in-Charge, Social Sciences Division.
26. Prof. Saswati Bandyopadhyay, Professor-in-Charge, Physics and Earth Sciences Division.
27. Prof. Subrata Kr. Roy, Professor-in-Charge, Biological Sciences Division.
28. Prof. C.A. Murthy, Professor-in-Charge, Computer and Communication Sciences Division.
29. Dr. Ashis Kr. Chakraborty, Head, SQC&OR Division.
30. Prof. Satya P. Das, Head, Delhi Centre.
31. Prof. N.S.N. Sastry, Head, Bangalore Centre.
32. Dr. S. Ponnusamy, Head, Chennai Centre.
33. Prof. Pradipta Bandyopadhyay, Dean of Studies.

Non-Member Secretary

Shri S.K. Iyer, Chief Executive (Administration & Finance).

INDIAN STATISTICAL INSTITUTE

Annual Report April 2013 – March 2014



203 Barrackpore Trunk Road
Kolkata – 700 108
(<http://www.isical.ac.in>)

**INDIAN STATISTICAL INSTITUTE
EIGHTY SECOND ANNUAL REPORT
April 2013 – March 2014**

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Director's Report

It is indeed a great privilege to write preface for the Annual Report 2013-14 of the Indian Statistical Institute, an Institute of National Importance with which I have been associated for more than three decades. This also gives us an opportunity to take stock of our achievements and efforts that we have put in during the academic year as well as help us to plan ahead for taking new steps towards evolving directions to further the growth and dissemination of statistical and scientific knowledge.

Reporting about the awards and honours won by our faculty members and students is always a proud moment for the Director. It gives me enormous sense of pride to share with you that Emeritus Professor Jayanta Kumar Ghosh, former Director of the Institute have been conferred Padma Shri by the Government of India for his significant contribution in field of Science and Engineering.

The many prestigious awards and honours received by some of my colleagues and students during the year have been a matter of pride and pleasure for us and require a special mention in this Annual Report. Ms. Neena Gupta was awarded with the INSA Medal for young scientist, Ms. Tanvi Jain received the SERB Women excellence award, and Dr. Gautam Paul received the Young Scientist Platinum Jubilee award from National Academy of Sciences. In addition to the above, Professor Sankar K. Pal was awarded with Golden Jubilee Medal of IEEE, USA and Diamond Jubilee Medal of IETE, India, Dr. Kattumannil S.K. was awarded with Indo-US Research Fellowship – 2013. Professor N.R. Pal got elected as the Vice-President for publication of the IEEE Computational Intelligence since January 2013. Professor Dilip Saha got elected as Fellow of West Bengal Academy of Science and Technology and Dr. Shiladri Sekhar Das is awarded with the Sharada Chandra Gold Medal for best Indian Paper by the Palaeontological Society of India. My colleagues in the field of economics also earned honours and awards for their consolidated efforts in their respective fields. Professor Satya R. Chakravarty was offered a position as Consultant in the Asian Development Bank, Manila, Philippines. Professor Manipushpak Mitra was awarded with the Mahalanobis Memorial Medal by the Indian Econometric Society for the year 2012. Dr. Pulakesh Maity has received the Leading Scientist of the World 2013 award sponsored by the International Biographical Centre. Professor Abhirup Sarkar has been appointed as the Chairman of the 4th Finance Commission of West Bengal and Dr. Chetan Ghate is appointed as a member of the Reserve Bank of India Expert Committee on strengthening Monetary Transmission in India, constituted by Reserve Bank of India.

The Giridih Branch of the Institute is being revamped and Training Programme on personality development including basic computer skills for local youths has already started. A Post Graduate Diploma in Computer Applications is all set to take off from the next academic year. One Semester course on Cryptology and Data Security spanning over four months for the officials of the various wings of Indian Defence establishments as well as intelligence wings operating under Ministry of Home Affairs, and Department of Telecommunications has already started during the academic year. The 1st batch has successfully completed the course and the 2nd batch is presently undergoing the training. A Post Graduate Diploma in Statistical Methods and Analytics exclusively for the students from North-East region of the country has already started from this academic year at ISI North-East Centre, Tezpur.

The Ministry of Statistics and Programme Implementation, Government of India has sanctioned an outlay of Rs. 115 Crores under the XIth Five Year Plan (EFC scheme) for setting up the R.C. Bose Centre for Cryptology and Security. In the council meeting held on 8th March, 2014, it was decided that the construction work for the Centre will be awarded to the National Buildings and Construction Corporation Limited. It has also been decided to restore the existing building named as Gupta Niwas in the area earmarked for setting up the R.C. Bose Centre for Cryptology and Security and preserve the same as a heritage building for future use and reference.

The year 2013 was observed as the International Year of Statistics over the world. The Institute has also observed the same through a series of lectures by eminent academicians.

Director's Report

A partial list of the conferences and workshops organized by the Institute are International Conference on 'Knowledge Modelling and Knowledge Management' as part of ITPAR project funded by DST, the 5th International Conference on "Pattern Recognition and Machine Intelligence", 5th World Congress on Paraconsistency, All India Conference on "Statistical Databases in Gram Panchayats", CESI Annual International Conference 2013 on Education, Diversity & Democracy and National workshop on "Nonlinear Dynamics and Applications".

The Institute undertook a large number of externally funded projects over the years. At present there are about 86 ongoing projects in the Institute. The major funding agencies of the projects are Government of India, CSIR, DST, DGCIS, ICAR, DAE, DBT, IBM (USA), and European Union Commission.

Research and development activities go hand in hand with the Institute's pursuit of academic excellence and to achieve further development in research several Memorandum of Understandings (MoUs) have been signed between the Institute and London School of Economics & Political Science (LSE), Yokohama National University, Japan, Qualcomm Technologies, Inc., Google Cultural Institute, Dublin, University of Hyderabad, De Beers India Private Limited, and Biomedical Devices of Kansas LLC etc.

I am grateful to Dr. C. Rangarajan, President of the Institute and also to the Chairman of ISI council for their kind co operation, and valuable guidance for smooth functioning of the Institute. I am grateful to all the Council members, Dr. T.C.A. Anant, Secretary, Ministry of Statistics and Programme Implementation, Government of India and all other officials of the Administrative Ministry for their kind co operation and advice from time to time. I express my sincere gratitude to all the office bearers and other workers of the Institute for their continued co operation through their respective activities.

March 31, 2014

Bimal K. Roy



INDIAN STATISTICAL INSTITUTE

203 B. T. Road Kolkata 700108.



Founder

Professor Prasanta Chandra Mahalanobis

The Indian Statistical Institute, a premier and internationally acclaimed research, teaching and training institute, founded in 1931, is recognized as an institute of national importance by an act of Parliament in 1959.

The Institute has distinguished faculty in statistics, mathematics, computer science, economics and other disciplines of natural and social sciences. Many of them are fellows of Indian National Science Academy, Indian Academy of Sciences, Indian National Academy of Engineering, National Academy of Sciences, India, Institute of Electrical & Electronics Engineers (IEEE) and many other distinguished scientific societies in India and abroad, and also recipients of prestigious awards like S.S. Bhatnagar Prize, Homi Bhaba Award etc.

The Institute offers -

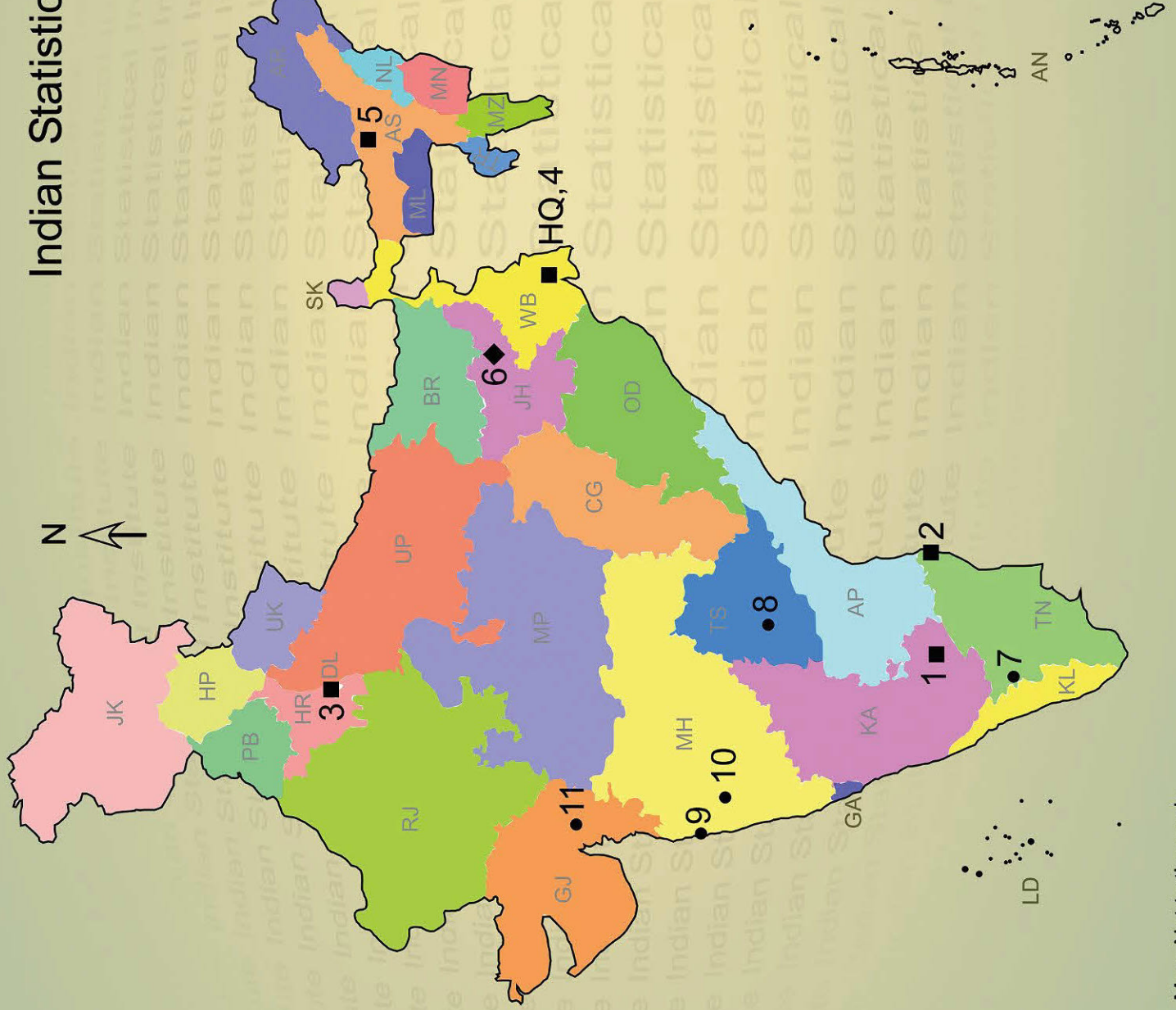
- B.Stat.(Hons.), B.Math.(Hons.), M.Stat., M.Math., M.S. in Quantitative Economics, M.S. in Library and Information Science, M.Tech. in Computer Science, M.Tech. in Quality, Reliability and Operations Research
- Post Graduate Diploma in Statistical Methods with Applications
- Junior/Senior Research Fellowships in several areas of natural and social sciences
- Ph.D. degrees in Statistics, Mathematics, Quantitative Economics, Computer Science and Quality, Reliability & Operations Research

The Institute also confers D.Sc. (Honoris Causa).

Organization of ISI by Divisions, Constituent Units and Associate Institutions



Indian Statistical Institute: Locations



Map: Not to the scale



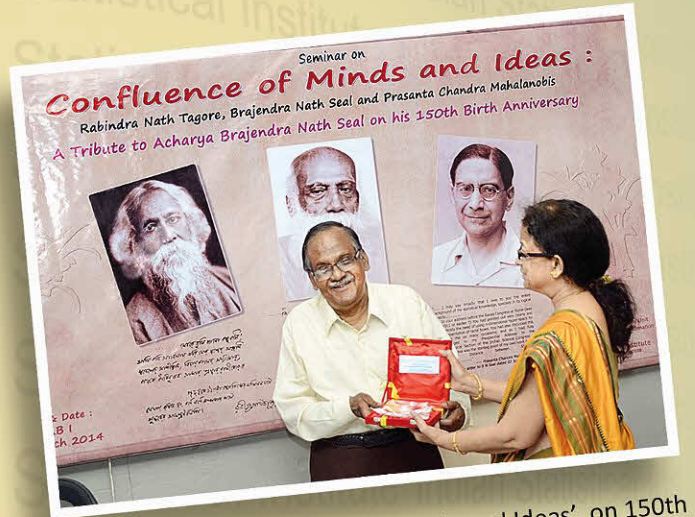
Celebrating International Year of Statistics 2013 at ISI Bangalore Centre. On the dias (L to R): Professors Ramachandran, Abhijit Sen and Pronab Sen



Prof. Pradipta Bandyopadhyay, Dean of Studies, ISI, delivering the Inaugural address at the National Conference on Quantum Correlations: Foundation and Applications organized by PAMU on 4 March 2014



Prof. Lorenzo Bruzzone, University of Trento, Italy delivering IEEE Geoscience and Remote Sensing Society (GRSS) talk at the ISI Bangalore Centre on 27 January 2014



Seminar on 'Confluence of Minds and Ideas' on 150th birth anniversary of Acharya B N Seal organized by Reprography & Photography Unit, Library on 13 March 2014



Hindi Workshop organized by ISI, Kolkata on 14 March 2014



Prof. Bimal K. Roy, Director speaking at the National Conference on Recent Trends on Biological Anthropology organized by BAU on 21 November 2013



International Conference on Knowledge Modelling and Knowledge Management organized by DRTC, ISI Bangalore Centre during 20-21 November 2013



Workshop on Computational and Cognitive Linguistics organized by LRU during 19-21 March 2014



Workshop organized by SQC & OR Unit, ISI Coimbatore Centre on 29 June 2013



Celebrating Business Analytics Program at ISI Chennai Centre during February-March 2014



Prof. Christopher W. Clifton, Purdue University, speaking at the 9th International Conference on Information Systems Security (ICISS 2013) organized by ECSU during 16-20 December 2013



Football Match of ISI students on 31 July 2013



● Programme on Six Sigma Green Belt organized by SQC & OR Delhi Centre during 4-6 February 2014



● 3rd International Symposium on Complex Dynamical Systems and Applications, jointly organized by AERU and PAMU, ISI, Kolkata on 10 March 2014



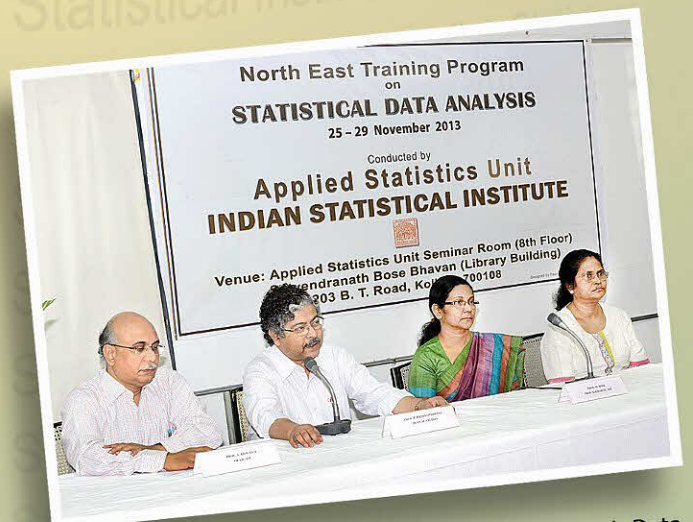
● Republic Day celebration 2013 at ISI Kolkata



● Felicitation of Prof. Hong Pham, USA, by Prof. Ashis Chakraborty, SQC & OR Division on 20 March 2014



● International Workshop on Official Data organized by SOSU on 11 July 2013



● North East Training Programme on Statistical Data Analysis organized by ASU on 25 November 2013

A BRIEF HISTORY OF THE INSTITUTE

In the 1920's, Prasanta Chandra Mahalanobis, then a Professor at Presidency College, Calcutta conducted several studies employing statistical methods with results that vindicated his ideas about the efficacy and possibilities of the emerging science of Statistics. In a meeting on 17th December 1931 presided by Sir R. N. Mukherjee, the first President of the Institute, the Indian Statistical Institute (ISI) was formally established and Prasanta Chandra Mahalanobis was appointed the Honorary Secretary. The Indian Statistical Institute was registered on 28th April, 1932, as a non-government and non-profit distributing learned society under the Societies' Registration Act No. XXI of 1860. The Institute is now registered under the West Bengal Societies Registration Act XXVI of 1961, amended in 1964. It has the following objectives:

- (i) To promote the study and dissemination of knowledge of Statistics, to develop statistical theory and methods, and their use in research and practical applications generally, with special reference to problems of planning for national development and social welfare;
- (ii) To undertake research in various fields of natural and social sciences with a view to the mutual development of Statistics and these sciences;
- (iii) To provide for, and undertake, the collection of information, investigations, projects, and operational research for purposes of planning and the improvement of efficiency of management and production.
- (iv) To undertake any other ancillary activities in fulfillment of the objectives (i), (ii) and (iii).

The Institute started functioning initially from a room of the Presidency College with enduring support from a number of distinguished personalities and devoted scholars in Kolkata. Over the first two decades, which turned out to be a glorious chapter in the annals of Indian science and institution building, the ISI embarked upon a series of pioneering programmes involving the application of Statistics in search of solution of the urgent and live problems of the country. Such programmes included innovative projects on sample surveys of yield and land utilisation of crops, socio-economic after-effects of Bengal famine and problems of flood research. These innovations and methodological research have since become classics in Statistics. At the same time, the training of scientific personnel began to grow. This also encouraged high level research and brought into focus the need for publication of the research results, for which *Sankhyā*, the first international journal of the country in Statistics, came into being in 1933.

Apart from the impact made in the world of Statistics, the Institute held a pivotal role in the task of nation building, when India became independent, through the brilliant choice of the area of surveys, which were socially and nationally relevant. The patronage and invaluable contribution of Sir Ronald A. Fisher played an important role. Led by Professor Mahalanobis and a very able group of younger statisticians including R.C. Bose, S.N. Roy and C.R. Rao, the Institute was poised to take on the larger role. The Institute is proud to have C.R. Rao, who is among the world leaders in statistical science over the last six decades and still active at the age of 93 as the Director of the Center for Multivariate Analysis at Pennsylvania State University, USA, in its list of alumni.

The 1950s saw the Institute establishing (i) a full fledged research and training school in Statistics and Probability, with its application in natural and social sciences, (ii) a planning wing entrusted with the formulation of the Second Five-Year Plan of India, (iii) publication of *Sankhyā*, (iv) the National Sample Survey wing engaging in comprehensive socio-economic data collection for the nation, (v) a string of Statistical Quality Control units for promoting the quality movement at various industrial centres in the country, (vi) a collaboration with the International Statistical Institute to train Government statisticians from Asia and Africa, and (vii) an Electronic Computer Laboratory that was responsible for

Brief History

developing (a) the 1st mechanical hand computing machine, (b) the 1st Analog computer, (c) the 1st Punched Card storing machine and (d) the 1st Solid State Computer in India, to name some of the principal activities. In 1954 Pandit Jawaharlal Nehru, the then Prime Minister of India, entrusted Professor Mahalanobis and ISI with the responsibility of preparing the draft Second Five-Year Plan for the country. The draft submitted by Prasanta Chandra Mahalanobis and the planning models formulated by him and his colleagues have since been regarded as major contributions to economic planning in India. In 1956, the Institute installed the first electronic computer in the country. In 1961, the ISI, in collaboration with Jadavpur University, undertook the design, development and fabrication of a fully transistorized digital computer, called ISI-JU-1, which was commissioned in 1966. The Institute, from its formative period till present times, received as guests eminent scientists, some of whom were Nobel Laureates. Besides Ronald A. Fisher, J.B.S. Haldane and Walter A. Shewhart, the luminaries included Frederic and Irene Curie, Neils Bohr, A.N. Kolmogorov, P.M.S. Blackett, J.D. Bernal, Joan Robinson, Genichi Taguchi and George Akerlof, 2001 Nobel prize winner in economics and a visiting professor of ISI during 1967-68. In recent times, the visit of Amartya K. Sen, Robert Aumann, Lotfi A. Zadeh, Joseph E. Stiglitz, Sir James A. Mirrlees, Eric Maskin and S.R.S. Varadhan, 2007 Abel Prize winner for his contributions to probability theory and an alumnus of the institute, may be specially mentioned.

The formal recognition came in December 1959, when Pandit Jawaharlal Nehru piloted in the Parliament the enactment of the Indian Statistical Institute Act of 1959, which designated ISI as an 'Institution of national importance'. The activities steadily grew, existing interests became more broad-based and a number of science units were created in the interest of live interaction between Statistics and Natural and Social Sciences. Empowered by the Act to award degrees, the Institute started the B. Stat. and M. Stat. courses. An excellent library was founded at Kolkata and the Documentation Research and Training Centre began functioning in Bangalore. Other developments in infrastructure also began.

During 1971-72, two decisions of the Government of India produced serious repercussions on the functioning of the ISI. One was de-linking of the Institute from the Perspective Planning Division of the Planning Commission in 1971, while the other was the separation of National Sample Survey from the ISI and its take-over by the Central Government in 1972. Professor Mahalanobis passed away on 28th June, 1972. It was a critical period for the Institute. To overcome the problem, the ISI sought to strike a judicious balance between the individual academic work on truly fundamental problems and the work that called for a greater engagement with the social and economic problems of the country. The members of the Institute, under the Chairmanship of Shri P.N. Haksar, held a Special General Body Meeting on 26th July, 1974 and amended the Memorandum of Association and the Regulations of the Institute, encouraging more inter-disciplinary research and enhancing active participation of the scientists of the ISI in decision-making process of the Institute. The organisational amendments were implemented, with the concurrence of Government of India, in August, 1976. The various research units in natural, social and computer sciences were grouped under a number of scientific Divisions.

Over the decades diversity in research thrusts began to grow manifold, with emphasis on Computer Science and application of Statistics in the new areas of research in natural and social sciences. Two centres, one at Delhi and one at Bangalore were created with full-fledged research and teaching programmes. The Delhi Centre, initially housed within the Planning Commission premises, was started in 1974, and shifted to its present campus in 1975. The Bangalore Centre was conceived by Prof. P.C. Mahalanobis during 1960s. With the Statistical Quality Control unit functioning in Bangalore from 1956, and Documentation Research and training Centre from 1962, Professor Mahalanobis thought of starting a centre of ISI around the mid-sixties. However, the activities of the Bangalore Centre started in September 1978 in a rented building under the Directorship of Professor G. Kallianpur. The various units moved to the present campus in May 1985 and in September 1996, the Bangalore Centre was formally declared as a Centre of ISI. The Chennai centre of the Institute came into being on 26th July, 2008 and has to its credit several theoretical and applied research work in Statistics and Mathematics, and many of the projects undertaken have been breakthrough applications. A North-East Centre of the Institute has been established at Tezpur, Assam on 23rd July, 2011 and it is also expected to focus

on such diversity of teaching, training and research. This centre is currently housed in Tezpur University campus. A new unit, called the Sampling and Official Statistics Unit (SOSU), has been created at the Headquarters in Kolkata on 1st March, 2012 to cater to the growing demand for research and training in sampling and official statistics.

The Institute is fully funded by the Ministry of Statistics & Programme Implementation, Govt. of India. The support and encouragement of the Ministry of Statistics & Programme Implementation, Govt. of India are among the major factors which are helping the Institute to sustain its academic growth and excellence. The Ministry provides funds to the Institute under Plan & Non-Plan budget as per the recommendations of a committee set up for the purpose by the Ministry of Statistics & Programme Implementation, Govt. of India under Section 8(1) of the "Indian Statistical Institute Act. 1959, No. 57 of 1959" based on the programme of research, teaching, training and various academic activities. The grants-in-aid provided by the Ministry of Statistics & Programme Implementation, Govt. of India to the Institute includes the funds required for construction of buildings, hostels, guest house, purchase of equipments, hiring manpower etc. The Ministry plays a pivotal role in expansion of the research & training activities of the Institute by way of opening its new Centres in various parts of the country. The North-East Centre at Tezpur, Assam which was inaugurated by Shri Prabab Mukherjee, the then Finance Minister, Govt. of India and the then Chairman, Indian Statistical Institute Council in the presence of Shri Srikant Jena, Hon'ble Union Minister for Ministry of Statistics & Programme Implementation, Govt. of India; Shri Tarun Gogoi, Hon'ble Chief Minister, Govt. of Assam; Dr. T.C.A. Anant, Secretary, Ministry of Statistics & Programme Implementation, Govt. of India and other dignitaries. In July 2012, the Ministry of Statistics & Programme Implementation, Govt. of India approved establishment of R.C. Bose Centre for Cryptology and Security as a separate Centre of the Institute.

The present structure of eight divisions has been arrived at through some further changes. Recently there have been some changes. Systems Science and Informatics Unit (SSIU) has been started as a part of the Computer and Communication Sciences Division (CCSD) at ISI Bangalore centre in August 2009. The Documentation Research and Training Centre (DRTC) has been made a part of CCSD. The Indian Statistical Institute Act of 1959 was amended by the Parliament in 1995 to empower the Institute to award Degrees/Diplomas not only in Statistics, but also in Mathematics, Quantitative Economics, Computer Science and such other subjects related to Statistics as may be determined by the Institute from time to time. Several new courses have also been added since: M. Tech. in Computer Science, M. Tech. in Quality, Reliability and Operations Research, M.S. in Quantitative Economics, B. Math. and M. Math.

In conclusion, a list of the distinguished scientists and statesmen who have served the Institute during the 80 years of its existence in the capacities of President, Chairman or Director is presented. A list of recipients of the honorary D. Sc. degree given by the Institute is also provided.

Presidents of the Institute

1	Sir Rajendra Nath Mookerjee	1932-35
2	Shri E.C. Benthall	1936-37
3	Shri James Reid-Kay	1938
4	Shri Badridas Goenka	1939-41
5	Dr. Nalini Ranjan Sarkar	1942-43
6	Dr. Chintaman D. Deshmukh	1944-63
7	Shri Y.B. Chavan	1964-66
8	Prof. Satyendra Nath Bose	1967-75
9	Shri Subimal Dutt	1976-89
10	Prof. M.G.K. Menon	1990-2012
11	Dr. C. Rangarajan	2012-till date

Brief History

Chairmen of the Institute

1	Shri B. Rama Rao	1954
2	Shri D.N. Mitra	1955-63
3	Shri K.P.S. Menon	1964-70
4	Shri S.C. Roy	1971
5	Dr. Atma Ram	1972
6	Shri. P.N. Haksar	1973-97
7	Dr. Bimal Jalan	1998-2001
8	Dr. N.R. Madhava Menon	2002-03
9	Shri Pranab Mukherjee	2004-12
10	Shri A.K. Antony	2012-May 2014

Directors of the Institute

1	Prof. P.C. Mahalanobis	Dec	1931	-	June	1972
2	Prof. C.R. Rao	July	1972	-	June	1976
3	Prof. G. Kallianpur	July	1976	-	Sept	1978
4	Prof. B.P. Adhikari	Aug	1979	-	Oct	1983
5	Prof. Ashok Maitra	April	1984	-	Jan	1987
6	Prof. J.K. Ghosh	Jan	1987	-	Jan	1992
7	Prof. B.L.S. Prakasa Rao	Jun	1992	-	Feb	1995
8	Prof. S.B. Rao	July	1995	-	July	2000
9	Prof. K.B. Sinha	Aug	2000	-	July	2005
10	Prof. S.K. Pal	Aug	2005	-	July	2010
11	Prof. Bimal K. Roy	Aug	2010	-	till date	

List of persons awarded the D.Sc. (Honoris Causa) by the Institute

February 1962	Prof. Satyendra Nath Bose, Prof. Ronald A. Fisher, Pandit Jawaharlal Nehru, Dr. Walter A. Shewhart
April 1962	Prof. A.N. Kolmogorov
May 1965	Dr. Chintaman Dwarkanath Deshmukh
December 1974	Prof. Raj Chandra Bose, Dr. M.V. Keldysh, Prof. Jerzy Neyman
February 1977	Prof. Harald Cramer
February 1978	Shri Morarji Desai, Prof. L.V. Kantorovich
December 1989	Prof. C.R. Rao
January 2001	Prof. Gopinath Kallianpur
February 2004	Prof. S.R. Srinivasa Varadhan
March 2006	Prof. L.A. Zadeh
December 2006	Dr. Manmohan Singh
February 2011	Dr. Subhas Mukherjee (Posthumously)
January 2013	Prof. K.R. Parthasarathy, Prof. Jayanta Kr. Ghosh, Prof. Pranab Bardhan

Summary of Activities at a Glance

- **MoU with other organisations (7 Nos.)** : London School of Economics & Political Science (LSA);
Yokohama National University, Japan;
Qualcomm Technologies Inc., California;
Google Cultural Institute, Dublin, Ireland;
University of Hyderabad;
De Beers India Pvt. Ltd., Bangalore;
Airport Authority of India

- **Number of books published** : 23

- **Number of papers published** : 725

- **Number of Conferences, Workshops and Seminars held (Total – 483)** : 24 (Conference)
135 (Workshop)
324 (Seminar)

- **Prestigious Awards and Honours**
 - **Jayanta K. Ghosh (Emeritus Professor)** : Padma Shri (Science & Engineering), Govt. of India, 2014;
 - **Neena Gupta (Stat-Math Unit, Kolkata)** : INSA Medal (Young Scientist), 2014;
 - **Tanvi Jain (Stat-Math Unit, Delhi)** : SERB Women Excellence Award, SERB, DST;
 - **Shiladri Sehekhar Das (GSU, Kolkata)** : Sharada Chandra Gold Medal, Paleontological Society of India, 2013;
 - **Manipushpak Mitra (ERU, Kolkata)** : Mahalanobis Memorial Medal, Indian Economic Society;
 - **Sankar K. Pal (CSCR, Kolkata)** : Diamond Jubilee Medal, IETE, India & Golden Jubilee Medal, IEEE, USA;
 - **Goutam Paul (RCBCCS, Kolkata)** : Young Scientist Platinum Jubilee Award, National Academy of Sciences, 2013

- **Regional Mathematical Olympiad (RMO), 2013**
 - **Date** : 01 December, 2013
 - **Participants** : 1094 (West Bengal),
2708 (Karnataka)
 - **Successful Students** : 36 (West Bengal),
35 (Karnataka)

- **Indian National Mathematical Olympiad (INMO), 2014**
 - **Date** : 02 February, 2014
 - **Participants** : 42 (West Bengal)

- **International Statistical Education Centre (ISEC)**
 - **Founded** : 1950
 - **Commencement date of 67th Term (2013-14)** : 01 August, 2013
 - **Number of Trainees** : 24
 - **Countries participated** : Bangladesh, Bhutan, Ethiopia, Gambia, Ghana, Mali, Mongolia, Namibia, Niger, Papua New Guinea, Sri Lanka, Tanzania & Uzbekistan

1. TEACHING AND TRAINING

A brief account of teaching and training activities of the Teaching and Training Division during the academic session 2013-2014 is given below.

Degree, Associateship and Training Courses

During the academic session **2013-2014**, a total of **14623** candidates applied for admission and were called for written selection tests for various courses offered by the Institute, viz., B. Stat. (Hons.), B. Math. (Hons.), M. Stat., M. Math., Master of Science (M.S.) in Quantitative Economics, Master of Science (M.S.) in Library and Information Science, M. Tech. in Computer Science, M. Tech. in Quality, Reliability and Operations Research, Post-Graduate Diploma in Statistical Methods and Analytics, **Research Fellowships** in Statistics, Mathematics, Quantitative Economics, Computer Science, Quality, Reliability and Operations Research, Physics and Applied Mathematics, Agriculture & Ecology, Sociology, Geology, Library and Information Science, Psychology and Linguistics. Admission tests were conducted at **31** different centres all over the country. A total of **9995** candidates finally appeared for admission tests, of which a total of **807** candidates qualified in the written tests and were called for interviews. Based on the performance in the written tests, interview and the academic records, **303** candidates were offered admission to various courses during the academic session under review.

The annual examinations for all the regular courses during 2012-2013 academic session were held during May 2013. The 2013-14 academic session commenced from **July, 2013**.

The number of candidates admitted to the different degree, Diploma programmes and in Junior Research Fellowship during 2013-2014 and the number of students who passed the annual examinations in 2013, are given in **Table 1**.

Till **31st March, 2014**, **144** trainees of Engineering and Technology courses from various Universities/Institutions (Amity University, Haryana; Assam University, Silchar; Banaras Hindu University; Bengal College of Engineering & Technology; Bengal Engineering and Science University, Shibpur; Bidhannagar College, Salt Lake; Birla Institute of Technology & Science, Pilani; Birla Institute of Technology, Mesra; Central University of Jharkhand, Ranchi; Galgotias University, U.P.; Gittam Institute of Science, Visakhapatnam; Government College of Engineering and Ceramic Technology; Greater Kolkata College of Engineering and Management; Haldia Institute of Technology; Heritage Institute of Technology; Indian Academy of Science; Indian Institute of Science Education and Research, Bhopal; Indian Institute of Technology, Bangalore; Indian Institute of Technology, Bombay; Indian Institute of Technology, Guwahati; Indian Institute of Technology, Kharagpur; Indian Institute of Technology, Roorkee; Indian School of Mines, Dhanbad; Jadavpur University; Kalyani Government Engineering College; KIIT University; Lovely Professional University; Maharshi Dayanand University, Rohtak; Meghnad Saha Institute of Technology; Narula Institute of Technology; National Institute of Technology, Durgapur; National Institute of Technology, Rourkela; National Institute of Technology, Surathkal; National Institute of Technology, Tiruchirappalli; Oriental Institute of Science and Technology; Pailan College of Management & Technology; Presidency University, Kolkata; R C C Institute of Information Technology; Sikkim-Manipal Institute of Technology; Siliguri Institute of Technology; Supreme Knowledge Foundation Group of Institutions; Symbiosis International University, Pune; Symbiosis School of Economics; Techno India; The English and Foreign Languages University, Hyderabad; University of Calcutta; University of Kalyani; University of North Bengal; Vellore Institute of Technology; Vidyasagar University, Midnapore; VIT University; West Bengal University of Technology, Salt Lake) received four weeks/six weeks/two months/three months/four months and six months Project training in different Units of the Institute, viz., ACMU, AERU, ASU, BIRU, CVPRU, DEAN'S OFFICE, ECSU, ERU, GSU, HGU, LRU, MIU, PAMU, Psychology Research Unit, SOSU and SQC & OR under the guidance of different faculty members of the Institute.

Convocation

The 48th Convocation of the Indian Statistical Institute was held on 10th January, 2014, at 10.00 A.M. It started with The National Anthem by Military Band, followed by a welcome address by Dr. C. Rangarajan, Chairman, Economic Advisory Council to the Prime Minister of India and President, ISI, annual review by Prof. Bimal K. Roy, Director, ISI, and Chairman's Address by Shri A.K. Antony, Union Minister for Defence, Govt. of India & Chairman of ISI Council. Shri Pranab Mukherjee, The President of India, awarded the medals to the recipients and delivered the Convocation Address. Dr. C. Rangarajan, President, ISI awarded the degrees to students and closed the Convocation after a vote of thanks by Prof. Pradipta Bandyopadhyay, Dean of Studies, ISI, and the National Anthem by ISI Club. The list of recipients of various medals and prizes is given below.

Prasanta Chandra Mahalanobis Gold Medal for the most outstanding performance in **M. Stat. (Hons.)** students (2011-2013) was given to:

Subhabrata Sen

ISI Alumni Association **Mrs. M.R. Iyer Memorial Gold Medals** for outstanding performances were given to:

B. Stat. (Hons.): Sourav Sarkar **M. Stat.:** Subhabrata Sen **M. S. (Q.E.):** V. Shiva Kumar

ISI Alumni Association **Rashi Ray Memorial Medals** for outstanding performance in **M. Tech. (CS)** (2011-2013) was given to:

Bipin Behari Nandi

D. Basu Memorial Gold Medal for outstanding performance in **B. Stat. (Hons.)** (2010-2013) was given to:

Sourav Sarkar

Nikhilesh Bhattacharya Memorial Gold Medal for the best student in **B. Stat. (Hons.)** (2010-2013) was given to:

Sourav Sarkar

Mukul Chaudhuri Memorial Prize for the highest scoring female student in **B. Stat. (Hons.)** second year batch (2011-2012) was given to:

Manjari Das

Mukul Chaudhuri Memorial Prize for the highest scoring female student in **B. Stat. (Hons.)** second year batch (2012-2013) was given to:

Enakshi Saha

Sunity Kumar Pal Gold Medal for the best dissertation in **M. Tech. (CS)** (2010-2012) was given to:

Monami Banerjee

Sunity Kumar Pal Gold Medal for the best dissertation in **M. Tech. (CS)** (2011-2013) was given to:

Sayan Bandyopadhyay

Sabyasachi Roy Memorial Gold Medal for the best project work in second year of **M. Stat.** (2010-2012) was given to:

Abhik Ghosh

Raja Rao Memorial Prize for the best research work done in India in Demography in **Survey Methodology/Econometrics/Demography and related topics** (2013-2014) was given to:

Dr. Nandita Saikia

TCS award for the best dissertation in **M. Tech. (CS)** (2011-2013) was given to:

Bipin Behari Nandi Soumajit Pramanik

Table – 1

**Number of students who passed during 2013 and
number of existing students/fellows during 2013-2014**

Sl. No.	Courses	Number of students who passed the Annual Examination	
		In 2013	During the year 2013-14
01.	B.Stat. (Hons.) 1 st year 2 nd year 3 rd year	20 25 26	25 20 29*
02.	B.Math. (Hons.) 1 st year 2 nd year 3 rd year	18 22 23	12 18 24**
03.	M.Math. 1 st year 2 nd year	06 01	19** 06
04.	M.Stat. 1 st year 2 nd year	52****=(31+21) 73****=(66+7)	46****=(26+13+7) 60***
05.	M.Stat. (Applications) 1 st year 2 nd year	07 03	- Shifted to Kolkata-MII
06.	M.S.(QE) 1 st year 2 nd year	34****= (13+21) 23****=(12+11)	30**** = (09+21) 35**** = (14***+21)
07.	M.Tech. (CS) 1 st year 2 nd year	15 22	25 15
08.	M.Tech. (QROR) 1 st year 2 nd year	14 09	17 14
09.	M.S. (Library and Information Science) 1 st year 2 nd year	05 04	10 05
10.	Post-Graduate Diploma in Statistical Methods with Applications (DST) 1 st year	05	-
11.	Post-Graduate Diploma in Statistical Methods and Analytics 1 st year	-	03
12.	Junior & Senior Research Fellows in different disciplines	11	203
Grand Total		418	616

* Four students repeating a year

** Two students repeating a year

*** One student repeating a year

**** Total number including Kolkata and Delhi

***** Total number including Kolkata, Delhi and Chennai

Table 2

Ph. D degree awarded by the Institute in the 48th Convocation held on 10.01.2014

Sl. No.	Name of the Fellow	Title of the Thesis	Subject	University / Institute	Name of the Supervisor(s)
1.	Md. Jiaul Hoque Paik, Master in Computer Application (Jadavpur University)	Automatic Language Independent Stemming for Information Retrieval.	Computer Science	ISI	Prof. Swapan Kr. Parui, CVPRU, ISI, Kolkata
2.	Minati De M. Tech. (Computer Science) (Indian Statistical Institute)	Space-efficient algorithms for geometric optimization problems.	Computer Science	ISI	Prof. Subhas C. Nandy, ACMU, ISI, Kolkata
3.	Aritra Banik, M. Tech. (Computer Science) (Indian Statistical Institute)	Voronoi Game and Its Variants	Computer Science	ISI	Prof. Sandip Das, ACMU, ISI, Kolkata
4.	Sourav Sen Gupta, Master of Mathematics (University of Waterloo, Canada)	Analysis and Implementation of RC4 Stream Cipher	Computer Science	ISI	Prof. Subhamoy Maitra, ASU, ISI, Kolkata
5.	Farkhondeh Alsadat Sajadi, M. Sc. (Statistics) (Isfahan University of Technology, Iran)	Three Stochastic Models on Discrete Structures.	Statistics	ISI	Dr. Antar Bandyopadhyay, SMU, ISI, Delhi
6.	Subhajit Dutta, M. Sc. (Statistics) (IIT, Kanpur)	Some Contributions to Discriminate Analysis Using Different Notions of Data Depth.	Statistics	ISI	Prof. Probal Chaudhuri, SMU, ISI, Kolkata
7.	Palash Ghosh, M. Sc. (Statistics) (Indian Institute of Technology Kanpur)	Analysis of Spontaneous Adverse Drug Reaction (ADR) Reports in Presence of Reporting Bias.	Statistics	ISI	Prof. Anup Dewanji, ASU, ISI, Kolkata
8.	Ghurumuruhan Ganesan, M. Sc. (Electrical and Computer Engineering) (Georgia Institute of Technology, Atlanta)	Infection Spread and Stability in Random Graphs.	Mathematics	ISI	Prof. Rahul Roy, SMU, ISI, Delhi

9.	Jayanarayanan C. R. M. Sc.(Mathematics) (University of Calicut, Kerala)	Proximality Properties of Subspaces and Intersection Properties of Balls in Banach Spaces.	Mathematics	ISI	Prof. T.S.S.R.K. Rao, SMU, ISI, Bangalore
10.	Trishita Ray Barman, M. A. (Economics) (University of Hyderabad)	Public Expenditure, Environmental Pollution and Endogenous Economic Growth.	Quantitative Economics	ISI	Prof. Manas Ranjan Gupta, ERU, ISI, Kolkata
11.	Debdatta Saha, M. Sc. (Economics) (University of London)	Essays on Network Industries: Markets, Committees, Information Revelation and Standardization.	Quantitative Economics	ISI	Prof. Prabal Roy Chowdhury, Eco. and PU, ISI, Delhi

Table 3

Research Fellows who have been awarded Ph. D degree by Academic Bodies other than ISI during 2013 for work done in the ISI

Sl. No.	Name of the Fellow	Title of the Thesis	University	Name of the Supervisor (s)
1.	Shalini Datta	Some contributions to the molecular genetics of persistent unconjugated hyperbilirubinemia.	University of Calcutta	Prof. P.P. Majumder, HGU, ISI, Kolkata
2.	Sayantana Datta	Studies on the role of mitochondrial and mitochondria associated nuclear gene variations in oral cancer and precancer.	Jadavpur University	Prof. Bidyut Roy, HGU, ISI, Kolkata
3.	Anindya Halder	Ant Colony Approach for Certain Tasks of Pattern Recognition.	Jadavpur University	Prof. Ashish Ghosh, CSCR, ISI, Kolkata and Dr. Susmita Ghosh, Dept. of Comp. Sc. & Eng., Jadavpur University
4.	Sneha Tripathi	Development of Algorithms for Indexing and Searching in Unicode: A Study with Hindi Language.	University of Kalyani	Prof. Juran Krishna Sarkhel, Dept. of Lib. & Inf. Sc., University of Kalyani and Dr. Devika P. Madalli, DRTC, ISI, Bangalore

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5.	Rajesh Kumar	An Image Processing and Pattern Recognition Framework for Forensic Document Fraud Analysis.	Dr. Hari Singh Gour Central University	Prof. Bhabatosh Chanda, ECSU, ISI, Kolkata
6.	Sampreeti Ghosh	Mining gene expression data using domain knowledge.	Jadavpur University	Prof. Sushmita Mitra, MIU, ISI, Kolkata
7.	Shilpi Dasgupta	Identification of susceptibility genes associated with polycystic ovary syndrome among Indian women.	Andhra University	Prof. B.M. Reddy, BAU, ISI, Hyderabad
8.	Bikashkali Midya	A Study of some solvable quantum mechanical models and their symmetries.	University of Calcutta	Prof. Barnana Roy, PAMU, ISI, Kolkata
9.	Debaprayag Chaudhuri	Study of Some Implementation Issues of TQM in Higher Education & Other Service Sectors and Gap Analysis with Lean Management.	Jadavpur University	Dr. Arup Ranjan Mukhopadhyay, SQC&OR, ISI, Kolkata and Prof. Sadhan Kumar Ghosh, Mechanical Eng. Dept., JU
10.	Rina Chakravorty	Multi-response optimization of multi-characteristic.	Jadavpur University	Dr. Susanta Kumar Gauri, SQC&OR, ISI, Kolkata and Dr. Shankar Chakraborty, Dept. Production Eng., Jadavpur University, Kolkata
11.	Sanjit Roy	Identifying Critical Success factors and Effectiveness Measurement System of Six Sigma Initiatives in Business Processes.	Bengal Engineering & Science University	Dr. Prasun Das, SQC&OR, ISI, Kolkata and Dr. Bidyut Kr. Bhattacharya, School of Occupational Health & Safety Engg., Bengal Eng. & Sc. University, Shibpur
12.	Rabindranath Ghosh	Energy and Bandwidth Issues in Wireless Communication Networks.	Jadavpur University	Prof. Bhabani P. Sinha, ACMU, ISI, Kolkata and Dr. Rana Duttagupta, Dept. of CSE., Jadavpur University
13.	Anwesa Bag	Chemical and Microbiological Analysis of Extracts of <i>Terminalia Chebula</i> Retz. Fruit Against Multidrug-Resistant Uropathogens with Special Emphasis on <i>Escherichia Coli</i> .	Jadavpur University	Dr. Rabi Ranjan Chattopadhyay, AERU, ISI, Kolkata

**Number of candidates who were awarded degrees/ associatiships in the
48th Convocation of the Institute held on 10th January, 2014**

Degree /Diploma	Number of candidates
Doctor of Philosophy (Ph.D.)	11
Master of Technology (M. Tech.) in Computer Science	22
Master of Technology (M. Tech.) in Quality, Reliability and Operations Research	09
Master of Statistics (M. Stat.)	76
Master of Mathematics (M. Math.)	01
Master of Science (M.S.) in Quantitative Economics	23
Master of Science (M.S.) in Library and Information Science	04
Bachelor of Statistics (Honours) [B.Stat. (Hons.)]	26
Bachelor of Mathematics (Honours) [B.Math. (Hons.)]	23
Post-Graduate Diploma in Statistical Methods with Applications	05
Total	200

**International Statistical Education Centre (ISEC)
Annual Report 2013-2014**

The International Statistical Education Centre (ISEC) was founded in 1950 at the initiative of Professor P.C. Mahalanobis. The Centre opened at Kolkata through an agreement between the International Statistical Institute and the Indian Statistical Institute (ISI). At present, the Indian Statistical Institute, under the auspices of the Government of India, runs the Centre. The Centre functions under a joint Board of Directors. In its history of more than 60 years, the Board of Directors of ISEC has had only two chairmen. Professor P.C. Mahalanobis was the Chairman since the inception of the Centre in 1950 until his death in 1972. Since then, Professor C.R. Rao has been the Chairman of the Board.

The Centre aims to provide training in theoretical and applied statistics at various levels to selected participants from countries of the Middle East, South and South-East Asia, the Far East and the commonwealth countries of Africa. The primary training programme is a 10-month regular course in Statistics leading to a Statistical Training Diploma. In addition, special course on different topics of varying duration are also organized.

The commencement date of the 67th Term ISEC Regular Course (2013-2014) was August 1, 2013. There were 24 trainees from 13 different countries, namely (1) Sri Lanka, (2) Gambia, (3) Mongolia, (4) Namibia, (5) Bangladesh, (6) Bhutan, (7) Ethiopia, (8) Ghana, (9) Mali, (10) Uzbekistan, (11) Niger, (12) Tanzania and (13) Papua New Guinea. Twenty trainees were supported by fellowships of the ITEC/SCAAP/TCS-Colombo Plan of Government of India. The Central Bank of Sri Lanka sponsored four trainees. They will be awarded Statistical Training Diploma in the Convocation, scheduled to be held in end of May, 2014. Earlier, the convocation for the 66th Term of ISEC Regular Course was held at the Geology Auditorium of ISI on May 30, 2013. The Chief Guest was Professor B.L.S. Prakasa Rao, Ramanujan Chair Professor, CR RAO Advanced Institute of Mathematics, Statistics & Computer Science, University of Hyderabad Campus and ex-Director of ISI. Eight trainees from Gambia, Georgia, Sri Lanka and Uzbekistan and three trainees from Cambodia received either the Diploma or the Certificate.

The trainees are provided with computer facilities and Internet connections in the ISEC PC room and in the ISEC hostel. They have access to the books at the ISI library. Teachers at the headquarter of the Indian Statistical Institute and statistical officers of the Government of India are participating in teaching the Regular Course during this year. Till now, nearly 1555 trainees from about 75 countries have received the Statistical Training Diploma.

The new building with modern amenities for ISEC at the 202 B.T. Road campus of the Institute is ready for inauguration in 2014. Professor Bimal Kumar Roy, Director, ISI, has taken special interest in enhancing the international image of the ISEC courses.

2. RESEARCH AND OTHER SCIENTIFIC ACTIVITIES

The major thrust of the Institute is on research in various disciplines comprising Theoretical and Applied Statistics, Mathematics, Computer Sciences, Biological Sciences, Economics and other Social Sciences, Physics and Earth Sciences, Statistical Quality Control and Operations Research, and Library and Information Sciences. Scientists of the Institute carry out independent research in their own basic discipline and also undertake interdisciplinary research in collaboration with other units within the Institute and also with outside organizations. The Institute also takes up various internally and externally funded projects in diverse fields on challenging live problems of national and international importance. As a part of research activities, scientists of the Institute are involved in consultancy work as well. This section gives a brief account of the principal areas of work over the past year of the scientific divisions of the Institute, namely, the Divisions of:

Theoretical Statistics and Mathematics

Applied Statistics

Computer and Communication Sciences

Physics and Earth Sciences

Biological Sciences

Social Sciences

Statistical Quality Control and Operations Research

Library, Documentation and Information Sciences

In addition, there are reports from the 'Center for Soft Computing Research: A National Facility,' the 'Computer and Statistical Services Centre' and the newly formed 'R.C. Bose Centre for Cryptology and Security'.

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Research in Commutative Algebra

It has been established that the Zariski Cancellation Conjecture does not Hold for the affine n -space in positive characteristic, for any $n > 2$.

Neena Gupta

Investigations on affine threefolds of the form $x^m y = F(x, z, t)$ have been made when $m > 1$ and necessary and sufficient conditions have been discovered for such hypersurfaces to be isomorphic to the affine three space. The main theorem proves the equivalence of ten conditions which reveal precise connections between lines in the plane, affine fibrations, the epimorphism and the cancellation problems and certain invariants of G -actions. The result thus brings under a common general framework several apparently different-looking questions which had been of long interest to mathematicians. One of the criteria for the triviality of threefolds belonging to the above family provides a simple explanation for the non-triviality of the Russell-Koras threefold as also the non-triviality of an Asanuma threefold (established earlier by Makar-Limanov and Neena Gupta respectively). Another

Research Activities

consequence of these results is a partial extension of the Sathaye-Russell theorem on linear planes in 3-space to linear hypersurfaces in 4-space, thereby confirming a special case of the Embedding Conjecture of Abhyankar-Sathaye in arbitrary characteristic.

Neena Gupta

It has been shown that the polynomial ring $k[X, Y]$ is cancellative over any (not necessarily perfect) field k . Earlier, this result had been established over perfect fields.

S.M. Bhatwadekar and Neena Gupta

Studies have been made on the Vaserstein symbol which describes an elementary symplectic Witt group structure on the orbit space of unimodular rows of length three modulo elementary action. An uncountably infinite family of non-isomorphic three-dimensional affine algebras over the field of real numbers have been constructed for which the Vaserstein symbol is not injective.

D.R. Rao and Neena Gupta

Described the structure of faithfully flat algebras over Noetherian normal domains whose generic and codimension one fibres are punctured lines. Obtained minimal sufficient conditions for such an algebra to be finitely generated.

Neena Gupta

A G_a -action of rank three has been constructed on the affine four-space over the field of complex numbers for which the Grothendieck group of the ring of invariants is infinitely generated, thereby providing an infinite family of non-isomorphic projective modules which are counterexamples to a question of Miyanishi. It has also been shown that the ring of invariants of any rank three G_a -action on the affine four-space over any field of characteristic zero is regular if and only if the ring of invariants is a polynomial ring.

S.M. Bhatwadekar, Neena Gupta and Swapnil Lokhande

The problem of embedding of quadratic planes in the affine three space is being investigated

S.M. Bhatwadekar and Neena Gupta

The concept of residual variable W in an affine fibration A over a Noetherian domain R has been investigated. One of the results show that the R -algebra A is stably polynomial over $R[W]$ if and only if the module of differentials of A over R is stably free.

Prosenjit Das and Amartya K. Dutta

Research in Statistics

Non-parametric statistics, Rates of convergence in Central Limit Theorem (CLT), Law of iterated logarithms (LIL) and Characterization theorems. Growth curve model, Applications of Statistics to Industrial quality control, Physics, Sociology, Agriculture, Education and other natural sciences.

R. Dasgupta

Research in Probability Theory

Preparing a book on Measure Theory.

Sreela Gangopadhyay and T.K.Chanda (BIRU)

Information economics. Spectral inference. Spectral properties of large dimensional random matrices, free probability.

Arup Bose

Research in Topology

Deformation theory of Algebras over quadratic operads have been studied.

Alice Fialowski, Anita Naolekar and Goutam Mukherjee

Lie algebroids, Fillipov algebroids are being studied.

Apurba Das, S. Gondhali and Goutam Mukherjee

Stat-Math Unit, Delhi

Research in Statistics

Techniques for improved variance estimation and prediction in finite populations have been studied. The proposed methods rely on using a sparse estimator of the regression parameter to select the relevant predictors. The techniques are applicable in situations where a large number of predictors are used in survey.

S. Adhya and Arindam Chatterjee.

Distance matrices associate with graphs

Work on distance matrices of graphs was continued. Some properties of the distance matrix of a tree were extended to graphs in which each block is a complete graph. The case of a weighted tree was considered where each weight is a matrix. Formulae for the determinant and the inverse were obtained in this case.

R.B. Bapat

Development of penalized empirical likelihood based techniques for high dimensional estimating equations using the L_1 penalty. This method uses the penalization on the dual representation of the empirical likelihood criterion and such a technique has been developed for the first time. Applications are in the fields of econometrics and high-dimensional data analysis.

P. Bertai and Arindam Chatterjee

Multilinear Algebra

Derivatives of tensor powers and their norms were computed. The work on higher order derivatives supplements the work on the first derivative begun in the 1980's.

Rajendra Bhatia

Inertia problems

Inertias of some matrices that have been important in different contexts were computed.

Rajendra Bhatia

Approximation problems

Study of approximation theory in the Riemannian manifold of positive definite matrices was initiated. Best approximants from some sets were characterised.

Rajendra Bhatia

Trace inequalities

New inequalities for traces of products on positive definite matrices, of interest in mathematical physics, were obtained.

Rajendra Bhatia

A work on understanding the limiting spectral distributions of symmetric random matrices with entries from a stationary Gaussian process was concluded. It turned out that the properties of the spectral

Research Activities

measure that generates the Gaussian process determines the nature of the limiting spectral distribution. Arijit Chakrabarty, Deepayan Sarkar (from SMU) and Rajat Subhra Hazra (from University of Zurich) were involved in the research.

Arijit Chakrabarty, Deepayan Sarkar and Rajat Subhra Hazra

Inertia of some special matrices: Some matrices important in theory of operator functions and numerical analysis display an interesting spectral behaviour. The spectra, especially, inertia of such matrices were studied. The study is still in progress.

Tanvi Jain and Rajendra Bhatia

Approximation problems in the Riemannian metric on positive definite matrices: There has been considerable work on matrix approximation problems in the space of matrices with Euclidean and unitarily invariant norms. The study of approximation problems in the space of positive definite matrices with Riemannian metric and other Finsler metrics was initiated. In particular, these approximation problems were reduced to the corresponding problems in the space of Hermitian matrices and in Euclidean spaces.

Tanvi Jain and Rajendra Bhatia

Geometric mean of exponentials of Pauli matrices

The geometric mean, especially the Riemannian mean has been of much interest in operator theory. It is relevant in various areas like diffusion tensor imaging, radar signal processing, elasticity and statistics of manifolds. An explicit formula for the Riemannian mean of two matrices has been long known. But there has been no formula for more than two matrices even for simple cases. An explicit formula for the Riemannian mean of the exponentials of the famous triple of Pauli matrices has been computed.

Tanvi Jain and Rajendra Bhatia

Work has been done on the detection of unknown periodicity in a continuous time periodic stationary process sampled at random time points. This work involves the development of novel techniques based on applications of the DFT in randomly sampled continuous time processes.

Subba S. Rao and Arindam Chatterjee

Work on (1) Rank of random matrices, (2) Random directed trees and the Brownian web continued.

Rahul Roy

Worked on the irreducibility of polynomials, particularly Hermite-Laguerre polynomials and interesting results generalising an earlier result of Schur. Worked on perfect powers and products of terms of recurrence sequences.

Shanta Laishram

Worked on exponential diophantine equations involving products of terms of Pell's and Pell-Lucas sequences with J. Bravo and S. Guzman of UNAM, Morelia and P. Das, Research Scholar at ISI Delhi. Proved explicit results on the perfect powers involving products of terms of recurrence sequences.

J. Bravo and S. Guzman, P. Das and Shanta Laishram

Joint Delay and Frequency Estimation

The problem of estimation of delay time between signals at two spatially separated sensors and the estimation of the other sinusoidal parameters are addressed. The least (norm) squares estimators are proposed and the strong consistency of the proposed estimators is proved and the asymptotic normality is obtained.

Swagata Nandi

Modified Newton-Raphson Algorithm for Fundamental Frequency Model

The problem of estimation of fundamental frequency in fundamental frequency model is being considered. The approximate generalised least squares estimator is obtained using a modified Newton-Raphson Algorithm. The theoretical properties of the estimator is studied.

Swagata Nandi

Research on Probability, random graphs, random directed trees, the Brownian web and extreme value theory has been continued.

Anish Sarkar

Proved results on some diophantine involving Fibonacci sequence which is being published in Fibonacci Q. With T. N. Shorey of IIT Mumbai, proved explicit results on the irreducibility of Hermite-Laguerre polynomials extending earlier results for arithmetic progressions.

F. Luca, Morelia and Shanta Laishram

Proved results on irreducibility of generalized Hermite polynomials, thereby a generalizing a result of Schur.

S. Nair, T.N. Shorey and Shanta Laishram

Work on computational biology and statistical graphics has been continued.

Deepayan Sarkar

Work on identifying orthogonal Latin hypercubes yielded some new designs.

Aloke Dey and Deepayan Sarkar

Research on semiparametric density estimation is ongoing.

Deepayan Sarkar and Kaustav Nandy

Statistical Inference based on quantiles

Techniques have been developed for nonparametric estimation of the quantile density function. Tests based on kernel type estimators for equality hazard quantile function have been developed.

Isha Dewan, Pooja Soni and Kanchan Jain

Residual life time at random time have been studied. Stochastic Orderings of Residual life time at two different random times have been studied.

Isha Dewan and Baha Khaleidi

Tests for exponentiality vs NBUE alternative have been developed.

Isha Dewan and Sudheesh Kumar Kattumannil

Cohomological Invariants of algebraic groups

With my student Miss Neha Hooda, we investigated the behaviour of certain cohomological invariants for exceptional groups of types G_2 and F_4 with respect to embedding of subgroups of type A_2 and certain rank-2 tori. The significance of these results stems from a well known conjecture of J. P. Serre that the invariants mod-2 of groups of type F_4 are somehow related to the mod-3 invariants of such groups. These result provide some positive evidence.

Neha Hooda and Maneesh Thakur

Reality properties for groups of type F_4

We investigated the reality properties of groups of type F_4 arising from Albert division algebras. It was proved that such groups have no non-trivial k -real elements, where k is the base field over which the

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Albert algebra is defined. It was also shown that if $G=Aut(J)$ for a reduced Albert algebra and -1 is a square in the base field then every real element is strongly real in a form of E_6 containing G .

Anirban Bose and Maneesh Thakur

Kneser-Tits conjecture

Continued our work on Kneser-Tits problem for groups of type E_8 which arise from Albert division algebras and have shown that $G=Aut(A)$ is R-trivial for any cyclic Albert algebra A .

Maneesh Thakur

Stat-Math Unit, Bangalore

Nilpotent completely positive maps

We study the structure of nilpotent completely positive maps in terms of Choi-Kraus coefficients. We prove several inequalities, including certain majorization type inequalities for dimensions of kernels of powers of nilpotent completely positive maps. This has been accepted by the Journal 'Positivity'.

B.V. Rajarama Bhat and Nirupama Mallick

Isometry semigroups on Hilbert C^* -modules

A structure theorem is proved for pure isometry semigroups on Hilbert C^* -modules.

B.V. Rajarama Bhat and M. Skeide

Quantum Sub-Markov semigroups

Dilation theory of a class of quantum sub-Markov semigroups is studied.

B.V. Rajarama Bhat and S. Wills

Absorbing quantum Markov semigroups

Quantum Markov semigroups which get absorbed to pure and mixed states are looked at. It is shown that absorption to mixed states is not possible in finite dimensions. We are trying to decipher the situation for infinite dimensions. This is a joint work with R. Hillieri.

B.V. Rajarama Bhat

Function Theory

Research work completed on Function theory and holomorphic maps on symmetric products of planar domains.

Polynomial Convexity

Research work is going on in polynomial convexity of the geometric configurations such as: finite union of maximal totally-real subspaces in C^n and graphs of certain class of cubics in C^2 .

Sushil Gorai

Liouville property

Liouville property for group actions were considered and many interesting results were proved.

Expansive automorphisms

Totally disconnected locally compact groups admitting expansive automorphisms are investigated. This was through a DAAD project.

C.R.E. Raja

Reflected processes

In view of the nice optimality properties of Skorokhod problem in an orthant, multidimensional insurance set up can be modelled in terms of reflected processes. Ongoing investigations of such models and their asymptotic properties were continued.

S. Ramasubramanian

Geometry of Banach spaces

Work continued in Geometry of Banach spaces. An old theorem of Shintani and Ando on proximality of space of integrable functions w. r. t sub-sigma algebras was extended to spaces of Bochner integrable functions with values in a L-embedded space.

T.S.S.R.K. Rao

Quotient modules

A complete characterization of quotient modules in terms of elementary tensor products of one variable quotient modules has been obtained. Related studies concerning submodules and quotient modules of reproducing kernel Hilbert module in the polydisc set up have been established.

Beurling-Lax-Halmos theorem

A generalization of classical Beurling-Lax-Halmos theorem, for commuting row contractions, has been established and some related results have been obtained in the unit ball set up.

Invariant subspaces

Doubly commutativity of invariant subspaces of the Bergman space and the Dirichlet space over the unit polydisc have been investigated.

Contractive tuples

Maximality of a contractive tuple of operators has been considered. A characterization for a contractive tuple to be maximal has been obtained.

Wold decomposition

A several variables analogue of the Wold decomposition for isometries on Hilbert spaces has been obtained for the class of doubly commuting isometries.

Jaydeb Sarkar

Ovoids in polar spaces

The existence and the distribution of ovoids in polar spaces, particularly in finite orthogonal space $O(4, q)$ and $O(5, q)$ were studied. Work is continued on the study of polarities of the geometries of type E_6 and maximal subgroups of the group $E_6(k)$, where k is a finite or all algebraically closed field.

N.S. Narasimha Sastry

K-theory of quadratic modules and Group Theory

A study of Roy's elementary orthogonal group was carried out.

B. Sury and A.A. Ambily

Studied the total character of finite groups.

B. Sury and Sunil Prajapati

Research Activities

Made progress towards the Fueter-Polya conjecture.

B. Sury, R. Balasubramanian and M. Ram Murty

Studied class groups of cyclic extensions of prime degree over cyclotomic extensions.

B. Sury, M. Kulkarni and D. Majumdar

Stat-Math Unit, Chennai

Univalence Criterion

We have considered recent univalence criteria of Pascu and Pascu and studied certain analogue results for sense-preserving harmonic mappings in the unit disk (centered at the origin). As a corollary to this result, we have derived a coefficient condition for a sense-preserving harmonic mapping to be univalent in the unit disk.

S.V. Bharanedhar and S. Ponnusamy

Isoperimetric type and Fejer-Riesz type inequalities

We have investigated the isoperimetric type and Fejer-Riesz type inequalities for pluriharmonic mappings. In particular, we have improved the main result of Kalaj and Meštrović, and generalized it to pluriharmonic mappings. Secondly, we extended the main result of Pavlović and Dostanić to pluriharmonic mappings.

Sh. Chen, S. Ponnusamy and X. Wang

Lipschitz-type spaces on planar harmonic mappings

We have investigated coefficient estimates and Landau's Theorem for some classes of locally univalent harmonic mappings, and then we studied some Lipschitz-type spaces for locally univalent and multivalent harmonic mappings.

Sh. Chen, S. Ponnusamy and A. Rasila

Harmonic shears of slit and polygonal mappings

In this paper, we study harmonic mappings by using the shear construction, introduced by Clunie and Sheil-Small in 1984. We consider two classes of conformal mappings, each of which maps the unit disk univalently onto a domain which is convex in the horizontal direction, and shear these mappings with suitable second complex dilatations. Mappings of the first class map the unit disk onto four-slit domains and mappings of the second class take the unit disk onto regular n -gons. In addition, we discuss the minimal surfaces associated with such harmonic mappings. Furthermore, illustrations of mappings and associated minimal surfaces are given by using MATHEMATICA.

S. Ponnusamy, T. Quach and A. Rasila

Partial sums of functions in the close-to-convex family

We consider a class of all normalized analytic functions that are locally univalent in the unit disk and geometrically each of these functions has its range convex in some direction. This class plays a crucial role in the discussion on certain extremal problems for the class of complex-valued and sense preserving harmonic convex functions and some other related problems in determining univalence criteria for sense-preserving harmonic mappings. In this article, we show that every section of a function in the class takes the disk $|z| < 1/6$ onto a convex domain and the radius $1/6$ is best possible. We conjecture that every section of functions in the family is univalent maps the disk $|z| < 1/3$ onto a close-to-convex domain, i.e. its complement with respect to the whole complex plane is the union of closed half lines with pairwise disjoint interiors.

S. Ponnusamy, S.K. Sahoo and H. Yanagihara

Harmonic close-to-convex functions

In this paper, we derive sufficient conditions for a sense-preserving complex valued harmonic function on the open unit disk to be close-to-convex. We describe certain cases in which the corresponding function is lifted to a minimal surface expressed by an isothermal parameter. Explicit representation for classes of minimal surfaces is given. Graphs generated by using Mathematica are used for illustration.

S. Ponnusamy, A. Sairam Kaliraj and A. Rasila

Coefficient criteria for univalent functions

In this paper, we provide sufficient conditions for constructing univalent analytic functions in the unit disk and motivate the results through several examples and present an interesting theorem involving Gaussian hypergeometric function.

S.V. Bharanedhar, M. Obradovic and S. Ponnusamy

Lipschitz spaces and Hardy spaces

In this paper, we investigate the properties on some classes of complex valued functions which satisfy certain elliptic partial differential equations. First, we discuss the Lipschitz-type spaces and Hardy spaces on these functions, and then we show that for a class of complex-valued functions, if it admits some bounded Dirichlet-type energy integral, then it has a harmonic majorant in the unit disk.

Sh. Chen and S. Ponnusamy

Covering and distortion theorems harmonic mappings

In this paper, we investigate Clunie and Sheil-Small's covering theorems for sense-preserving planar harmonic univalent mappings defined in the unit disk. Our results significantly improve the earlier known result. Also, we obtain a distortion theorem for fully starlike harmonic mappings in the unit disk.

Sh. Chen, S. Ponnusamy and X. Wang

Yamashita's conjecture area integral

In this paper, we prove a more general version of Yamashita conjecture (1990) on the area of the image of the sub-disk of the unit disk under conformal maps. As a consequence, Yamashita's conjecture (when the range is convex) is shown to be true.

M. Obradovic, S. Ponnusamy and K.-J. Wirths

Applied Statistics Division

The Applied Statistics Division came into being in September 1996 in place of the Applied Statistics, Surveys and Computing Division. The Computer Science Unit was renamed as the Applied Statistics Unit and the Biometry Unit was transferred to the Biological Sciences Division. Till 2005-2006, the Applied Statistics Division consisted solely of the Applied Statistics Unit. During the years 2006-2007, 2011-2012 and 2012-2013, three new units viz. Bayesian and Interdisciplinary Research Unit, Sampling and Official Statistics Unit and Applied and Official Statistics Unit were created within this Division, the last being part of the Tezpur Centre of the Institute. However, the Sampling and Official Statistics Unit moved to Social Sciences Division in 2012-2013 and Applied Statistic Unit, Chennai came into being during the same year. The following are the research and other activities of the Applied Statistics Division during the year.

Applied Statistics Unit, Kolkata

Scientists of the Applied Statistics Unit (ASU) are involved in various teaching, training, research and development activities. This unit regularly conducts teaching/training programmes like North East Workshops, winter/summer schools, workshops and Probationers' Training for Indian Statistical Service Trainees. The members of the faculty conduct research in various areas of statistics, mathematics and computer science, including cryptology with special emphasis on applications. Some members collaborate with other units of ISI on joint projects and also with scientists from other Universities/Institutes. Currently, there are collaborative on-going projects with the Theoretical Statistics and Mathematics Division, Computer and Communication Sciences Division, SQC & OR Division, and the Biological Sciences Division. Presently, the Unit has 16 faculty members.

Sample Surveys for Estimating Stigmatizing Characteristics

For estimating the proportion in a community of people bearing a stigmatizing characteristic, a novel approach in which an RRT (randomized response technique) is employed by repeating trials till a specified 'success' is encountered for the first time, has been found to be effective. Appropriate procedures have been developed with this approach.

Kajal Dihidar, Purnima Shaw and Arijit Chaudhuri

Theory of Sample Surveys

The protection of privacy of a respondent to sensitive quantitative questions has been examined applying a Bayesian approach. As a by-product an empirical Bayes estimate for the mean number of people with sensitive features has been developed. Though a simple correlation coefficient may be easily estimated drawing varying probability samples, it is observed that the method does not extend to cover Spearman's rank correlation coefficients but does so for estimating Kendall's Tau. The issue of respondent privacy protection in randomized response surveys is studied when the variable under study is a discrete quantitative variable and the objective is to estimate the population mean. Measures of privacy protection are proposed and a scheme is suggested so that the efficiency of estimation can be maximized while guaranteeing a desired level of privacy protection.

Arijit Chaudhuri and Mausumi Bose

Design of Experiments, Combinatorial Methods and their Applications

Research on optimal response-adaptive designs has been carried out under different types of constraints. The role of orthogonal arrays and related combinatorial structures has been explored to construct partially cover-free families of sets with a view to constructing union distinct families. The approximate design theory is being used to study optimal design measures. An equal probability scheme has been proposed for shared key operations and it has been shown to have improved anonymity measures for groups and also for individual participants, over the existing schemes. The problem of optimal allocation of units, with given prognostic variates or covariates, between two treatments has been studied. This work is being generalized for more than two treatments and the method is being extended to solve the Travelling Salesman Problem (TSP). Optimal compound designs in the context of dose-response studies of phase II clinical trials are under study. Some problems related to model selection and parameter estimation for a class of competing models are being investigated. Some design issues related to optimal hybrid censoring plan have been looked at. Similar problem for choosing an optimal progressive censoring plan is being considered.

Mausumi Bose, Anup Dewanji and Atanu Biswas

Signal Processing

A minimum separation between successive samples is a practical constraint that often comes in the way of sampling of a continuous-time stationary stochastic process for the purpose of spectrum estimation. It is known from a recent study that additive random sampling subject to the said constraint

can be alias-free for bandlimited spectra with any specified support, but known estimation approaches do not work. A new spectrum estimator for this purpose has been proposed and it has been shown to estimate accurately and precisely any power spectral density limited to an arbitrarily large but known support.

Debasis Sengupta

Financial Statistics

Models for high volatility financial data and related inference were further studied.

Ashis SenGupta

Statistical Inference

Intersection-Union tests and their relation to P^3 tests in mixture models have been studied. Bayesian methods for growth curve analysis and for change-point problems are being enhanced. Research on certain foundational principles of inference is being carried out, with an attempt to extension in infinite dimensional problems.

Ashis SenGupta and Debapriya Sengupta

Categorical Data Analysis

A detailed study in the context of a general model for longitudinal categorical data is going on.

Atanu Biswas

Time series

Modeling, analysis and coherent forecasting are being done for discrete-valued time series data. In particular both categorical and count data are considered. Zero-inflated count data has also been considered for this purpose. Some Bayesian methods are under investigation.

Atanu Biswas

Directional Data Analysis

New models and inference methods were developed for observations on hyperdiscs and on smooth manifolds with applications to geo-informatics. Inference procedures were also developed for homogeneity of location (scale) parameters of circular distributions in the presence of orthogonal nuisance parameters. Multivariate circular distributions were presented with applications to phase differences in gene data. Some test procedures for circular data were carried out in the context of cataract surgery data. Also modeling and analysis of multivariate circular data in the context of some galaxy data are under study. Some inferential and design issues are being addressed for a two-treatment clinical trial set up where the responses are circular data. The methodologies are derived with reference to an eye-related data set.

Ashis SenGupta and Atanu Biswas

Cryptology

Areas in cryptology on which research has been carried out include theoretical aspects of hash functions, study of weak keys for RSA, correlation and biases in RC4, Boolean functions, key pre-distribution and detection in sensor networks, broadcast encryption and modes of operations of a block cipher. S-boxes having large number of linearly independent multivariate bi-affine or quadratic equations may be susceptible to certain kind of algebraic attack. Techniques have been developed to find maximal set of linearly independent, bi-affine and quadratic equations for S-boxes based on power mappings. Two algorithms (having time-complexity $O(N^6)$) for calculating the bi-affine and quadratic equations for any (n,n) S-box based on power mapping have been presented. Cryptographically significant maximum distance separable (MDS) matrices have large applications in coding theory,

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design of block ciphers and hash functions. It is highly nontrivial to find MDS matrices which could be used efficiently in lightweight cryptography. Methods for more generic construction of such matrices have been proposed. A simple algorithm was also provided to check if a given matrix is MDS. Sajadieh et. al. (2012) had provably constructed involutory MDS matrices which were also Hadamard in a finite field by using two Vandermonde matrices. We showed that the same matrices can be constructed by using Cauchy matrices and provided a much simpler proof of their constructions. Further, it was established that the 16×16 involutory MDS matrix over F_{2^8} proposed Nakahara et. al. (2006), that was claimed to be an MDS matrix, is not so.

Bimal K. Roy, Palash Sarkar, Subhamoy Maitra, Kishan C. Gupta and Mridul Nandi

Clinical Trials

Response-adaptive designs were carried out in clinical trials to allocate a larger number of patients to the better treatment, resulting in ethical gain. Some works related to several response-adaptive designs in different set up were carried out. In particular, a study to obtain optimal target allocation is going on. Comparison of treatments in a clinical trial set-up was done in the presence of surrogate responses, with the objective of using the surrogate responses efficiently to enhance the quality of associated inference. Inference on treatment difference in clinical trials was studied in the presence of surrogate responses when not all the true responses are available. The existing results were improved upon in the case of binary treatment responses. Distribution of log odds-ratio and comparison of several standard estimation procedures in this context were studied for such surrogate-augmented data. It was observed that the efficient use of surrogate data improves the inference. Asymptotic closeness of Mantel-Haenszel estimator and profile log-likelihood estimator are being studied. The problem of investigating Adverse Drug Reaction (ADR) associated with a specific drug from the post-market spontaneous response database has been studied. Similar analysis with continuous exposure is under way.

Atanu Biswas and Anup Dewanji

Mathematical Genomics

Theoretical foundation of the classification methodology is on the verge of completion and is being applied to protein classification. Also, comparison of 3D protein structures has been conducted using mathematical morphology, with future application to specific proteins. For these studies, three protein families, namely, PpcA-homolog, Mer-homolog and siroheme $[\text{Fe}_4\text{S}_4]$ binding and residues (Sulphite reductase (SR) and Sulphite reductase like proteins (Dsr Lp) are being used. Easy identification and generation of n -variable canalizing Boolean Functions (most suited to biological networks) have been studied with a view to application on cancer gene regulatory networks. Also biological networks are being modelled by Interaction Graphs (for avoiding combinatorial explosion of Boolean networks).

Pabitra Pal Choudhury

Multiple Testing under Dependence

Multiple hypothesis-testing under dependence has been considered. Several testing procedures have been proposed in this context when the usual p-values based on individual tests are dependent. These procedures are shown to have desirable properties in terms of overall misclassification rate and compare favourably with many existing procedures. A useful admissibility result is also proved for one of the proposed procedures.

Prasenjit Ghosh and Arijit Chakrabarti

Multiple Hypothesis-testing based on a General Class of Normal Scale Mixture Prior

(Near) asymptotic optimality of a multiple hypothesis-testing rule based on a general class of normal scale mixture prior is established. This class of priors includes the important global-local scale mixture prior, namely the Horseshoe prior. An open conjecture is also shown to hold in this context about (near) optimality of the generalised double-Pareto prior.

Prasenjit Ghosh, Malay Ghosh, X. Tang and Arijit Chakrabarti

Reliability and Survival Analysis

The problem of non-parametric estimation of the distribution of quality-adjusted lifetime under the simple illness-death model with dependent sojourn time distributions is being considered. The problem of estimating regression parameters and baseline cause specific hazards in competing risks framework with general missing pattern has been investigated. A continuous-time software reliability growth model for the analysis of software testing data with periodic debugging schedule has been considered. An additional objective of this work is to find optimal release time of the software. A semi-parametric method has been developed to analyze software reliability data with multi-type defects with application to modern bug database. Also, in describing reliability growth through a sequence of parametric models for successive failure time distribution, a conservative confidence bound for the parameter of interest has been developed with minimum coverage probability. A method is being developed to evaluate reliability of a system under dynamic stress strength scenario and also to estimate the model parameters from specific data configurations. Further results for Stress-Strength models were derived and their properties were studied. New parametric models and tests for Accelerated Life Testing problems using parametric models have been studied based on conditional specifications. Change-point problems with multivariate non-normal observations on cancer patients were also studied. Some new testing procedures for the goodness of fit of nonparametric classes of life distributions have been proposed and analyzed. These are expected to complement the existing spectrum of methods of testing for exponentiality against various types of ageing. Utilization of recall data poses new challenges in the analysis of age at menarche of adolescent and young adult women. Recall is often imperfect, and the associated censoring is informative. A new formulation of the problem has been developed, thus permitting parametric and nonparametric estimation of the menarchial age distribution.

Anup Dewanji, Bimal K Roy, Debasis SenGupta and Ashis SenGupta

Multivariate Analysis

In continuation of some earlier work of estimation of scale matrix of multivariate t-distribution, a new method has been developed that uses the estimates of the scale parameter of the marginal distribution. Model-based clustering techniques for non-linear data were studied.

Sumitra Purkayastha and Ashis SenGupta

Sociobiology and Cognitive Science

With a view to understanding the nature-nurture debate, it was observed earlier that inadequate attention seems to have been paid to the role of the environment. Drawing inspiration from existing work, in particular, of Alison Gopnik (University of California, Department of Psychology) an attempt has been made to emphasize this.

Sumitra Purkayastha

Environmental pollution

With respect to a data set from Taiwan, a study is being conducted on the clinic visit rates due to respiratory failure caused by different pollutants.

Atanu Biswas

Bayesian and Interdisciplinary Research Unit

Scientists of Bayesian and Interdisciplinary Research Unit (BIRU) are involved in different kinds of research, training and development activities. Some members collaborate with scientists of other units of ISI on joint project and also with scientists from other Universities/Institutions. The major research interests of the Unit faculty include Pattern Recognition, Image Processing, Machine Learning, Survey Sampling, Minimum Distance Inference, Robust Inference, Multivariate Analysis, Biostatistics, Sample Survey Methodology, Stability Model and various errors in population counts, Mathematical Models in

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Insurance, Analysis and Combinatorial aspects of Design of Experiments, Classification of Multivariate data, Bayesian Statistics, Bayesian Computation, Probability Inequalities, Mathematical Inequalities, Majorization, Ranking and Selection, Clinical Trials, Large Deviations, Asymptotic Theory of Statistics, Limit Theorems in Statistics and Probability, Foundations of Statistics. A brief account of the current research contributions and studies is given below.

Laws of Large Numbers

The study of L_p – convergence and almost sure convergence in the context of the laws of large numbers is continuing. Some results related to the Kolmogorov - Etemadi SLLN have been obtained.

Tapas Kumar Chandra

Survey Sampling

An attempt has been made to derive exact expressions for the mean square errors (MSEs) of ratio estimator, regression estimator, generalized regression estimator, separate ratio and regression estimator and combined ratio and regression estimator in stratified random sampling, and also for unbiased estimators (UEs) of their MSEs. Noting that Rao's (1979) procedure fails to derive an exact expression for the MSE of the product estimator of the population total, an alternative procedure is suggested to get an exact expression for the variance of a homogeneous linear UE of the population total and also for a UE of the variance of the estimator. This procedure is illustrated in the cases of the Horvitz-Thompson estimator, the Hansen-Hurwitz estimator based on PPSWR sampling, Murthy's unordered estimator based on PPSWOR sampling, ratio estimators based on Lahiri (1951), Midzuno (1952) and Sen (1953) sampling schemes, and the Hartley–Ross (1954) unbiased ratio-type estimator based on SRSWOR sampling scheme.

Arun Kumar Adhikary

Some New Minimum Distance Methods in Statistical Inference

Several new density-based minimum distance techniques which are useful in the area of robust estimation and testing of hypotheses are being developed.

Arun Kumar Guchibhotla, Souvik Seal, Taranga Mukherjee, Biswajit Basak and Ayanendranath Basu

Efficient and Robust Weighted Likelihood Methods

Weighted likelihood methods, which have full asymptotic efficiency together with very strong robustness properties, are being developed. The estimators are widely applicable, and likely to be very useful practical tools.

Debopratim Banerjee, Ujan Gangopadhyay, Promit Ghosal, Adhidev Biswas, Suman Majumdar, Tania Roy, Kripa Shankar Dubey and Ayanendranath Basu

Statistical Inference Based on the Density Power Divergence and its Extensions

The density power divergence, which is a popular density-based divergence in robust minimum distance estimation, has many possible applications, which go beyond the standard i.i.d. set-up. Several of these directions are being explored, including applications to non-homogeneous data and robust Bayesian inference. In the process the density power divergence is extended to a larger class which demonstrates the limitations of the influence function approach.

Abhik Ghosh and Ayanendranath Basu

Hypothesis-testing based on the Density Power Divergence

Different aspects of hypothesis-testing based on the density power divergence measure are being considered.

Abhijit Mandal, Nirian Martin, Leandro Pardo and Ayanendranath Basu

Statistical Inference based on the C-Divergence

This represents a new divergence, and is a super-family which includes both the power divergence and density power divergence families. Inference based on this family has led to many interesting results.

Avijit Maji and Ayanendranath Basu

Robust Alternatives to the Two-Sample t-test

Some robust alternatives to the two-sample t-test are being developed, based on the method of disparities. The test is expected to provide strong outlier resistance together with efficient performance under the true model.

Sayar Karmakar and Ayanendranath Basu

New Developments in Minimum Disparity Estimation

A comprehensive framework of minimum distance estimation in case of continuous models is being developed which leads to a general theory in this case. Research is also ongoing on alternative constructions of divergences which are based on sums over the observed data points rather than integrals over the entire sample space. This leads to an alternative weighted likelihood estimator which is also linked to the minimization of a divergence. Overall, this leads to a significant computational advantage; it is also theoretically advantageous as it leads to a direct proof for the breakdown results of the procedure.

K. Arun Kumar and Ayanendranath Basu

Optimal Choice of Covariates in a Cross-over design

The use of covariates model is a well-accepted practice for reducing the experimental error, in order to obtain more accurate estimates of the parameters of interest. For the estimation of covariate parameters attaining the minimum variance (global optimality), the choice of values of the controllable covariates for a given design has attracted the attention of many researchers in recent times. In the present work, the problem of construction of globally optimal covariate designs have been undertaken under the set-up of strongly balanced and balanced cross-over designs with as many covariates as possible in a given context. Hadamard matrices, mutually orthogonal Latin squares, orthogonal arrays and Kronecker product play the key role in this study.

Ganesh Dutta and Rita SahaRay

Optimal Blocked Main Effects Plans with unequal even block sizes

Experimental situations are considered where a main-effects plan is to be used to study m two-level factors using n runs, partitioned into b blocks of even sizes. Optimal designs are obtained with respect to very general classes of optimality criteria within the class of designs providing estimation of all main effects orthogonal to the block effects. In the wider class of all available m two-level unequal even-sized blocked main effects plans, D- and E-optimal designs are also obtained generalizing some of the published results. Simple construction methods for these optimal designs are discussed.

Rita SahaRay and Ganesh Dutta

Contaminated One-way ANOVA Model

A study has been undertaken for a one-way ANOVA model in which the distribution of errors is a mixture of normal distributions. Saddle-point approximation is being used to study the behaviour of the usual F-statistic.

Robert Paige, Rita SahaRay and Joydeep Chowdhury

Statistical Issues in Content-based Image Retrieval

The problem of content-based Image retrieval with relevance feedback has been posed as a classification problem. Efficient retrieval algorithms have been developed by combining conventional and statistical classification techniques (such as discriminant analysis, CART and Support Vector Machines) which have yielded significant improvements in retrieval performance.

Smarajit Bose and Amita Pal

Robust Speaker Identification

The conventional GMM-MFCC based speaker identification algorithm fails miserably for noisy speech recordings. This algorithm can be viewed as a comparison between the estimated densities of the training and test utterances based on K-L divergence. Algorithms based on robust statistical procedures involving other divergence measures are being developed. A simple algorithm based on trimmed mean has already showed quite a bit of improvement.

Smarajit Bose, Ayanendranath Basu and Amita Pal

Inequalities in Random Replacement Scheme

Considering different replacement schemes where drawn unit is replaced with different probabilities, it was not known whether variance of the sample mean is ordered according to replacement probabilities. A solution has been proposed for this problem.

Ambarish Chattopadhyay and Subir Kumar Bhandari

On Optimal Scaling of Additive Transformation Based Markov Chain Monte Carlo

Dutta and Bhattacharya (2012) developed a novel MCMC methodology that uses simple deterministic transformations of some arbitrary, one-dimensional random variable to update high-dimensional random variables in a single block. The proposed methodology, referred to as Transformation-based Markov chain Monte Carlo (TMCMC), has been shown to have superior mixing properties compared to standard MCMC methods and to be computationally much less expensive. The diffusion limits of additive TMCMC have been studied under various set-ups. These investigations lead to appropriate scaling of the one-dimensional proposal density associated with the high-dimensional TMCMC.

Kushal Dey and Sourabh Bhattacharya

On Geometric Ergodicity of Additive and Multiplicative Transformation Based Markov Chain Monte Carlo in High Dimensions

Two significant transformations associated with TMCMC are additive and multiplicative transformations. Combinations of additive and multiplicative transformations are also of much interest. The geometric ergodicity associated with additive and multiplicative TMCMC, along with their combinations, has been investigated.

Kushal Dey and Sourabh Bhattacharya

Non-marginal Decisions: New Bayesian Multiple Testing Procedures

In the multiple testing literature, Bayesian and non-Bayesian, the decision rules are usually functions of the marginal probabilities of the corresponding individual hypotheses. In the Bayesian paradigm, when the hypotheses are dependent, then it is desirable that the decision on each hypothesis should depend on decisions on every other hypothesis through the joint posterior probabilities of all the hypotheses. Novel procedures that coherently take this requirement into consideration have been developed.

Noirit K. Chandra, Prasenjit Ghosh and Sourabh Bhattacharya

Nonparametric Non-stationary Modelling of Spatio-temporal Data through State Space Approach

A state space based nonparametric non-stationary model has been introduced for the analysis of spatio-temporal data. It is assumed that the data-generating process is driven by some latent spatio-temporal process, which is itself evolving with time in some unknown way. This unobserved evolutionary transformation has been modelled via compositions of a Gaussian process, while the unknown functional dependence between the data generating process and the latent spatio-temporal process has been modelled by another Gaussian process. This model has been investigated in detail, the covariance structure has been explored, and a fully Bayesian method for inference and prediction has been formulated.

Suman Guha and Sourabh Bhattacharya

Trans-dimensional MCMC Algorithms Based on Deterministic Transformations with Application in Spatial Statistics

The Transformation-based MCMC (TMCMC) methodology introduced by Dutta and Bhattacharya (2012) has been extended to Transdimensional TMCMC (TTMCMC), where the number of random variables to be updated is itself a random variable. TTMCMC has been applied to mixture models with unknown number of components and two novel and completely different nonstationary, nonparametric, nonseparable spatio-temporal models involving many series with unknown number of summands. All the applications, as well as several simulation studies, yielded very encouraging results.

Moumita Das and Sourabh Bhattacharya

Applied Statistics Unit, Chennai

Estimation of Integrated Volatility in diffusions driven by Fractional Brownian Motion

Inference for option prices when the stock price is driven by a fractional Brownian motion It has been proposed to model stock prices as a diffusion driven by fractional Brownian motion in order to capture long range dependence of stock price in reality. Option prices for such models are obtained by Necula (2002) under constant drift and volatility. For BM setup, the common practice of estimating integrated volatility is from sum of frequently sampled squared data, known as the quadratic variation. We show that even in the fBM setup, when volatility is constant, quadratic variation is indeed consistent and asymptotically normal. Confidence intervals for volatility can now be translated to confidence intervals for option prices.

R. Sen and A. Lahiri

Capital Asset Pricing using Horseshoe Prior

A consequence of Fama's Efficient Market Hypothesis (EMH) is that one cannot consistently achieve return in excess of average market return on risk-adjusted basis. However, since the late 1990s, many empirical studies have shown that EMH is not necessarily true. If EMH is true then all the assets in market are always fairly priced, leading to the Capital Asset Pricing Model (CAPM). This turns out to be a hypothesis-testing problem, where null hypothesis is EMH is true or assets are fairly priced versus alternative hypothesis as EMH is false or assets are over/under-priced. As there are thousands of assets, this problem turns out to be a multiple testing problem. We develop a Bayesian multiple testing procedure with the Horseshoe prior for the CAPM. We present the back-testing (aka out-of-sample performance) of the method for 500 stocks that are considered in S&P 500 index for the period from 2008 to 2013.

S. Das and Rituparna Sen

Research Activities

An Exact test for exponentiality against decreasing mean time to failure class

The mean time to failure (MTTF) is a concept widely used to describe the reliability characteristic of a repairable system. A non-parametric method has been developed to test exponentiality against decreasing mean time to failure class. The exact null distribution of the test statistic has been derived. Asymptotic properties of the proposed test statistic were studied. The test statistic is shown to be asymptotically normal and consistent against the alternatives. The Pitman's asymptotic efficacy shows that the proposed test performs better than the other test available in the literature. Some numerical results were also presented to demonstrate the performance of the testing method. The test procedure has been illustrated using two real data sets.

K.K. Sudheesh and P. Anisha

Applied and Official Statistics Unit, North-East Centre, Tezpur

Reliability

Stochastic modeling of deterioration process and estimation of failure distribution is being studied.

S.M. Bendre

Polyphenolic compounds and antioxidant activity of CTC black tea of North-East India

Tea (*Camellia sinensis*) is a perennial crop and the second most popular drink after water, consumed by over two-third of the world's population. Black tea quality depends mainly on the components of the tea infusions and tea prices vary mostly depending on the quality which has traditionally been assessed by a tea taster who has developed a language of his own to describe various quality attributes of a tea infusion. Black tea quality is influenced by many factors such as season and altitude, genetic make-up of the plant and the region of production and climate. We are investigating the phenolic compounds and antioxidant activity of CTC black tea of six tea growing regions of Assam and West Bengal, India. Another important objective of this research is to evaluate the impact of black tea phenolic compounds on antioxidant activity and tea taster's quality.

Lakshmi Bhuyan, Santanu Sabhapandit and Pradip Bhattacharyya

Utilization of tea industry coal ash as useful material for agriculture

Small scale industries like tea factories generate considerable amount of coal ashes that substantially contaminate land and water resources by acidification and releasing heavy metals and sulphur compounds. Till toady, nobody has reported any findings on these types of coal ashes. Our objective is to find out a compatible bioconversion technique for converting these Coal ashes into organic fertilizers. Here we are trying to address the possibilities to utilize Tea Factory coal ash and Paper Mill coal ash as potential nutrient source for crop plants using vermiconversion and composting technologies. This work is going in collaboration with Dept. of Environmental Science, Tezpur University, Assam.

SatyaSundar Bhattacharya and Pradip Bhattacharyya

Bioconversion of sewage sludge and municipal solid wastes by vermiconversion technologies

Considerable amount of Water Treatment Plant Sludge (WTPS) is produced during mechanical, biological and chemical sewage treatment. WTPS contains significant proportions of toxic substances that create acute health hazards in urban areas. Interestingly, irrespective of the toxic compounds, WTPS contains substantial amount of nutrients and organic matter that can be useful for agriculture. We are trying to evaluate the impact of composting and vermiconposting on physico-chemical properties of WTPS.

SatyaSundar Bhattacharya and Pradip Bhattacharyya

Investigations on point free rings of continuous functions

Partha Pratim Ghosh, Sudip Kumar Acharyya and Goutam Bhunia

Computer and Communication Sciences Division

Advanced Computing and Microelectronics Unit

The research activities of the Advanced Computing and Microelectronics Unit (ACMU) comprise theoretical and applied research in the areas of high-performance computing, pervasive and mobile computing, wireless and sensor networks, VLSI design tools and electronic design automation, logic synthesis and testing, error correction and fault-tolerance, physical design of microchips, embedded systems, microfluidic lab-on-a-chip, system-on-a-chip, low-power architectures, discrete and computational geometry, algorithms and data structures, computational biology, hardware for image processing, nano-technology and giga-scale integration techniques, hardware and software validation. During the period 2013-2014, the faculty members of the unit were engaged in the following internally-funded research projects:

- Algorithmic and Architectural Design Issues of Microfluidic Nano-Biochips for Bioassay Execution (MICROBE): 2012-2015
- Distributed Computation in Pervasive Computing Environment (DCPC): 2012-2015
- Extending the scope of Formal Verification with Assertion Mining from Simulation Traces (ASMT): 2012-2015
- Power and Bandwidth Management in Wireless Networks - Phase II (PoBaMa-II): 2013-2015
- The QoS Improvement through Internetworking of WLAN and UMTS Networks (HybridUMTS-WLAN): 2013-2016
- Visibility with Diffuse Reflections: Bounds and Algorithms (VisibilityDifRef): 2013-2016
- Physical Design for 3D IC's (3DPD): 2011-2014
- Reconfiguration Problems (ReconP): 2011 -2014
- Partitioning and Covering Problem of Polygon in 2D (ParCov): 2011-2014

A brief report on each of these projects is presented below.

Algorithmic and Architectural Design Issues of Microfluidic Nano-Biochips for Bioassay Execution (MICROBE)

Microfluidic labs-on-chip (LoC) offer a viable platform for implementing several biochemical laboratory assays or protocols on a tiny device. This evolving technology of biochips has brought a complete paradigm shift in biochemistry automation including DNA analysis, toxicity grading, drug design and delivery. Biochips can facilitate reduction of healthcare cost of cardiovascular diseases, cancer, diabetes, and can be used for providing point-of-care (P-o-C) health services and for the management of bio-terrorism threats. Sample preparation, which includes dilution and mixing of bio-fluids in a certain ratio, is a fundamental step needed in almost all bio-protocols. Sample preparation plays a pivotal role in biochemical laboratory protocols, e.g., in polymerase chain reaction (PCR), and in other applications in biomedical engineering and life sciences. An important step in sample preparation is dilution, where the objective is to prepare a fluid with a desired concentration (or dilution) factor. Mixture preparation is the generalization of dilution where more than two reagents are to be mixed in a certain ratio. We have studied the problem of generalized sample preparation with digital microfluidics and have designed algorithms and CAD tools which optimize sample preparation time and reactant usage. A number of LoC architectures have been designed for implementing these procedures on-

Research Activities

chip. We have also developed a powerful formal verification tool that can be used for automated checking of the correctness of a biochemical assay implemented on a chip.

Bhargab B. Bhattacharya

Distributed Computation in Pervasive Computing Environment (DCPC)

In many applications of pervasive computing and communication, it is often mandatory that a certain service area be fully covered by a given deployment of nodes or access points. Hence, a fast and accurate method of estimating the coverage area is needed. However, in a scenario with a limited computation and communication capability as in self-organized mobile networks, where the nodes are not static, computation-intensive algorithms are not suitable. Given a set of n sensor nodes distributed randomly over a 2-D plane, this paper addresses the problem of computing the area covered by the sensors assuming that each sensor covers a circular area of radius r . To make the computation simple, instead of considering real circles, a digital geometry based approach is followed here. A detailed study on intersection of digital circles reveals many interesting properties that lead to the development of a novel $O(n \log n)$ centralized algorithm using primitive arithmetic operations to compute the area covered by n uniform digital circles. Next, a distributed version of the same is proposed to select a subset of nodes to cover a given area. Comparison with earlier works by simulation shows that the proposed distributed algorithm improves the estimated area coverage significantly. Next for faster estimation of the collective coverage of n such circles, we approximate each real circle by the tightest square that encloses it as well as by the largest square that is inscribed within it, and present an $O(n \log n)$ time algorithm for computation. We study the variation of the estimated area between these two bounds, for random deployment of nodes. In comparison with an accurate digital circle based method, the proposed algorithms estimate the area coverage with only 10% deviation, while reducing the complexity of area computation significantly. Moreover, for an over-deployed network, the estimation provides an almost exact measure of the covered area.

Nabanita Das

Extending the scope of Formal Verification with Assertion Mining from Simulation Traces (ASMT)

In this project, the following aspect of formal verification has been investigated. Automated debugging for evolving programs: Increasing design complexity as well as skyrocketing fabrication costs for modern digital systems led to growing importance of comprehensive and automated design verification. Akin to software configuration management, it is becoming commonplace to maintain large hardware designs by hardware configuration management tools. A missing piece of crucial technology in this approach is to manage design verification across evolving hardware designs. In this project, we are currently working on developing techniques for automatically localizing design errors across design versions. The proposed technique can be easily integrated into a hardware configuration management framework and is scalable for large designs. We are working on demonstrating the efficacy of our approach on a couple of bugs on open-source hardware designs across multiple evolving variants.

Ansuman Banerjee

Power and Bandwidth Management in Wireless Networks (PoBaMa – II)

We have addressed the problem of channel allocation for multimedia signal communication in a Cognitive Radio Network (CRN). Our approach is based on utilizing several frequency channels, each of width smaller than the required bandwidth but whose sum total equals at least the required bandwidth. We present algorithms for channel sensing, channel reservation and channel deallocation along with transmission and reception protocols for the proposed scheme. We have proposed a novel scheme for multi-path secure routing in a Cognitive Radio Network (CRN) for multimedia communication, even when a contiguous band of required width is not available for any hop in the route. Each data packet of the multimedia signal is split into several sub-packets, which needs much smaller bandwidth than the original packet, and these sub-packets are sent through different routes to be eventually received by the destination node with the desired QoS. For security purpose we would first find node-disjoint paths between the source and the destination, divide the original packets of the

given multimedia signal into sub-packets and then send these sub-packets through multiple such node-disjoint paths. Thus, an attacker will not be able to have the complete information about the multimedia signal by attacking only one intermediate node of the network. We also propose a novel distributed on-demand routing scheme for multimedia communication through Cognitive Radio Networks (CRN). We have also proposed an elegant source coding technique for encoding the messages to be transmitted, so that the frequencies of different symbols in the encoded messages become highly asymmetric, i.e., some symbol is present at a relatively much higher frequency than any of the others. Keeping this symbol period with the highest frequency of occurrence as silent during transmission, we achieve substantial savings of transmitter and receiver energies by using a hybrid ASK – FSK modulation/demodulation technique. We also design the corresponding protocols for transmission and reception of messages using this coding technique and evaluate its performance to compare with other existing techniques. Our results demonstrate that for Additive White Gaussian Noise (AWGN) noisy channels, on an average, the transmitter side energy is reduced by about 53%, while at the receiver side there is about 17.2% savings. Due to the savings of transmitter and receiver energies and the low cost/complexity of the proposed transceiver, our proposed scheme is suitable for multi-hop communication in Cognitive Radio Networks (CRNs). We have proposed a new steganographic technique for embedding a secret file (any file e.g. Audio, video) into a color image. We have used RC4 technique to generate pseudo random position for embedding secret data. After determining the position embedding is done using Variable Least Significant Bit (VLSB) method. The number of bits embedded into a pixel depends on the pixel value itself. An $(N \times N)$ cover image is divided into q number of $(b \times b)$ blocks and for each block RC4 method has been applied. $2q$ different key values for random key generation of q blocks are the secret key here. As RC4 algorithm is being used for randomizing the position of embedding, this method ensures higher level of security with good embedding capacity. Besides that the amount of embedded bits into a pixel purely depends upon the pixel itself, so the image quality is less distorted.

Bhabani P. Sinha

The QoS improvement through internetworking of WLAN and UMTS networks

In the near future, mobile users will operate in heterogeneous environment integrating different wireless access technologies with a view to increasing the throughput for data services at low cost. The 3G universal mobile telecommunication system (UMTS) and wireless LAN (WLAN) are two most promising technologies and their internetworking has attracted much research attention. However, the interworking of UMTS and WLAN are associated with many technical challenges. The quality of service (QoS) provisioning in this type of hybrid network is a challenging task since each access network provides different levels of bandwidth, coverage and throughput to the end user. An important decision problem faced in such a hybrid network is that of the user-network association. This involves decision of an arriving mobile user to connect to one of the two constituent networks in an optimal way. For the effectiveness of the WLAN-UMTS interworking, the handover must be completed as quickly as possible as real time data services are involved. This includes both the vertical handover between a base station (BS) in UMTS and an access point (AP) in WLAN and the horizontal handover between BSs or between APs. This project aims to resolve these issues for making an efficient and practical internetworking between WLAN and UMTS.

Sasthi C. Ghosh

Physical Design of Three-dimensional ICs

Three-dimensional integrated circuits (3D IC) with two or more layers of active electronic components promise lower interconnection complexity and delay. A new global routing method has been designed. Monotone staircase routing region definition by top-down hierarchical balanced bipartition is obtained in polynomial time. At each level of the hierarchy, the objectives are minimizing the cut-size, the number of bends in the monotone staircase and maximizing the balance. A linear weighted combination of these three parameters constituted the cost of the optimization. Experiments were

Research Activities

performed on the MCNC/GSRC floorplanning benchmark circuits to arrive at the weights yielding best solutions. Then global routes through these regions were obtained with 100% routability for each of the nets, without any over-congestion through the monotone staircase channels. The wire length for each of the t -terminal ($t \geq 2$) nets is comparable to the Steiner length of that net in almost all cases. Both 2-layer and multi-layer global routing solutions were found. This framework also supports inclusion of additional capacity constraints on the routing regions due to optical proximity corrections.

Susmita Sur-Kolay

Logic Synthesis for Quantum Computers

Quantum computing is an emerging paradigm of computing with provably super-polynomial speed-up in crucial hard problems such as factoring of integers. Physicists have developed a few technologies but mapping these algorithms onto the appropriate hardware in a cost-effective, reliable and fault-tolerant manner has to be done efficiently. A method called PAQCS for placement and routing of quantum gates to realize a quantum algorithm in a reliable manner with minimal number of gates and additional qubits, has been designed. In addition to synthesis of binary quantum logic, those for multi-valued logic which has the advantages of less hardware cost, have also been achieved. Synthesis techniques have been devised to realize a number of quantum algorithms such as Shor's factoring, Grover's search in the ternary and quaternary logic domain with lower quantum gate cost. An efficient and modular method to realize symmetric binary functions as quaternary quantum/reversible circuits has been developed. In contrast to the existing binary synthesis methods, our design in quaternary domain offers a simple and regular cascade structure composed of quaternary quantum modules. Further, a method to obtain an optimal realization has also been designed; this uses a few special quaternary quantum modules of low quantum costs. Experimental results confirm that our new method leads to realization in quaternary domain with a significant reduction in number of lines, gate counts and quantum cost compared to the existing approaches in binary domain. Hence, our design in quaternary logic offers a useful alternative to existing designs in binary logic for realizing symmetric functions.

Susmita Sur-Kolay

Reconfiguration Problems

We are given a graph $G = (V, E)$ where each vertex is marked as either empty (E), or occupied by a red or blue chip (R/B). Each colored chip can move to an adjacent empty vertex. An R-receptor (B-receptor) is located adjacent to some particular vertex of the graph. Once a red (blue) chip reaches that particular vertex, it can be removed from the graph, thus making that particular vertex empty. Thus the number of empty vertices in the graph increases as colored chips are brought to their respective receptors. The goal is to empty the graph by taking all the colored chips to their respective receptors with minimum number of moves. It is already known that any 2-connected graph $G = (V, E)$ can always be emptied if there be at least one empty vertex initially. We have got the following results: (i) the feasibility and optimality questions for the problem are in P, and NP respectively, (ii) if $G = (V, E)$ be a graph with k cut-vertices, then G can always be emptied if there be at least $k+1$ empty vertices initially, and (iii) given a graph, let k be the length of a shortest path p between R-receptor and B-receptor. The graph can always be emptied if there are initially at least $k+1$ empty vertices in the graph.

Arijit Bishnu and Arijit Ghosh

Partitioning and Covering Problem of Polygon in 2D

The one-round discrete competitive facility location problem, with respect to a n point user set U , consists of two players Player 1 (P1) and Player 2 (P2). At first, P1 chooses a set F_1 of m facilities following which P2 chooses another set F_2 of m facilities, disjoint from F_1 , where $m = O(1)$ is a positive constant. The payoff of a player i is defined as the cardinality of the set of points in U which are closer to a point in F_i than to every point in F_j , for $i = j$. The objective of both the players in the game is to maximize their respective payoffs. We address the case where the points in U are located along a line. We show that if the sorted order of the points in U along the line is known, then the

optimal strategy of P2, given any placement of facilities by P1, can be computed in $O(n)$ time. We then prove that for $m \geq 2$ the optimal strategy of P1 in the one-round discrete competitive facility location problem game, with the users on a line, can be computed in $O(n^{m^{\lambda m}})$ time, where $0 < \lambda m < 1$, is a constant depending only on m .

Sandip Das

Computer Vision and Pattern Recognition Unit

Document Analysis

Optical Character Recognition (OCR) in video stream of flipping pages is a challenging task because flipping at random speed causes difficulties to identify frames that contain the open page image (OPI). Also, low resolution, blurring effect, shadows add significant noise in selection of frames. For OCR of flipping page, we focus on the problem of identifying the set of optimal representative frames for the OPI from a video stream of flipping pages and perform OCR without using any explicit hardware. We present an algorithm that exploits cues from edge information of flipping pages. These cues, extracted from the region of interest (ROI) of the frame, determine the flipping or open state of a page. Then a SVM classifier is trained with the edge cue information for this determination. We have obtained a classification accuracy of 88%. For each OPI we obtain a set of frames. Next we choose the central frame from that set of frames as the representative frame of the corresponding OPI and perform OCR. Experiments are performed on video documents recorded using a standard resolution camera to validate the representative frame selection algorithm and we have obtained character recognition accuracy of 82% and word recognition accuracy of 77%.

Umapada Pal, Dibyayan Chakraborty, Partha Pratim Roy and Jose M. Alvarez

Recognition of curved text in natural scene image is a challenging task. Due to complex background and unpredictable characteristics of scene text and noise, text characters in strings are often touching that affects the performance of segmentation and recognition. We proposed a novel approach for curved text recognition using Hidden Markov Models (HMM). From curved text, a path of sliding window is estimated and features extracted from the sliding window are fed to the HMM system for recognition. We evaluate two frame-wise feature extraction algorithms namely Marti-Bunk and local gradient histogram. The proposed approach has been tested on different natural scene benchmark as well as video databases, e.g. ICDAR-2003 competition scene images, MSRA-TD500 and NUS. We achieve recognition accuracy of word about 63.28%, 58.41% and 53.62% respectively for horizontal text, non-horizontal text and curved text.

Umapada Pal, S. Roy, P.P. Roy, P. Shivakumara, G. Louloudis and Chew Lim Tan

We proposed a system for Multi-Oriented Scene Text Detection in Video based on Wavelet and Angle Projection Boundary Growing. Here we first divide a video frame into 16 blocks and propose a combination of wavelet and median-moments with k-means clustering at the block level to identify probable text blocks. For each probable text block, the method applies the same combination of feature with k-means clustering over a sliding window running through the block to identify potential text candidates. We introduce a new idea of symmetry on text candidates in each block based on the observation that pixel distribution in text exhibits a symmetric pattern. The method integrates all blocks containing text candidates in the frame and then all text candidates are mapped on to a Sobel edge map of the original frame to obtain text representatives. To tackle the multi-orientation problem, we present a new method called Angle Projection Boundary Growing (APBG) which is an iterative algorithm and works based on a nearest neighbour concept. APBG is then applied on the text representatives to fix the bounding box for multi-oriented text lines in the video frame. Directional information is used to eliminate false positives. Experimental results on a variety of datasets such as non-horizontal, horizontal, publicly available data (Hua's data) and ICDAR-03 competition data (camera images) show that the proposed method outperforms existing methods proposed for video and the state of the art methods for scene text as well.

Umapada Pal, Palaiahnakote Shivakumara, Anjan Dutta and Chew Lim Tan

Research Activities

Presence of multi-oriented characters, connected characters with graphical lines, intersection of text and symbols with graphical lines/curves etc. are very common in graphical documents. As a result word spotting in graphical documents is still a challenging task. We proposed a system for word spotting in graphical documents and the proposed approach proceeds in two stages. In the first stage, recognition of isolated components is done using rotation invariant features and an SVM classifier. The characters having good recognition score and match in the query string are first selected for initial spotting. Because of structural complexity of graphical documents as well as of touching components, we may miss some of the query characters during spotting in some documents. In that case, based on the position, size and orientation of the recognized characters in the input document image, regions where missing characters may be located (candidate regions) are defined. In the second stage, Scale Invariant Feature Transform (SIFT) is used to find those missing characters in the candidate regions for possible spotting. Finally using the positional, size, orientation as well as inter character gap information of the recognized components spotting is validated. Experimental results showed that the method was efficient to locate a query word in multi-oriented and/or touching graphical documents.

Umapada Pal, Arundhati Tarafdar, Partha Pratim Roy,
Nicolas Ragot and Jean-Yves Ramel

Although a large number of methods for video text detection and recognition have been proposed over the past years, it is hard to find the best state-of-art method because of non-availability of standard dataset, ground truth and common evaluation measures. Therefore, we proposed a semi-automatic system for ground truth generation of video text detection and recognition, which includes English and Chinese text of different orientation. The system has a facility to allow the user for manual correction of the ground truth if the automatic method produces wrong results. We proposed nine attributes at word level namely: line index, word index, coordinate values of bounding box, area, content, script type, orientation information, type of text (caption/scene) and condition of text (distortion/distortion free) to evaluate the performance of the method. We also introduce a new dataset which consists of 466 video frames collected from TRECVID 2005 and 2006 databases. The video frames in our dataset contain both horizontal texts (278 frames; 181 with English texts and 97 with Chinese texts) and non-horizontal texts (188 frames; 140 English and 48 Chinese). Furthermore, the performance of the proposed system is compared with existing text detection methods by calculating measures manually and automatically to show usefulness of our semi-automatic system. The dataset, the ground truth and the semi-automatic system will be released to public.

Umapada Pal, Trung Quy Phan, Palaiahnakote Shivakumara, Souvik Bhowmick,
Shimiao Liand and Chew Lim Tan

Script identification is an important step in multi-script document analysis. As different textures present in text portion of a script are the main distinct features of the script, we proposed a new algorithm for printed script identification based on texture analysis. Since local patterns is a unifying concept for traditional statistical and structural approaches of texture analysis, here the basic idea is to use the histogram of the local patterns as description of the script stroke directions distribution which is the characteristic of every script. As local pattern, the basic version of the Local Binary Patterns (LBP) and a modified version of the Orientation of the Local Binary Patterns (OLBP) are proposed. A Least Square Support Vector Machine (LS-SVM) is used as identifier. The scheme has been verified on two databases. The first or training database is a database with 200 sheets of 10 different scripts. The scripts font is provided by the Google translator. The second or test database has been obtained by scanning different newspapers and books. It contains 5 common scripts among 10 different scripts of the first database. From the experiment we obtained encouraging results.

Umapada Pal, Miguel A. Ferrer and Aythami Morales

Biometrics

Towards biometrics we proposed a new sclera vessel recognition technique. The vessel patterns of

sclera are unique for each individual and this can be utilized to identify a person uniquely. In this research we have used a time adaptive active contour-based region growing technique for sclera segmentation. Prior to that, we have made some tonal and illumination correction to get a clearer sclera area without the distributing vessel structure. This is because the presence of complex vessel structures occasionally affects the region-growing process. The sclera vessels are not prominent in the images, so in order to make them clearly visible, a local image enhancement process using a Haar high pass filter is incorporated. To get the total orientation of the vessels, we have used Orientated Local Binary Pattern (OLBP). The OLBP images of each class are used for template matching for classification by calculating the minimum Hamming Distance. We have used the UBIRIS version 1 dataset for the experimentation of our research. The proposed approach has achieved high recognition accuracy employing the above-mentioned dataset.

Umapada Pal, Abhijit Das, Miguel A. Ferrer Ballester and Michael Blumenstein

Among all of the biometric authentication systems, handwritten signatures are considered as the most legally and socially accepted attributes for personal verification. Hence we proposed a signature verification technique involving off-line Bangla (Bengali) signatures. Only very few research works employing signatures of Indian script have been considered in the field of non-English based signature verification. To fill this gap, a threshold-based scheme for the verification of off-line Bangla signatures is proposed. Some techniques such as under-sampled bitmap, intersection/end point and directional chain code are employed for feature extraction. The Nearest Neighbour method is considered for classification. Furthermore, a Bangla signature database, which consists of 2400 (100x24) genuine signatures and 3000 (100x30) forgeries, has been developed and is employed for experimentation. We obtained 12.33% Average Error Rate (AER) as the best verification result using directional chain code features in this research work. As a comparative study, a different dataset (GPDS) and an SVM classifier have also been considered.

Umapada Pal, S. Pal, A. Alireza and M. Blumenstein

Development of a large database of real-life online handwriting samples

Development of a very large database of online Bangla handwriting sample database is near its completion. This database will consist of isolated characters, unconstrained words and continuous texts. A significant part of its cursive word samples has been annotated at sub-stroke level. The handwriting samples of this database are stored in different formats which include UNIPEN format, XML files etc. Also, it consists of a large character subset segmented automatically from the mixed cursive words written in the unconstrained manner. This subset contains ground truth in UNICODE.

Ujjwal Bhattacharya, Soumik Bhattacharya, Durjoy Sen Maitra and Swapan Kumar Parui

Generation of synthetic samples of online Bangla handwriting

We developed a methodology to synthetically generate a large sample database from a small set of original online handwriting specimens. The global paradigm is based on the Kinematic Theory of rapid human movements and its Sigma-Lognormal model. After extracting the parameters that allow the optimal reconstruction of a given word, random fluctuations are applied to the lognormal parameters to automatically generate simulated samples. The human likeliness and structural similarity of the synthetic prototypes are confirmed through various human perception experiments and computer evaluations. A large online handwritten word database so developed is used to train and evaluate different kinds of automatic handwriting recognition systems. It is observed that recognition systems can be trained using only synthetic samples and still provide better generalization on an independent test set.

Réjean Plamondon, Ujjwal Bhattacharya, S. Dutta Chowdhury and Swapan Kumar Parui

Online Bangla handwriting recognition

Extensive studies towards robust approaches of online Bangla handwriting recognition have been conducted in two fronts – (i) Limited Vocabulary Recognition and (ii) Generic (Non-Limited vocabulary)

Research Activities

Recognition. For limited vocabulary recognition two different approaches have been implemented and tested. In one of them, a novel Hidden Markov Model based on von Misses distribution has been used and in the other a novel and robust feature set has been developed to classify online handwritten words based on a modified Levenstein distance function. The above approach has also been implemented for online Bangla handwritten isolated character recognition tasks. The generic recognizer is based on a novel idea of horizontal sub-region based sliding window and the above modified Levenstein distance function.

Ujjwal Bhattacharya, S. Dutta Chowdhury, O. Samanta and Swapan Kumar Parui

Extraction of texts from camera captured images

A robust but simple method to extract as much texts as possible from natural scene images affected by serious uneven lighting conditions such as specular reflection of light or varying contrasts has been studied. Its goal is to enhance and extract the information after reducing the presence of noisy pixels as much as possible. Our approach not only extracts texts from scene images having uneven specular reflections, in which most of the current algorithms fail, but also works equally well for other difficult situations such as presence of shadow, varying contrasts, texts at arbitrary orientations etc. Here, we use Otsu's thresholding method for binarization purposes. It is an established fact that Otsu's method is an efficient binarization approach as long as the input image is not affected by non-uniform illumination. Thus, we apply Otsu's method severally on smaller rectangular regions within each of which the variation in illumination condition is less likely to occur. Moreover, the smaller rectangular regions are not selected on an ad hoc basis but these are obtained as the minimum rectangular regions enclosing the connected components of Canny edge image. The above is the main factor behind the robustness of the proposed approach for extraction of texts from general camera captured images.

Ujjwal Bhattacharya, Sudipto Banerjee and Koustav Mullick

Segmentation-free Bangla word spotting

Bag-of-Features Hidden Markov Models has been studied for spotting of Bangla words from printed documents. Here, we considered a segmentation-free Query-by-Example scenario. The query is, therefore, given by a word that is selected in a document image. Visually similar regions in the document database are then retrieved and returned in a ranked list. This way digital archives containing, for example, historical documents are made accessible. Otherwise they cannot be efficiently explored, because state-of-the-art text recognition systems do not achieve sufficient recognition results. This is especially a problem in handwritten or degraded printed documents where characters and words substantially vary in their visual appearance.

L. Rothacker, G.A. Fink, Purnendu Banerjee, Ujjwal Bhattacharya
and Bidyut B. Chaudhuri

Study of Sentiment Analysis

"What others think" is often important to many of us. This is also a major factor influencing the decision of the management of a manufacturer or a service provider in adaptation of the existing policies or framing of new strategies. Now-a-days people express their sentiments over the internet through Twitter, Facebook, Blogs, Forums etc. Analysis of public sentiments over certain specific topic or product is very important to various decision-making bodies. Such sentiments are often categorized as +ve or -ve. However, such a simple categorization is too coarse to its effective use. Categorization of sentiments over a finer scale should help the decision-making authorities in a great way. On the other hand, analyzing these sentiments manually is a difficult task considering the volume of such sentiments spread over the Internet. Thus, the need for some automatic sentiment analyzers is now-a-days growing rapidly. Research and Development works towards such analyzers essentially require some training and test data. In a recent attempt, we developed such training and test data for sentiment analysis in the domain of Cellular Mobile Services. This sentiment data is annotated based on the following taxonomy and the degree of sentiments of these samples is scaled in the set {-2,-

1,0,+1,+2}. Also, we developed a baseline system for their automatic analysis based on the cosine similarity.

Saprativa Bhattacharjee, Anirban Das, Sanjay Sarkar, Srijani Pal, Ujjwal Bhattacharya, Swapan K. Parui and Nirmalya Chattopadhyay

Computational Forensics

A probabilistic approach has been implemented to reconstruct a document from its torn pieces which is extremely helpful for the legal system. The method investigates several previously unexplored issues and proposes probabilistic dependencies of different (available) parts (or pieces) of a document. It iteratively calculates the probability of an arrangement subject to some constraints and attempts to produce the best possible configuration (or solution) using low level image statistics. The reconstruction method also ranks different (final) arrangements in order to help decision making process. Two types of data were used in the investigation. A set of documents where documents were torn naturally (as we do it in our daily life) and the second set consisting of documents that were torn to destroy particular evidences. Evaluation shows that the method is quite robust to tackle both the problems. International Workshop on Computational Forensics (IWCF) 2014 is being organized to address some related issues.

Utpal Garain, Ankush Roy and Faisal Shafait

Document Image Analysis

In the field of document image analysis (DIA), many algorithms are now available for doing a particular task (e.g. binarization, page segmentation, character recognition, etc.) and choosing a particular algorithm(s) for a particular task is often a nontrivial problem. A model has been configured for automatically selecting the correct algorithm(s) for a given problem. Binarization has been taken a reference to illustrate the proposed approach. Therefore, for a given document image, our model selects a set of one or more binarization techniques suitable for different regions of the document. This selection is completely automatic and guided by the machine learning approaches. Formulation of a completely automatic way for generating the annotated data for training the learning algorithms is also a novel contribution of this work. Evaluation of the approach is done using ICDAR 2003 Robust Reading dataset and results highlight the potential of the proposed approach for automatic selection of correct DIA algorithm(s) from a set of several alternatives.

Utpal Garain, Tanushyam Chattopadhyay and V. Ramu Reddy

Natural language processing and applications

An off-the-shelf anaphora resolution (AR) system called GuiTAR has been reconfigured for Bengali. The language specific preprocessing modules of GuiTAR (v3.0.3) are identified and suitably designed for Bengali. Anaphora resolution module also undergoes changes in order to realize different configurations of GuiTAR. Performance of each configuration is evaluated and experiment shows that the off-the-shelf AR system can be effectively used for Indic languages. In the field of BioNLP, event mining has been explored for cancer genetics. In another attempt, text-to-diagram conversion problem is targeted by integrating artificial intelligence and NLP tools. Under this research, machine is able to draw the diagram described in a piece of text (e.g. geometric/physics problems). This research has been extended for the Blind people so that they can perceive the diagrams on a Braille print out.

Utpal Garain, Apurbalal Senapati, Arjun Das, Debojyoti Sinha, Sanghamitra Bandyopadhyay and Anirban Mukherjee

Handwriting Recognition

The shared task, Competition on Handwritten Mathematical Expression Recognition (CROHME), is continued in collaboration with others labs in South Korea, France and USA. CROHME-III was

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organized with the 12th Int. Conf. on Document Analysis and Recognition (ICDAR) in USA and eight teams from academia and industry took part in CROHME-III. For the third CROHME, the training dataset was expanded to over 8000 expressions, and new tools were developed for evaluating performance at the level of strokes as well as expressions and symbols. Data and tools used for the competition will be made publicly available.

Utpal Garain, Harold Mouchère, Christian Viard-Gaudin and Richard Zanibbi

Electronics and Communication Sciences Unit

Image Processing and Analysis

Investigation in super resolution (SR) imaging technique, which is an important task to overcome hardware limitations for sensor resolution, is being carried out. A novel algorithm for single frame SR image reconstruction is developed based on fuzzy clustering and fuzzy rule base. Membership of antecedent and consequence rules are determined based on a database of natural images and Takagi-Sugeno model. The method is tested on benchmark data available in public domain and is found superior to state-of-the-art methods.

Video Retrieval

In general, an essential step for video indexing/retrieval is video structuring followed by video summarization. We have developed scene detection methods using shot level key-frames following two approaches: one method splits the key-frame sequence into scenes, while the other, by merging the key-frames to form the scenes. Both the methods rely on the observation that shots appear in a quasi-periodic pattern in a scene. The methods are tested on benchmark datasets.

Iris recognition for human identity authentication

Two block based algorithms are developed for human identity verification and recognition based on iris image. First one relies on a new representation of texture properties of the image, while the second one relies on structural property of the image extracted through morphological filtering. The algorithms are tested on four different benchmark datasets, which yields encouraging results.

B. Chanda

Evolutionary Computing and Swarm Intelligence

Efficient variants of the Differential Evolution algorithm have been derived to provide elegant solutions of dynamic single and multi-objective optimization problems, where the nature of the functional landscape changes with time. Inter-agent communication, search dynamics and the chaotic dynamical characteristics of certain simulated swarms have been investigated both analytically and experimentally to gain better insight into the coordinated swarm control observed in nature. Some of the devised optimization algorithms have also been applied to solve some challenging antenna array optimization problems.

Swagatam Das

Recognition of Human Actions and Emotions seen in a Video

We have initiated research in recognizing actions performed by human being when the 3D skeleton data of the person is being captured using Kinect camera. The use of 3D skeleton data helps in applications where the identity of person performing an action cannot be compromised, for example, in applications like monitoring daily activities for elderly health care. At this stage the focus of the research is to remove sensor noises that are prevalent in Kinect captured data. For emotions, our research is oriented more towards synthesizing six basic emotional expressions like happiness, sadness, anger, surprise, disgust and fear. We are designing SVM classifier based feature vectors

specific for each of the above-mentioned expressions. Our model of synthesis is to add these emotion-specific features to emotion-neutral face images in order to synthesize emotions. We are also investigating if mixed emotions (e.g. happily surprised, fearfully surprised etc.) can be synthesized.

Detection of Architectural Distortion in Mammogram Image

Spicule analysis, part of detection of architectural distortion of breast image in a mammogram, is necessary for detecting abnormalities in the breast tissue. A ridge detector might be used for detecting the spicules. An essential criterion which existing methods of ridge detection fail to meet is that faint spicules be detected without the introduction of unwanted shapes e.g. edges. A multi-scale and multi-orientation approach to ridge detection has been designed based on the statistical notions of mean and variance. We compare the developed method with the result obtained using Gabor filter. The proposed ridge detector could achieve almost 30% improvement in AUC of ROC curve compared to Gabor filter.

D.P. Mukherjee

Fuzzy Sets

Characterization of dissimilarity/divergence between intuitionistic fuzzy sets is important as it has applications in different areas including image segmentation and decision making. We present an axiomatic definition of divergence measures for Intuitionistic Fuzzy Sets (IFSs), which is a particular case of dissimilarities between IFSs. The relationships among IF-divergences, IF-dissimilarities and IF-distances are studied. Finally, we propose a very general framework for comparison of IFSs, where depending on the conditions imposed on a particular function, we can realize measures of distance, dissimilarity and divergence for IFSs. Some methods for building divergence measures for IFSs are also introduced. We have proved some results that can be used to generate measures of divergence for fuzzy sets as well as for intuitionistic fuzzy sets. The Interval Type-2 Fuzzy Set (IT2 FS) is characterized by its upper and lower membership functions, containing all possible embedded fuzzy sets, which together is referred to as the footprint of uncertainty (FOU). The FOU results in a span of uncertainty measured in the defuzzified space, and is determined by the difference of the centroids of all embedded fuzzy sets taken together. We propose a closed-form formula to evaluate the span of uncertainty of IT2 FS. The closed-form formula offers precise measurement of the degree of uncertainty in IT2 FS with a run-time complexity lower than that of the classical iterative Karnik-Mendel algorithm and other formulations employing iterative Newton-Raphson algorithm.

Bioinformatics

Predicting the locations of linear B-cell epitopes within a protein can help development of peptide vaccines by using synthetic peptides. We propose two encoding schemes using information of n-mer amino acid composition (n-mer AAC) and use them to develop methods to identify linear B-cell epitopes. Our strategies not only enhance the contrast of occurrence of n-mer AAC between the positive data and negative data, but also eliminate the problem associated with an existing amino acid propensity method when some n-mer patterns do not appear in the training data. Our approach can exploit the higher order interaction between residues and can perform quite well in linear B-cell epitope prediction. Our method can be useful to choose appropriate candidate peptides for producing peptide vaccines.

Neural Networks

We develop methods for sensor selection, where a sensor is responsible for a group of features, maintaining a controlled level of redundancy between feature-sets generated by different sensors. In this context, we define different measures of sensor redundancy. To realize our model, we use two popular neural architectures: multi-layer perceptron and radial basis function networks. The advantages of our approach are three fold. It looks at all groups together and can exploit non-linear

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interactions between the groups. It can simultaneously select useful groups as well as learn the underlying system. The level of redundancy among groups/sensors can be controlled.

N.R. Pal

Design of Online Atmospheric Pattern Detection System

Indigenously designed three SODAR systems are fabricated and tested along with its software part. Two systems are being installed at ISI, Kolkata: One is installed at the roof of our library building and other the one is ready to be installed at the backward of ISI transport unit. The third one will be installed at the Firm house of ISI, Giridih. Site preparation is in progress. These systems will run round-the-clock basis to capture atmospheric boundary layer thermal structures up to a height of 1 Km. All these data are important for weather forecasting, studies of pollution control, earthquake detection, and other boundary layer studies. In order to generate the supporting ground truth data for the SODAR system, we have also designed automatic weather station. We have fabricated two such systems. Shortly we will install our indigenously designed automatic weather station one at ISI Kolkata and the other at ISI Giridih near the site where SODAR systems are being installed.

Analysis and Modelling of Atmospheric Pollutant

One High Volume Sampler (HVS) machine is already installed at ISI, Giridih for data collection of Suspended Particulate Matters (SPM) of size 10 micron (PM_{10}) and the experiment is being continued. HVS is running at ISI, Giridih centre for 8 hours duration each day and every alternate days samples are being taken. Micrometeorological conditions are being recorded on the sampling days with respect to wind direction, wind velocity, humidity and temperature. We are going to install another HVS machine at ISI, Kolkata for data collection of SPM of size 10 micron (PM_{10}). Particles in the $PM_{2.5}$ (2.5 micron) size range are able to travel deeply into the respiratory tract, reaching the lungs. Exposure to fine particles can cause short-term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath. Exposure to fine particles can also affect lung function and worsen medical conditions such as asthma and heart disease. Scientific studies have linked increases in daily $PM_{2.5}$ exposure with increased respiratory and cardiovascular hospital admissions, emergency department visits and deaths. Studies also suggest that long term exposure to fine particulate matter may be associated with increased rates of chronic bronchitis, reduced lung function and increased mortality from lung cancer and heart disease. People with breathing and heart problems, children and the elderly may be particularly sensitive to $PM_{2.5}$. In order to design model for source identification and prediction of $PM_{2.5}$ pollutant levels in air, we are going to install two $PM_{2.5}$ monitoring machines: one at ISI, Giridih and other at ISI, Kolkata. All these samplers draw a known volume of ambient air at a constant flow rate through a size selective inlet and a filter. Particles are then collected on the Quartz Microfibre (QMA) filter papers during the sampling period. These collected samples are stored under dry condition at $-20^{\circ}C$ till analysis. Water soluble ionic components (WSIC) of PM_{10} and $PM_{2.5}$ are being analysed using Ion Chromatograph and Organic Carbon (OC) as well as Elemental Carbon EC analysis has been carried out by OC/EC carbon analyser at the National Physical Laboratory (NPL), New Delhi.

We have communicated three works in the Journal

- (i) Empirical Model for the Estimation of Organic Carbon and Elemental Carbon from Water Soluble Ionic Components of PM_{10} .
- (ii) Atmospheric Fine and Coarse Mode Aerosols at Different Environments of India during Winter-2014: Implication of an Integrated Campaign.
- (iii) Spatial variation of ambient ammonia and other trace gases at urban sites of Indo Gangetic Plain (IGP) of India.

S. Pal and N.C. Deb

DNA Computing (Wet lab and Dry lab approach)

Fuzzy Reasoning based on DNA computing approach has been developed and applied on real life problem. The Watson-Crick automata and its applications have also been studied.

Non Monotonic Reasoning for Commonsense

An algorithm has been developed for commonsense reasoning based on nonmonotonic logic.

Para-consistent Logic

Determination of inconsistent set of literals from the knowledge base and corresponding inference under such circumstances has been developed based on para-consistent logic.

3D Object Tracking and Scale Space Image Analysis

Scale space approach for image analysis has been developed for tracking 3D objects.

Gesture Recognition including Emotion

Human gesture recognition including emotional parameters like joy, sorrow etc are considered for recognition in real time.

K.S. Ray

Machine Intelligence Unit

Computational Systems Biology

Metabolic Pathways

A novel second-order learning rule, based on Newton-Raphson method, has been developed for determining optimal paths from the substrate to a target product of a metabolic network, through which the amount of the target is maximum. A comparison with the standard gradient descent and the extreme pathway analysis technique is also performed. Unlike the gradient descent method, the present method, being independent of the learning parameter, exhibits improved results. The method has also been applied to gene regulatory networks for determining optimal gene regulatory pathways.

R.K. De

Metabolic Pathways and Engineering

Advances in 'omics' high-throughput technologies have led to a vast amount of available biological data. It has fostered the development of bioinformatics methods to interpret these data. In this regard, characterization of cellular metabolism is a useful task to understand the phenotypic capabilities of an organism. Several in silico approaches have emerged for analysis of metabolic pathways, including structural and stoichiometric analysis, metabolic flux analysis, metabolic control analysis, and several kinetic modeling based analysis. A comprehensive survey on existing metabolic pathway analysis methodologies has been done. It also includes metabolic engineering with an emphasis on microbial strain optimization.

R.K. De

Metabolomics

Metabolomics is one of the key approaches of systems biology that consists of studying biochemical networks having a set of metabolites, enzymes, reactions and their interactions. One of the useful

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strategies in this regard is using path mining strategies and graph-theoretical approaches that help in building hypothetical models and perform quantitative analysis. Furthermore, they also contribute to analyzing topological parameters in metabolome networks. Path mining techniques can be based on grammars, keys, patterns and indexing. Moreover, they can also be used for modeling metabolome networks, finding structural similarities between metabolites, in silico metabolic engineering, shortest path estimation and for various graph-based analysis. A detailed review has been made on some core and applied areas of path-mining for modeling and analysis of metabolic networks.

R.K. De

Disease Biology

Disease Systems Biology is an area of life sciences, which is not very well understood till date. Analyzing infections and their spread in healthy metabolite networks can be one of the focused areas in this regard. A theory has been developed based on the classical forest fire model for analyzing the path of infection spread in healthy metabolic pathways. A simulation model has been constructed, which is used to study the infection caused in the metabolic networks from the start of infection, to spread and ultimately combating it. For implementation, we have used two approaches, first, based on quantitative strategies using ordinary differential equations and second, using graph-theory based properties. The simulation model has been tested on metabolic pathways involved in Type I Diabetes mellitus in *H. sapiens*. For validating our results biologically, we have used sensitivity analysis, both local and global, as well as for identifying the role of feedbacks in spreading infection in metabolic pathways.

R.K. De

Human Wnt Signaling Pathway Diseaseome

The human Wnt signalling pathway is responsible for a variety of crucial biological functions such as regulation of cell fate determination, proliferation, differentiation, migration, and apoptosis. Abnormal behavior of its members causes numerous types of human cancers, dramatic changes in bone mass density that lead to diseases such as osteoporosis-pseudo-glioma syndrome, Van-Buchem disease, skeletal malformation, autosomal dominant sclerosteosis, and osteoporosis type I syndromes. So far, single genes have been investigated for their disease-causing properties, and single diseases have been traced backwards to discover foul-play of the system pathways. Differential expression of the whole genome has been mapped by microarray. But how all the genes involved in a pathway affect each other in single/multiple disease state(s) and whether the presence of one disease state makes a person prone to another kind of disease(s) (i.e., co-morbidity among diseases associated with a certain important biological pathway) is still unknown. A human Wnt signalling pathway diseaseome has been developed and analyzed it for finding answers to such questions.

R.K. De

Immunoinformatics

Response of an immune system to a pathogen attack depends on the balance between the host immune defense and the virulence of the pathogen. Investigation of molecular interactions between the proteins of a host and a pathogen helps in identifying the pathogenic proteins. It is necessary to understand the dynamics of a normally behaved host system to evaluate the capacity of its immune system upon pathogen attack. An integrated pathway system has been constructed, which includes Staphylococcal Superantigen (SAg) expression regulatory pathway and TCR signaling pathway of *Homo sapiens*, and compared the behavior of an unperturbed and pathogen perturbed host system. The entire study has been divided into six different cases, based on the perturbed/unperturbed conditions. Based on the computed results, it has been hypothesized that the balance between TCR signaling inhibitory and stimulatory molecules can keep TCR signaling system into resting/stimulating state, depending upon the perturbation. The developed integrated host-pathogen interaction pathway model has accurately reflected the experimental evidences. The significance of this kind of

investigation lies in revealing the susceptible interaction points that can take back the Staphylococcal Enterotoxin (SE)-challenged system within the range of normal behavior.

R.K. De

Soft Computing

Neuro-fuzzy Computing

A methodology has been developed for selecting genes that may have a role in mediating a disease in general and certain cancers in particular. The methodology, first of all, groups an entire set of genes. Then the important group is determined using two neuro-fuzzy models. Finally, individual genes from the most important group are evaluated in terms of their importance in mediating a cancer, and important genes are selected. A method for multiplying existing data has also been developed to create a data rich environment in which neuro-fuzzy models are effective. The effectiveness of the proposed methodology is demonstrated using five microarray gene expression data sets dealing with human lung, colon, sarcoma, breast and leukemia. It has been found, through extensive experimentation, that the proposed methodology has been able to select genes that are more biologically significant in mediating certain cancers than those obtained by the others.

R.K. De

Rough Hypercuboid Approach

A new feature selection algorithm is presented based on rough hypercuboid approach. It selects a set of features from a data set by maximizing the relevance, dependency, and significance of the selected features. By introducing the concept of hypercuboid equivalence partition matrix, a novel representation of degree of dependency of sample categories on features is proposed to measure the relevance, dependency, and significance of features in approximation spaces. The equivalence partition matrix also offers an efficient way to calculate many more quantitative measures to describe the inexactness of approximate classification. Several quantitative indices are introduced based on rough hypercuboid approach for evaluating the performance of proposed method. The superiority of the proposed method over other feature selection methods, in terms of computational complexity and classification accuracy, is established extensively on various real life data sets of different sizes and dimensions.

P. Maji

Fuzzy-Rough Approach

A feature selection method is presented here based on fuzzy-rough sets by maximizing both relevance and significance of the selected features. This work also presents different feature evaluation criteria such as dependency, relevance, redundancy, and significance for attribute selection task using fuzzy-rough sets. The performance of different rough set models is compared with that of some existing feature evaluation indices based on the predictive accuracy of nearest neighbor rule, support vector machine, and decision tree. The effectiveness of the fuzzy-rough set based attribute selection method, along with a comparison with existing feature evaluation indices and different rough set models, is demonstrated on a set of benchmark and microarray gene expression data sets. A novel dimensionality reduction method, based on fuzzy-rough sets, is presented that simultaneously selects attributes and extracts features using the concept of feature significance. The method is based on maximizing both relevance and significance of the reduced feature set, whereby redundancy therein is removed. The paper also presents classical and neighborhood rough sets for computing relevance and significance of the feature set, and compares their performance with that of fuzzy-rough sets based on the predictive accuracy of nearest neighbor rule, support vector machine, and decision tree. An important finding is that the proposed dimensionality reduction method based on fuzzy-rough sets is shown to be more effective for generating relevant and significant feature subset. The effectiveness of the proposed fuzzy-rough set based dimensionality reduction method, along with a comparison with existing attribute selection and feature extraction methods, is demonstrated on real life data sets.

P. Maji

Research Activities

Pattern Recognition

Cluster Validity Indices

The performance of 19 cluster validity indices has been compared in identifying some possible genes mediating certain cancers, based on gene expression data. For the purpose of this comparison, a method has been developed, which involves cluster generation, selection of the best k-value or c-values, cluster identification, identifying the altered gene cluster, scoring an altered gene cluster and determining the best k-value or c-value exploring through biological repositories. The effectiveness of the method has been demonstrated on three gene expression data sets dealing with human lung cancer, colon cancer, and leukemia. Biochemical pathways related to these cancers and p-value statistics have been considered for validating the study.

R.K. De

Multiobjective evolutionary algorithm in PR and DM

A comprehensive survey on the recent developments of multiobjective evolutionary algorithms for data mining problems has been conducted. First, some basic concepts related to multiobjective optimization and data mining are provided. Subsequently, various multiobjective evolutionary approaches for several major data mining tasks, namely feature selection, classification, clustering, association rule mining and some others. Moreover a general discussion on the scopes for future research in this domain is provided. A novel interactive genetic algorithm-based multiobjective clustering approach has been proposed. The method periodically interacts with the human decision maker (DM) during execution and adaptively learns to obtain the final set of validity measures to be optimized for the input dataset along with the final clustering result. The algorithm has been applied for clustering real-life benchmark gene expression datasets and its performance compared with those of several other existing clustering algorithms to demonstrate its effectiveness. A new multiobjective (MO) clustering technique (GenClustMOO) is proposed which is able to detect the appropriate number of clusters and the appropriate partitioning from data sets having either well-separated clusters of any shape or symmetrical clusters with or without overlaps. A novel encoding strategy is used. Three objective functions, one reflecting the total compactness of the partitioning based on the Euclidean distance, the other reflecting the total symmetry of the clusters, and the last reflecting the cluster connectedness, are considered here. The effectiveness of the proposed GenClustMOO in comparison with state-of-the-art clustering techniques is comprehensively demonstrated for nineteen artificial and seven real-life data sets of varying complexities.

S. Bandyopadhyay

Document Processing

A new similarity measure between documents, named 'extensive similarity', has been proposed. A new clustering approach for documents, namely 'clustering using extensive similarity (CUES) has been successfully proposed, and its better performance over existing clustering approaches has also been demonstrated. A new modification on K-nearest neighbor classification rule, titled 'Tweak on K-NN rule (TKNN) has been proposed for document classification. One need not choose the value of K for this modification. Secondly, the modified rule has a choice of not classifying a document to one of the existing categories in the data. Lastly, the number of computations for proposed method is found to be much smaller than other nearest neighbor based classifiers and SVMs.

C.A. Murthy

Image Analysis

Orthogonal polynomial moments have ability to act as features. Invariance is a long standing issue in identification. Scale, rotation and illumination invariance sometimes are required for better identification. Shifted orthogonal polynomial moments have been considered in our algorithm for

computation of effective features. These features, computed on a unit discrete disk, have been shown to be invariant under rotation and illumination. The algorithm is fast because we compute only the normalized low order moment. Effectiveness of our features is based on both high and low frequencies in test signals.

S.N. Biswas

Video Processing

A novel moving object detection technique is proposed by constructing a stable background model. The constructed background model is compared with different image frames of the same sequence to detect moving objects. In the proposed scheme the background model is constructed by analyzing a sequence of linearly dependent past image frames in Wronskian framework. The Wronskian based change detection model is further used to detect the changes between the constructed background scene and the considered target frame. Similarly, Wronskian change detection model uses a spatial region of support in this regard. The proposed scheme relies on spatio-temporal modes arising over time to build the appropriate background model by considering both spatial and temporal modes. The results obtained by the proposed model is found to provide accurate shape of moving objects. The effectiveness of the proposed scheme is verified by comparing the results with those of some of the existing state of the art background subtraction techniques on benchmark databases. An algorithm is developed that can efficiently track the contour extracted from silhouette of the moving (irregular) object of a given video sequence using local neighborhood information and fuzzy k-nearest-neighbor classifier. To classify each unlabeled sample in the target candidate frame, instead of considering the whole training set, a subset of it is considered depending on the amount of motion of the object between immediate previous two consecutive frames. This technique makes the classification process faster and may increase the classification accuracy. Classification of the unlabeled samples in the target candidate frame provides object (silhouette of the object) and background (non-object) regions. Transition pixels from the non-object region to the object silhouette and vice versa are treated as the boundary or contour pixels of the object. Contour or boundary of the object is extracted by connecting the boundary pixels and the object is tracked with this contour in the target candidate frame. We show a realization of the proposed method and demonstrate it on eight benchmark video sequences. The effectiveness of the proposed method is established by comparing it with three state of the art contour tracking techniques, both qualitatively and quantitatively.

A. Ghosh

Face Recognition

An efficient illumination invariant face recognition method based on two-stage two dimensional linear discriminant analyses (2S2DLDA) has been proposed. The proposed method uses a reflectance-illumination model (RI-Model) based on maximum filter to obtain illumination invariants of an image. Various combinations of two dimensional feature extraction techniques (PCA, 2DPCA family and 2DLDA family) with RI-Model were analyzed for the first time in the paradigm of face recognition problem. A vital unresolved problem of 2DLDA is that it needs large feature matrix for the task of recognition, as it considers only row correlation. 2S2DLDA method overcomes this problem by considering both row and column correlations. Nearest Neighborhood (NN) classification approach is adopted for classification. For experimental purpose Yale B and Extended Yale B face databases were used. The performance superiority of the combination RI-Model and 2S2DLDA (proposed) among all other combinations is established through extensive experiments.

A. Ghosh

Multimodal biometrics

An algorithm for classification of humans has been proposed using images of two biometric characteristics namely Iris and face. Its superior performance over existing similar techniques has been demonstrated. Additionally, a method for producing new face and iris images of the same person

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has also been successfully proposed. The method used for these tasks is based on set estimation procedure.

C.A. Murthy

Bioinformatics

Sequence Alignment

Sequence alignment is a fundamental task in Bioinformatics where pairs of sequences (DNA, RNA or protein) are arranged in such a way so as to identify their degree of similarity. One popular global alignment algorithm is the dynamic programming based Needleman Wunsch method. A major problem of the NW algorithm is its high this algorithm time and space complexity. We propose a new algorithm called FOGSAA (Fast Optimal Global Sequence Alignment Algorithm) that provides the optimal alignment of sequences without any parameter tuning. FOGSAA is applicable for all types of sequences, with any scoring scheme, and with or without affine gap penalty. Compared to NW, FOGSAA achieves a time gain of (70–90)% for highly similar nucleotide sequences (. 80% similarity), and (54–70)% for sequences having(30–80)% similarity. For other sequences, it terminates with an approximate score. For protein sequences, the average time gain is between (25–40)%. Compared to three heuristic global alignment methods, the quality of alignment is improved by about 23%–53%.

Clustering Co-Expressed Genes

A gene clustering algorithm, termed as robust rough-fuzzy c-means, is proposed judiciously integrating the merits of rough sets and fuzzy sets. The concept of possibilistic lower bound and probabilistic boundary of a cluster, introduced in robust rough-fuzzy c-means, enables efficient selection of gene clusters. An efficient method is proposed to select initial prototypes of different gene clusters, which enables the proposed c-means algorithm to converge to an optimum or near optimum solutions and helps to discover co-expressed gene clusters. The effectiveness of the algorithm, along with a comparison with other algorithms, is demonstrated both qualitatively and quantitatively on fourteen yeast microarray data sets.

P. Maji

A new symmetry based fuzzy clustering technique is developed to solve the problem of clustering microarray data. The effectiveness of the proposed technique is demonstrated on five publicly available benchmark data sets. Results are compared with some widely used microarray clustering techniques. Statistical and biological significance tests have also been carried out. A novel triclustering algorithm delta-TRIMAX is proposed to mine 3D gene expression datasets by introducing a mean squared residue (MSR) score as a measure of coherence of the resultant triclusters. Applying delta-TRIMAX on a time series gene expression dataset from an estrogen induced breast cancer cell, key drivers for each resultant tricluster were identified and a number of hub genes that are known to be associated with breast cancer or estrogen responsive elements were found. Additionally, co-regulation analysis reveals synergistic regulatory effects of transcription factors. The primary cause for type 2 diabetes (T2D), a metabolic disease affecting a vast majority of the global population, is insulin resistance due to the disruption of the insulin signal transduction mechanism. Several proteins like those in the Insulin receptor substrate family (IRS), GLUT4 etc. are known to play important roles in insulin signalling pathway. Using computational biology techniques, the structure of IRS proteins and GLUT4 have been modelled, and key structural elements have been identified. For the first time, a detailed study was undertaken to study the role of microRNAs in T2D. Various miRNAs have been identified that are involved in regulating the main protein cascades in the insulin signaling pathway and affect insulin resistance.

S. Bandyopadhyay

Selection of Differentially Expressed Genes/MicroRNAs

A comprehensive survey on different parametric and nonparametric statistical testing methodologies for identifying differentially expression genes/microRNAs from microarray datasets has been conducted. The performances of the different testing methods have been compared based on some real-life miRNA and mRNA expression data sets. Finally, a list of advantages and limitations of the different statistical tests has been provided, along with indications of some areas where further studies are required.

S. Bandyopadhyay

A new miRNA selection algorithm, called μ HEM, is presented based on the concept of rough hypercuboid approach. It selects a set of miRNAs from a microarray data set by maximizing both relevance and significance of the selected miRNAs. The degree of dependency of sample categories on miRNAs is defined, based on the concept of hypercuboid equivalence partition matrix, to measure both relevance and significance of miRNAs in approximation spaces. The effectiveness of the new approach is demonstrated on six publicly available miRNA expression data sets using support vector machine. The so-called .632+ bootstrap error estimate is used to minimize the variability and biasedness of the derived results.

P. Maji

MicroRNA Analysis

MicroRNA targets predicted by different algorithms can be combined as multiple ordered lists. Rank aggregation methods are used for the same. Kemeny Optimal Aggregation, one of the most popular rank aggregation approaches, does not ensure uniformity in the distribution of disagreements with the given ranked lists. In a recent work, Kemeny Optimal Aggregation objective is modified to address this and solved using simulated annealing. In another work for the first time a greedy algorithm for the Kemeny Optimal Aggregation is proposed and used for combining microRNA target orderings obtained from multiple target prediction algorithms. Predicting the transcription start sites (TSSs) of microRNAs (miRNAs) is important for understanding how these small RNA molecules are regulated themselves. In a recent work, epigenetic as well as genetic features are combined for the prediction of the primary transcripts of brain-specific miRNAs. A sophisticated feature selection technique and a robust classification model are used. The proposed prediction model achieves an accuracy of more than 80% and establishes the potential of epigenetic analysis for in silico prediction of TSSs. The expression profiles of microRNAs in the gray matter (GM) and white matter (WM) of early Alzheimer's patients have been studied. For this, a network of differentially co-expressed microRNAs in GM and WM is first built, and the notion of differentially co-expressed switching modules is defined. Useful and novel insights are gained. miR-423-5p emerges as a hub of the network and a significant role of WM in early AD progression is observed. To obtain a robust functional relationship between microRNAs, by integrating different co-expression networks in a systems biology approach, a novel integrative measure, and a corresponding methodology are proposed. This is useful for identifying the dependence between co-expression and functional similarity. Results are demonstrated for evaluating the expression profiles of microRNAs taken from bone marrow samples of patients with leukemia. The detailed role of microRNAs and its regulation by transcription factors is explored for Parkinson's disease. For the first time TF-miRNA-mRNA regulatory network as well as miR co-expression network in this disease is built. In order to explore the crosstalk between TF, miR and target mRNA, regulatory networks were constructed. Study of these networks resulted in 14 Inter-Regulatory hub miRs whereas miR co-expression network revealed 18 co-expressed hub miRs. High conservation patterns were observed for most of these hub miRs across different species including human. The study identified 23 novel miR markers which can open up new avenues for Parkinson therapeutic efforts.

S. Bandyopadhyay

Attribute Clustering in Microarray Gene Expressions

A novel application of Fuzzy Clustering of Large Applications based on Randomized Search (FCLARANS) was made for attribute clustering and dimensionality reduction in gene expression data.

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Domain knowledge based on gene ontology and differential gene expressions were employed in the process. The use of domain knowledge helped in the automated selection of biologically meaningful partitions. Gene ontology (GO) study helped in detecting biologically enriched and statistically significant clusters. Fold change was measured to select the differentially expressed genes as the representatives of these clusters. Tools like Eisen plot and cluster profiles of these clusters established their coherence. Important representative features (or genes) were extracted from each enriched gene partition to form the reduced gene space. While the reduced gene set formed a biologically meaningful attribute space, it simultaneously lead to a decrease in computational burden. External validation of the reduced subspace, using various well-known classifiers, established the effectiveness of the proposed methodology on four sets of publicly available microarray gene expression data.

S. Mitra

Tumor Classification

An integrated analysis of statistical methods and association rule mining on mRNA expression and DNA methylation datasets for the prediction of Uterine Leiomyoma using a novel rule-based classifier has been conducted. The performance of the classifier is compared with that of different existing rule-based classifiers. Also we have predicted the status of some important genes (through frequency analysis in association rules for tumor and normal class-labels individually) that have a major role for tumor formation in Uterine Leiomyoma.

S. Bandyopadhyay

Protein Protein Interaction Network

A multiobjective genetic algorithm-based biclustering technique has been proposed to mine protein interaction network of HIV-1 and human, realized as a weighted bipartite graph, to obtain dense biclusters having high mean interaction strengths. The identified biclusters (quasi-bicliques) correspond to strong interaction modules. The human proteins involved in the strong interaction module have been found to share common biological properties and they are identified as the gateways of viral infection leading to various diseases. These human proteins can be potential drug targets for developing anti-HIV drugs. The problem of detecting human protein complexes by partitioning large human Protein-protein interaction (PPI) network into clusters is posed in a multiobjective genetic algorithm framework. Different graph-based properties and a fuzzy semantic similarity measure are optimized. The performance is demonstrated on the human PPI network and the resulting complexes are analyzed in the context of Gene Ontology (GO) and pathway enrichment. The biological relevance of our predicted complexes is also established here by linking them with 22 key disease classes.

S. Bandyopadhyay

Medical Imaging

Bias Field Correction in MRI

A novel approach is presented for bias field correction in MR images. It judiciously integrates the merits of rough sets and contraharmonic mean. While the contraharmonic mean is used in low-pass averaging filter to estimate the bias field in multiplicative model, the concept of lower approximation and boundary region of rough sets deals with vagueness and incompleteness in filter structure definition. A theoretical analysis is presented to justify the use of both rough sets and contraharmonic mean for bias field estimation. The integration enables the algorithm to estimate optimum or near optimum bias field. Some new quantitative indices are introduced to measure intensity inhomogeneity artifact present in a MR image. The performance of the proposed approach, along with a comparison with other approaches, is demonstrated on both simulated and real MR images for different bias fields and noise levels.

P. Maji

Gene Regulatory Networks

Inference of gene regulatory networks (GRNs) is one of the most challenging research problems of Systems Biology. A new GRNs inference methodology, called Entropic Biological Score (EBS), which linearly combines the mean conditional entropy (MCE) from expression levels and a Biological Score (BS), obtained by integrating different biological data sources, is developed. The EBS is validated with the Cell Cycle related functional annotation information, available from Munich Information Center for Protein Sequences (MIPS) and compared with some existing methods like MRNET, ARACNE, CLR and MCE for GRNs inference. For real networks, the performance of EBS, which uses the concept of integrating different data sources, is found to be superior to the aforementioned inference methods. Approximately 40% of the inferred connections by EBS are found to be correct and significantly better than related methods. The results also indicate that expression profile is able to recover some true connections that are not present in biological annotations, thus leading to the possibility of discovering new relations between its genes.

S.S. Ray

Machine Vision and Perception

The Oriented Difference of Gaussian (ODOG) filter of Blakeslee & McCourt (1999) has been successfully employed to explain several brightness perception illusions which include illusions of both brightness-contrast type, e.g. Simultaneous Brightness Contrast (SBC) and Grating Induction (GI) (McCourt 1982), and brightness-assimilation type, e.g. White effect and shifted White effect. We demonstrate some limitations of ODOG in predicting perceived brightness through a new study involving specific parameters such as test patch length and spatial frequency in some selected brightness illusions.

K. Ghosh

Documentation, Research and Training Centre (DRTC), Bangalore

The main areas of research in which the DRTC Faculty were engaged during the period are furnished below.

Knowledge Organization

The focus of Knowledge Organization has transformed substantially in the last one decade as a direct consequence of the emergence of digital resources, digital libraries and the World Wide Web. Knowledge organization, today, has to meet the twin objectives of facilitating organization of information resources for effective retrieval while at the same time look at ways and means of effective tagging of the huge volume of digital resources to support retrieval at acceptable levels of precision. Development of Faceted ontology for Music was also done. Research on the following issues is being carried out:

- a) How to reshape and sharpen traditional knowledge organization tools such as classification schemes and thesauri to meet the changing requirements of information representation and retrieval?
- b) Development of Faceted Ontologies based Colon Classification Principles.

Devika P Madalli

Faceted Approach for Domain Ontology Development

The research focuses on developing a systematic, comprehensive and formal methodology for domain ontology construction. The goal is to build a general process flow independent of any specific domain. Towards this we have already come out with preliminary result, a process flow called YAMO, yet

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another Methodology for Ontology Development. Currently its further refinements base upon the results also found through its applications in constructing ontologies. Developed a process flow called YAMO, Yet Another Methodology for Ontology Development.

Biswanath Dutta and S.R. Ranganathan

Linguistic Phenomenon and Knowledge Organization

The research focuses on finding the various linguistic phenomena (e.g., complementary polysemy, contrastive polysemy, metonymy, metaphor) that are present in WordNet, a large scale lexical database highly used for the Natural Language Processing (NLP) tasks. Besides resolving the linguistic phenomena issues, we are also working on adding semantics into it by making structural changes applying the knowledge organization techniques. The goal is to make WordNet a truly useful resources for NLP tasks, for instance, word sense disambiguation, relationship extraction, annotation, abstract construction, question answering. The first version of the cleaned knowledge base is delivered. In this work resolved the linguistic phenomena such as complementary polysemy and contrastive polysemy. The next target is to resolve the issue of other linguistic phenomena including metonymy.

A.A. Freihat, F. Giunchiglia and Biswanath Dutta

Digital Libraries and Semantic Web

Research is carried out in faceted ontologies in social and media research. Study of Wordnet for semantic compatibility as part of EU funded FET Living Knowledge Project, was under taken. The main objective of the project is to develop ontologies using faceted approach, in order to provide folksonomies which should facilitate visualizations to the end-user. DRTC is actively pursuing research in web ontologies using RDF (Resource Description Framework), OWL (Web Ontology Language) and SKOS (Simple Knowledge Organization system). The ultimate goal is to develop context based search mechanisms combined with inference engines. Domain based ontologies in LK format are being built.

Open Data Repositories

With more and more open data being published, the questions of how to harness, organize and build useful applications on data have risen. Open Data repositories is the next big stop in data management processes, standards and architectures. Indus: Harvested Repository in agricultural for Asia and Thematic harvesting model from Generic representation was also done.

A.R.D. Prasad and Devika Madalli

Semantic Application

The research focuses on developing semantic applications (e.g., semantic content management system, semantic digital library, semantic learning management system, question answering system) applying the semantic techniques and technologies, such as, RDF, OWL, SPARQL, Description Logics, Rules, etc. Also, we are working on tools for translating a natural language query into a SPARQL query.

Biswanath Dutta

Multilingual Data in Indian languages for Universal Decimal Classification

Coordination and supervision of translation and mapping of concepts for Universal Decimal Classification in Indian languages such as Hindi, Kannada, Tamil, Telugu, Marathi and Punjabi is being pursued. Presently work on Urdu is ongoing. We also worked on Hindi translation for the following ontologies: Space, food, schema.org, ETLO ontology.

Devika P. Madalli and Biswanath Dutta

Library and Information technology

In the recent past, several technology applications to library and information work have been demonstrated. As a part of this kind of research, a LiveCD called Liblivecd has been released. It is preconfigured with DSpace digital library software + Koha, Library Management Software + PKP Harvester (which collects metadata from various digital/institutional repositories to provide a single stop search engine) + dbwiz, a federated search engine which facilitate searches across e-journals and online databases. The Liblivecd is hosted on <http://sourceforge.net/projects/liblivecd>. The updated version has been provided at the same site.

A.R.D. Prasad

Institutional Repositories and Open Access to Information

In the 1990's a movement was started to enhance public access to scholarly journal articles through the pre-print servers. In these servers, authors would deposit pre-prints of articles. It thus provided readers worldwide with a quick access to research outputs. These types of servers began as informal vehicles for the dissemination of preliminary research and literature. However, the last decade witnessed the rapid evolution of such resources into increasingly important media for dissemination of research results in certain fields. Broadly known as "Open Access to Information". In keeping with International and national importance of the area of Open Access to Information at DRTC the following contributions were made:

- Comparative study of open source tools for digital repositories
- Study the Feasibility of designing and developing an appropriate prototype Institutional Repository (IRs) model using open source software easily implementable in all the universities in India.
- Study the adequacy of existing standards in this regard especially for scholarly material in Indian languages and scripts.
- Design an end user interface for browsing, navigating through and searching the Institutional Repository.

A.R.D. Prasad and Devika P. Madalli

Development of Universal Knowledge Core

DRTC has a long history in its contribution to Knowledge Modeling and management for systems in libraries. The principled approach of analytico synthetic classification is now applied to semantic web especially for developing faceted ontologies. The work in the past few years has lead to an international team working towards development the Universal Knowledge Core. Development of food ontology and matter ontology was also done.

Devika P. Madalli and Biswanath Dutta

Systems Science and Informatics Unit, Bangalore

Broad areas of research carried out by the faculty members at Systems Science and Informatics Unit (SSIU) fall under the category 'Computing in Science and Engineering'. SSIU deals with multidisciplinary research. Nature, Society, and Science consists of numerous phenomena and processes, the behaviors of which traverse various phases ranging from very simple to highly strange. Current faculty members of SSIU are dealing with some of such phenomena and processes from certain (but different) domains—such as terrestrial systems, urban and environmental systems, brain function, sociological systems etc—via computationally rigorous approaches and also via informatics. Efficient way of understanding the dynamical behavior of many complex systems of nature, society and science is possible through data acquired at multiple spatial and temporal scales. Earlier, several toy models were developed via classical mathematics to explain several possible phases in dynamical behaviors of complex systems. With the advent of computers with powerful graphics facilities, about three decades ago the interplay between numeric (generated via classical equations explaining the

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behaviors of dynamical systems) and graphics are shown. That progress provided initial impetus to visualize the systems' spatial and/or temporal behaviors that exhibit simple to complex patterns on graphical screens. Since last two decades, we have been seeing significant breakthroughs in data acquisition procedures with precision. Retrieving relevant information from such precisely acquired spatial-temporal data of varied types about a specific complex system is a basic prerequisite to understand the spatial-temporal behavior of a system. The varied but coherent phases involve in developing cogent domain-specific models include information retrieval from the source data, information analysis, information reasoning, and simulation and modeling. These essential components that faculty members deal with at SSIU are basic ingredients of informatics, the science and engineering of information. They are pursuing vigorous research programs in Spatial Informatics, Computational Neuroscience, and Computational Intelligence. These areas of research are presently being carried out in two broad research groups: Spatial Informatics Research Group, and Computational Neuroscience Research Group.

B.S. Daya Sagar, Kaushik Majumdar and Saroj Meher

Variable-Specific Classification of Zones, Pairs of Zones, and Clusters of a Spatial System via Modified Gravity Model

Zones and a cluster are the terms employed to respectively denote segmented regions and an image, states and a country etc. We provide a modified gravity model by incorporating dilation distances between the zones, and the location significance indexes of the corresponding zones. This model yields asymmetrical level of interaction between the zones. Traditional gravity model computes the variable-specific level of interaction between the two zones by considering the variable-specific masses and the distance between the two zones. The heuristic argument is that the level of interactions between the zones, with corresponding masses, situated at strategically insignificant locations would be much different from that of the zones, with similar masses, but situated at strategically highly significant locations. In support of this argument we provide a modified gravity model by incorporating (i) dilation distances between the zones, which will be asymmetrical, and (ii) the product of location significance indexes of the corresponding zones. This model yields asymmetrical level of interaction between the two zones that is more realistic. We demonstrate this modified gravity model on the 28 states of India, whereby the areal extents of each state is considered as a parameter mass. The levels of interactions are shown for all possible pairs of states.

B.S. Daya Sagar

Ranks for Pairs of Spatial Fields via Metric based on Grayscale Morphological Distances

A new metric to quantify the degree of similarity between any two given spatial fields is proposed. This metric is computed by taking the product of two ratios, where the parameters are derived from both the spatial fields. These two ratios include: (i) ratio of areas of infima and suprema of two spatial fields, and (ii) ratio of minimum and maximum of grayscale morphological erosion and dilation distances computed between the two spatial fields with respect to a structuring element. This metric that relies on the aforementioned parameters of morphological significance can be used to derive best pair(s) of spatial fields among a large number of spatial fields available in a database. This metric can be used in the image classification, in particular hyperspectral image classification. A training set (like a sub-image depicting a variable acquired via physical mechanism) can be used as a probing subimage, with which similar subimage would be searched within a image required to be classified. This search would be via computation of metric between the every 3x3 region of the image to be classified and the probing subimage (training set) so that the main image can be converted into a kind of ranked (metric) image, which further needs categorization of the regions based on defined ranges for thresholding. Extending this approach (i) by replacing the considered flat symmetric structuring element with a structuring function, and (ii) for color and hyperspectral images are open problems.

B.S. Daya Sagar and Lim Sin Liang

Neural Signal Processing

Worked on astrocytes modulated synaptic plasticity modeling under a DST funded project as the PI. Worked on neural signal processing to study ensemble phase synchronization on scalp EEG of patients with schizophrenia vis-à-vis normal controls (in collaboration with NIMHANS). Studied epileptic seizure offset dynamics in terms of mutual dependence among focal intracranial EEG signals under an ISI funded project. Most significant finding is 'number of simultaneous peaks and troughs across focal intracranial EEG channels is more after the seizure offset than during the seizure, where duration after the offset is equal to the seizure duration.

Kaushik Majumdar

Granular Neural Networks for Pattern Classification

The objective of this study is to develop a new concept of granular neural networks and establish a solid framework as to the underlying ideas of information granules and their role in the construction of neural networks. Our intent is also to analyze how the level of granularity of the available data may impact the learning in the networks as well as influence their resulting performance. The present work discusses an idea of granular computing regarded as a development environment of neural networks and leading to the emergence of a new class of granular neural networks. Such networks are viewed as new computing architectures that are focused on processing information granules rather than being geared towards plain numeric processing as usually encountered in most neural networks. The considered information granules are represented as assembles that may be formalized in the setting of set theory, fuzzy sets, rough sets or specified within a probabilistic environment. We will discuss several main approaches to the design of information granules. A number of fundamental issues will be tackled including specificity of information granules vis-a-vis learning complexity in the neural networks along with their generalization features. We also provide with a list of architectures of granular neural networks and elaborate on the associated training (learning) scenarios.

Saroj K. Meher and D. Arun Kumar

Development of mathematical morphology-based algorithms for generation of contiguous cartograms from point-data and, for modelling the spatiotemporal behaviour of varied phenomena via cartograms

Models developed via analytical means limit our understanding as it is hard to visualize the spatiotemporal behavior. However, modelling the spatiotemporal behavior of a phenomenon via proper visualization across spatial and temporal scales enhances our understanding. In conventional Geographical Information Science (GISci), development of models to visualize the spatiotemporal behavior is strictly by using choropleth raster maps. This modeling approach has various limitations as we employ some indicators such as color, shade, hatching, label to represent the strength of a variable. But it is proposed to develop variable-specific cartogram, in which the strength of the variable reflects in terms of area occupied by the unit. Employing such variable-specific cartograms of varied related phenomena is more appropriate to develop models to understand the spatiotemporal behavior of a phenomenon, as well as to understand the spatial relations between the cartograms of varied phenomena. The main objectives of this study include: (i) to develop efficient mathematical morphology-based algorithms to generate variable-specific cartograms that preserve global, topological and local shapes with minimum area-errors, (ii) to develop cartogram-based models to characterize spatio-temporal behavior of time-varying geographic phenomena of varied types, and (iii) to show the spatial relationships among the varied types of geographic variables that are visualized in the forms of cartograms and to demonstrate the potential of cartograms-based relationships.

B.S. Daya Sagar and Raghvendra Sharma

Computer Science Unit, Chennai

Strategic reasoning: Building cognitive models from logical formulas

Continuing from previous year, we revised and finalized a journal paper on bridging the gap between logical and cognitive treatments of strategic reasoning in games. The purpose and the motivation of this attempt were clarified in a better way, and the usage of the logical framework was worked out in greater details.

S. Ghosh, B. Meijering and R. Verbrugge

Conditional preference networks support multi-issue negotiations with mediator

Conflicts of interest occur in various aspects of our daily life and we often come to an understanding by negotiating our way through these conflicts. This paper presents a simple interactive negotiation approach to resolve certain conflicts that involve multiple issues. The focus is on mediation to facilitate a solution based on alternating offers over a finite-time bargaining game. The mediator explores the possibilities and proposes a jointly optimal negotiation text for all the players participating in the negotiation process, based on their conditional preference networks (CP-nets). Each individual player then makes a decision to accept or reject the proposal based on their utility CP-nets. If any player rejects, the mediator offers another negotiation text and the process goes on until an agreement is achieved or some time limit is reached. Two algorithms are developed with regard to the players as well as the mediator, and a daily-life situation is investigated based on them. A historically important negotiation event has also been investigated using this model.

S. Ghosh, T.H. Kyaw, and R. Verbrugge

Agreeing to agree: Reaching unanimity via preference and reliability dynamics

We study the process through which unanimity can be reached on various issues among multiple agents by investigating the ways the individual preferences change. To model such scenarios we consider agents with a preference ordering on the set of possible worlds and a reliability ordering on the set of agents, and we introduce different procedures for revising individual preference and reliability as a consequence of the announcement of the individual preferences. We develop characterizations and decision procedures which sheds insight into this process of reaching unanimity under different constraints.

S. Ghosh and F.R. Velazquez-Quesada

Backward and Forward Induction Behavior in Dynamic Perfect Information Games

We conducted an experiment where subjects played a perfect-information game against a computer, which was programmed to deviate often from its backward induction strategy right at the beginning of the game. Subjects knew that the computer is nevertheless optimizing against some belief about their future strategy. However, we found no conclusive evidence that subjects typically took advantage of this knowledge to increase their payoffs, by employing forward-induction reasoning which could have rationalized the computer's initial move. We are also trying to set up parsimonious epistemic logic syntax to address both backward and forward induction reasoning in perfect-information games so as to set up directly comparable axiom systems, one for backward induction reasoning and the other for extensive form rationalizable reasoning.

S. Ghosh, A. Heifetz and R. Verbrugge

Variations in Vertex Coloring

The problems concerning coloring and independent sets of graphs have been driving research in graph theory in a major way from the beginning of graph theory. Many real world problems like storage problem, register allocation and time table scheduling can be modeled as graph coloring

problems. Several variations of vertex colorings have been introduced and studied in the literature. Even for very restricted classes of graphs, the coloring problems are NP-complete. Theoretically, one is interested in obtaining a characterization or a structural description of graphs with a given chromatic number. A star coloring of a graph G is a coloring of vertices of G such that (i) no two adjacent vertices receive the same color, and (ii) no path on 4 vertices is bi-colored. The star chromatic number of G , $\chi_s(G)$, is the minimum number of colors needed to star color G . We showed that if a graph G is either non-regular subcubic or cubic with girth at least 6, then $\chi_s(G) \leq 6$, and the bound can be realized in linear time.

T. Karthick and C.R. Subramanian

Independent Sets in Graphs via Decomposition Techniques

Graph decompositions play a crucial role in structural graph theory and in designing efficient graph algorithms. Among them, clique separator decomposition (a decomposition tree of the graph whose leaves have no clique separator (so-called atoms)) used by Tarjan for solving various optimization problems recently received much attention. We first derived the atomic structure of two subclasses of P_5 -free graphs, where P_5 is a chordless path on five vertices. These results enabled us to provide efficient solutions for the Maximum Weight Independent Set problem in these classes of graphs.

T. Karthick

Practical (Second) Preimage Attacks on the TCS_SHA-3 Family of Cryptographic Hash Functions

TCS_SHA-3 is a family of four cryptographic hash functions that are covered by a United States patent (US 2009/0262925). The digest sizes are 224, 256, 384 and 512 bits. The hash functions use bijective functions in place of the standard compression functions. In this paper we describe first and second preimage attacks on the full hash functions. The second preimage attack requires negligible time and the first preimage attack requires $O(2^{36})$ time. In addition to these attacks, we also present a negligible-time second preimage attack on a strengthened variant of the TCS_SHA-3. All the attacks have negligible memory requirements. To the best of our knowledge, there is no prior cryptanalysis of any member of the TCS_SHA-3 family in the literature.

Gautham Sekar and Soumyadeep Bhattacharya

Meet-in-the-Middle Attacks on Reduced-Round GOST

The block cipher GOST (GOST 28147-89) is a Russian standard for encryption and message authentication that is included in Open SSL 1.0.0. In this paper, we present meet-in-the-middle attacks on several block ciphers, each consisting of 22 or fewer rounds of GOST. Our 22-round attack on rounds 10–31 requires only 5 known plaintexts and a computational effort equivalent to testing about 2223 keys for a success probability of 1-2-65. This attack is the best (going by the number of rounds) low data complexity key-recovery attack on GOST.

Gautham Sekar, Nicky Mouha and Bart Preneel

Lightweight Cryptograph

The goal of the project is to design a block cipher that is secure and suitable for constrained environments such as smart cards and RFID tags.

Gautham Sekar, G. Ravindran and Cidambi Srinivasan

Hidden Protocols: modifying our expectations in an evolving world

Continuing from previous year, we revised and finalized a journal paper on how agents perceive protocols that are not commonly known, and propose logic to reason about knowledge in such scenarios. The framework is extended to incorporate fact changing actions, and the example of

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'hundred prisoners and a light bulb' was analyzed, where the guard's perspective was modeled adequately.

H. Van Ditmarsch, S. Ghosh, R. Verbrugge and Y. Wang

Cryptographically Significant Boolean Functions

Boolean functions with high nonlinearity on odd number of variables.

Ayineedi Venkateswarlu

Physics and Earth Sciences Division

Geological Studies Unit

Channel dynamics in the Sundarban estuarine system: a study from the Basanti-Gosabaregion, south 24-Parganas

The salinity of water increased gradually from postmonsoon to premonsoon period and decreased to a lowest value in monsoon. The salinity measured at the end of 2012 monsoon was of the order of 6000 ppm (mg/l) that reduced to 5000 ppm at the end of 2013 monsoon. The study carried out in the Matla-Bidyadhari interfluvium (tidal range- 5-8 m, average elevation- 3 m) revealed that the pattern of channel network and tidal flow path is extremely complex leading to extensive bank erosion, breaching of embankments and overbank flooding. It was inferred that the principal parameters controlling the continuous change in the hydro-morphological environment of the region are sediment influx from the sea, longitudinal variation in the cross-sectional profiles of the creeks. It has also been observed that the flow pattern in the creeks is greatly influenced by anthropogenic activity such as building up of embankments. Many of the transverse creeks seem to have their origin from man-made canals as human settlement began in the area in the 19th century.

C. Chakraborty

Sedimentology of the Triassic mud-dominated fluvial systems

The occurrence of thick intervals of mud-rich sediments in an ancient fluvial succession normally suggests a low-energy depositional environment characterized by sluggish rivers in wide, muddy floodplains. In such a situation mud-sized sedimentary grains comprise a significant proportion of the load and are transported in suspension. In contrast to that field sedimentologic evidences obtained from the Late Triassic Maleri Formation of Pranhita-Godavari Valley Gondwana basin, A.P., indicated that these mudstones are dominantly composed of sand-sized mud aggregates that were transported as traction load in flash-flood dominated, high-energy ephemeral streams. Formation of silt-sized aggregates due to flocculation of clay particles is well known. However, sand-sized aggregates surviving energetic fluvial transport would require unique geochemical environment. Formation of clay-rich regoliths by weathering of source rocks under an earlier, highly oxygenated atmosphere, followed by erosion of sparsely vegetated landscape under the arid climate of the Triassic Period could explain these atypical sediments.

P. Ghosh, S.N. Sarkar, S. Dasgupta and S. Goswami

Evolution of dolomite formations in the Cuddapah basin: Numerical estimation constrained by field proxies

The objective was to understand the physical aspects of the lower Cuddapah succession that includes estimation of depositional time needed for thick carbonate formation and fluid – rock interactions including mineralization and groundwater contamination, by combining numerical modeling and geochemical analysis. Towards this, one dimensional transient reactive–transport models were developed to (i) test the hypotheses and estimate the rate of dolomite formations, (ii) estimate

quantitatively calcification of Vempalle dolomite by constant volume replacement mechanism, and (iii) estimate groundwater fluoride release by dissolution of minerals pulled by carbonate precipitation.

Amlan Banerjee

Fault zones, fractals and crustal deformation in the Eastern Himalaya

Fault traces corresponding to the Main Boundary Thrust (MBT) separating the Siwalik rocks from the Gondwana rocks have been identified in the Lish River section, North Bengal. The fault zone affects both the footwall and the hanging wall protoliths through production of coarse breccia, microbreccia, ultracataclasite and foliated gouges. Above the MBT fault zone, the coal bearing Gondwana strata were deformed by disharmonic folds and fault detachments with ultracataclasite smears derived from coal/carbonaceous shale. The middle-upper Siwalik Sandstone was homoclinal (gentle northerly dip), except near the MBT, where a footwall syncline was formed. Otherwise, deformation in the MBT footwall was dominated by brittle fracturing. On the basis of preliminary fault slip analysis from the Lish River section Northeast trending horizontal maximum compression in the MBT zone has been deduced.

Dilip Saha and Abhijit Patra

Tectonics of metabasalt-metagranite association in a geochemical approach

On the basis of field observation, petrography, and geochemical data two distinct group of metagranites have been recognized in the southern Nellore schist belt. The first group with negative Eu anomaly were associated with metabasaltic rocks such as plagiogranite veins as in the Kandra ophiolite complex, those intercalated with Vinjamuru Group metabasalts, and small felsic stocks intruding metapelites. All these contained primary hornblende, and the REE geochemistry indicated derivation from differentiated tholeiitic basalt magma. The second groups of granites were foliated, contained common mafic enclaves as around Gurrankonda, had slightly fractionated LREE, and low Σ HREE.

Dilip Saha and Arnab Sain

Microstructure and garnet composition in the Lesser Himalayan sequence (LHS) in Eastern Himalaya

New mineral chemistry data and garnet microstructures in association with structures of the LHS in Arunachal and Sikkim Himalaya have been interpreted as Paleoproterozoic tectonic activity leading to a possible Pacific type accretionary orogen along the northern margin of greater India.

Dilip Saha

Formation and Characterization of Reverse Micelles or Water-in-oil Microemulsions in Ionic Liquids (ILs)

A correlation between the solubilization capacity in presence of ionic liquids (bmimCl or hmimCl or bmimBF₄ or BzmimCl) with percolation of conductance vis-à-vis droplet dimensions and the states of confined water has been drawn to underline mechanism of solubilization phenomenon in mixed surfactant microemulsions [AOT/non-ionic surfactants of different hydrophilic and hydrophobic moieties (Brij-56 or Brij-58 or Brij-76 or TX-100 or Tween-80)/heptane (Hp) or decane (Dc) or IPM/water]. The significance of this study demonstrates prospective applications of these systems in the synthesis of nanomaterial and controlled release. Formation, thermodynamic properties and microstructural characterization of a water-in-oil nonionic microemulsion [Tween-20/1-pentanol (Pn)/cyclohexane (Cy)/water] in absence and presence of an ionic liquid (IL) (1-butyl-3-propylbenzimidazolium bromide) under different physicochemical conditions, have been investigated. In addition, C-C cross coupling reaction (Heck reaction) has been employed to explore the properties of the IL (additive) in confined environment of the microemulsion vis-a-vis its interaction with the constituents of the interface. The novelty of this work demonstrates that the highest yield (75%) of the Heck product at a certain concentration wherein the microemulsion forms spontaneously with highest

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stability. Formation, thermodynamic properties and microstructural characterization of a water-in-oil anionic microemulsion [SDS/1-pentanol (Pn)/R-(+)-limonene or isobutyl benzene (IBB)/water] under various physicochemical conditions in absence and presence of an ionic liquid, [bmim]Cl have been investigated. The significance of this study is that both oils have been found to influence interfacial, thermodynamic, transport and microstructural properties of these systems, due to different extent of penetration in microenvironments.

Bidyut K. Paul, Kaushik Kundu, Sajal Das and Soumik Bardhan

Evolution of carbonate platform through time: examples from PG Valley, Chattisgarh and Cuddapah basins

The primary focus was on an integrated analysis of the lower Cuddapah succession, combining stratigraphy, depositional processes, depositional systems, and provenance. Stratigraphic analysis established how major sea level fluctuations coupled with regional tectonic events shaped the development of unconformity bound successions of the Papaghni and Chitravati groups of the Cuddapah succession. The oldest sequence, the Papaghni Group is represented by fan-delta, prodelta and shallow shelf deposits. The fault controlled sedimentation of the thick wedge of immature clastics (fan-delta) represents the syn-rift stage of basin evolution. The sediments at the delta-front were strongly reworked by wave- and tide-dominated coastal processes that enhanced both textural and compositional maturity, and generated beach and tidal bar complexes. Basement uplift and a hiatus in deposition follow the first cycle of sedimentation (Saha and Patranabis-Deb, 2014). The principal research effort for the year 2013-2014 was to complete the geological mapping in the area around Gooty in the south-western part of the Cuddapah basin. A revised geological map of the southwestern part of the Cuddapah basin around Gooty was prepared. Petrographic analysis of sandstones from different stratigraphic levels of the Papaghni and Chitravati groups display changing provenance, climate, and tectonics with time. The relationship between sandstone composition and sea level changes is being tested.

S. Patranabis Deb, Dilip Saha, Tuasha Mazumder and Prolay Ganguly

Community structure and ecology of the Mesozoic non-marine tetrapods of the Gondwana basins of peninsular India

Work on two ongoing Ph. D. dissertations, one on the significance of the varied temnospondyl amphibians and the other on some unique taxa of archosauromorphs; have been carried out during 2013-2014. A comprehensive review of the non-marine land vertebrate bearing Permian and Triassic formations of the world with special reference to the coeval Indian fauna has been done. As a part of the morphometry related phylogeny, posterior portions of lower mandibles of some temnospondyl amphibians have been successfully used to work out the phylogeny of the group at least at generic levels. A taxonomic scheme carried out on the post glenoid areas of mandibles of Triassic temnospondyls from the Panchet Formation, Eastern India, has been worked out. A study on some enigmatic vertebrae from Middle Triassic Yerrapalli Formation of Central India has been carried out. These vertebrae possibly indicate the presence of a fresh water shark in the Yerrapalli Fauna. A detailed taphonomic study of a temnospondyl occurrence in the Denwa Formation, Central India, has been carried out.

D.P. Sengupta, S. Bandyopadhyay and Saradee Sengupta

Study of gastropod diversity from the Indian fossil record (Mesozoic-Cenozoic) with special emphasis on phylogenetic systematics, evolutionary trends and palaeoecological interactions

Previously, intense naticid drilling (DF \approx 25%) on a Late Cretaceous turritelline lineage was reported from the latest Cretaceous sections in Rajahmundry, India. Now Naticid drilling predation has been documented at assemblage level of gastropod community as well as another group of mollusc i. e. scaphopods from the same horizon. We recorded a new dataset of naticid drilling predations, involving about 32 thousand gastropod specimens. These specimens belonged to 40 species of 20 families, thus representing a spectacular gastropod diversity that was not known until recently from this region.

5884 complete or near complete specimens were examined to quantify naticid drilling predation on this assemblage. It appeared that drilling frequency was significantly higher from all previous Cretaceous values. This was true for both assemblage-level and lower taxon-level results. Numerous studies of drilling predation on bivalves, gastropods, echinoids, brachiopods and ostracod were made, but only a few records of drilling predation on scaphopods were so far known. Class Scaphopoda is a small clade within Phylum Mollusca. Although scaphopods first appeared in the Silurian, drill holes were reported only from the Upper Cretaceous rocks of U.S.A. and Canada. Scaphopods likewise show very low rate (5-13%) of drilling predation.

S.S. Das

A Study of Neogene and Quaternary successions of eastern Himalayan foreland basin

In contrast to the fresh water fluvial environment reported for the Siwalik foreland deposits in the western and central (Nepal) Himalaya, a marine-deltaic environment has been inferred to have dominated the foreland basin paleogeography in the eastern Himalaya. Corroborative evidences from soil profiles, major and trace element geochemistry, traces of burrowing organism and spore-pollens are being investigated. The evidences collected so far will have important bearing on the general understanding about the Siwalik basin. In the modern Ganga-Brahmaputra River basin the different landforms like megafans, smaller alluvial fans and river terraces were studied. The study reveals that, in contrast to the prevalent notion of dominant tectonic controls of the landform in these mountain-front areas, climate played a significant role. A simple model for the megafan deposition was worked out.

T. Chakraborty, P. Ghosh, Suchana Taral, Subhra Mallick,
Sandip More and Subir Bera

Physics and Applied Mathematics Unit

Physics

Astro Optics

Analytic formulae for extinction spectra of ultra small silicate grains, a fourth component of Interstellar dust considered to play important role in classification of galaxies has been done as a final step to proceed for analytic study of interstellar dust in a general way.

A.K. Roy, R. Gupta, S.K. Sharma and P. Ranadive

Bayesian Approach to Data Analysis in Quasar Astronomy

The relation between distance and redshift for quasars has been estimated using Bayesian methodology. The data from Sloan Digital Sky survey (SDSS) has been analyzed with Bayesian Methodology and the data clearly indicate the deviation of Hubble relation at high redshift for Quasars. It sheds new light on the debates related to cosmological vs non-cosmological origin of redshift.

S. Roy, Sourabh Bhattacharya (BIRU) and Sabyasachi Bhattacharya (BIRU)

Cosmology of the Early Universe

Cosmic inflationary scenario has been analyzed in the light of latest observational data available from WMAP9 and Planck. The proposed models are (i) inflection-point inflation with Hubble-induced corrections embedded within Minimal Supersymmetric Standard Model, (ii) potential-driven DBI Galileon inflation in background Supergravity and (iii) Higgs inflation using the superconformal approach in Kaehler geometry. These potentials have then been employed in modeling inflation and in subsequent study of primordial quantum fluctuations for scalar and tensor modes, followed by confrontation with latest dataset. The flexibility of the potential allows us to match the observed amplitude of the TT-power spectrum, spectral tilt, and virtually mild running of the spectral tilt, which can put a bound on an upper limit on the tensor-to-scalar ratio consistent with observations.

Supratik Pal

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Dark Energy and Present Universe

A two-parameter generalization for the dark energy equation of state (EOS) for thawing dark energy models has been proposed and confronted with the latest observational data namely Type Ia supernovae, observational Hubble data, cosmic microwave background and Baryon Oscillation Spectroscopic Survey data. Our analysis revealed that the phantom type of thawing dark energy is favored upto 2σ confidence level. These results also showed that unlike the standard observable parameters, the model-independent parameters and the variations of EOS serve as better model discriminators for thawing dark energy models.

Supratik Pal

Physics of Cosmic Microwave Background Radiation

A method to extract the unlensed, intrinsic cosmic microwave background (CMB) temperature and polarization power spectra from the observed (i.e. lensed) spectra has been proposed using a matrix inversion technique. The delensed spectra obtained by the technique were calibrated against the Code for Anisotropies in the Microwave Background (CAMB) using Wilkinson Microwave Anisotropy Probe (WMAP) 7-year best-fit data and applied to WMAP 9-year unbinned data as well. In principle, the methodology may help in subtracting out the E-mode lensing contribution in order to obtain the intrinsic B-mode power, thereby providing important information about primordial gravitational waves.

Supratik Pal

Quantum Control Theory and Generation of Non-classical States in Interacting Fock Space

Significant advances in quantum optics, trapping of cold atoms and ions infused ample interest in the development of controlling of these systems. Recent breakthroughs in nano-scale engineering of artificial atoms have ushered the interest in the development of theoretical foundation of quantum control theory. On the other hand, realization of extremely strong intensity of laser beam and pulse shaping on the laser technology motivated the study of coherent quantum control both theoretically and experimentally. One of the main concerns in this development was to design the dynamics of a system to steer its initial state to a desired target state. In this context, a stable operation would be the fundamental prerequisite for proper functioning of any technological system. Quantum control theory would be an emerging field with application to Modern Technology of Quantum Computer and Quantum Information Processing. In recent years, much attention has been focused in designing and developing quantum control systems in Hilbert space. New models were studied to generate nonclassical state, which have P-representations that do not satisfy the requirement of non-negative definiteness valid for classical states. The studies developed earlier in interacting Fock space were continued. It was found that a two-level atom-interacting field system acquires a space parameter dependent Berry phase, which can be applied to implement the fault-tolerant quantum gate. A significant advance occurred in the generation of non-classical states with the help of three-level atoms.

P.K. Das

Quantum Information Theory

It was known that the degree of nonlocality of a theory is determined by the uncertainty of the theory if steering is present. Interestingly, it has been shown by us that the bound on nonlocality can be derived from degree of complementarity alone. In quantum theory, Bohr's complementary concept (expressed in a quantitative form) exactly reproduces the bound on nonlocality. The question whether the bound derived in this way would be achieved in a particular theory remains open. An ontological theory where quantum state is not a property of the physical system has recently been the subject of intense debate. The preparation contextuality for such theory has been established for all mixed qubit state. The nonlocality of every pure two qubit entangled state has also been shown by using a stronger condition on degree of epistemic nature of the quantum states.

G. Kar

Separable states have become important since they have been shown to possess non classical correlations. Recently, it has been conjectured that no two-qubit separable state of rank greater than two could be maximally non classical. Towards this, partial results have been obtained. An analytic proof was given to show that among the subclass of X states, there is a unique, upto local unitary equivalence, maximal separable state of rank two. The general problem is still open.

P. Parashar

Quantum Mechanics

Coherent states built with certain type of exceptional orthogonal polynomials have been constructed and various properties of such states have been examined. Dirac oscillator in the presence of a magnetic field in a noncommutative space has been studied and the corresponding chirality phase transition has been examined in details. Solutions of Dirac equation in (2+1) dimensions in the presence of various potentials have also been obtained.

P. Roy

Rational extension of quantum nonlinear oscillator model has been obtained. The extended model was shown to retain exact solvability, admitting a discrete spectrum and corresponding closed form solutions in terms of Jacobi type X_m exceptional orthogonal polynomials. A method for generating rational extensions of time dependent potentials, such that the associated Schroedinger equation admits solutions in terms of exceptional orthogonal polynomials, has been given.

B. Roy

Non-Commutative space times compatible with Generalized Uncertainty Principle were used in the context of external electromagnetic interactions, to show that compatibility with Generalized Uncertainty Principle leads to novel features in charged particle dynamics. Furthermore relativistic particle models compatible with various forms of noncommutative phase space algebra have been constructed, starting from a master model, in a unified way.

S. Ghosh

Quantum Field Theory

In the context of Higher Derivative Field Theories, it has been shown that higher derivative terms can lead to a novel Spontaneous Symmetry Breaking in momentum space leading to a space-dependent condensate structure. Stability of this condensate has also been established. Studies are being pursued in AdS-CFT correspondence leading to descriptions of holographic superconductors where the Black Hole solution in AdS is generalized to a solution in non-commutative space-time.

S. Ghosh

Applications of Quantum Field Theory techniques have been studied in the context of photon pair production in Metamaterial – conventional material junction, where Metamaterial samples has been considered with negative permittivity and permeability.

S. Ghosh and S K. Maiti

Quantum Transport in Low-Dimensional Systems

Most studies involving electron transport in nanojunctions address the overall transport properties of the junction, while works that consider the current distribution within the junction are relatively scarce. Recently, this issue was considered by us with focus on the phenomenon of voltage driven circular currents in molecular wires that have single or multiple loop structures. From the perspective of the overall conduction, the loop structure of the molecular bridge implied the existence of multiple pathways and consequently the possible effect of interference, as is often discussed and recently demonstrated. Understanding the local implication -- the possible existence of circular currents in such multiple path systems -- is important because of its consequences on the junction magnetic response:

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the production of a considerable magnetic field through the loops, the possible coupling to the electron spin with ramifications for spin-selective transport, and magnetic field control of molecular-size ring junctions.

S.K. Maiti

Quantum Tunneling for Dissipative System

The phenomenon of quantum tunneling in various dissipative environments has been considered for last decade or so. In order to do that investigations have been done on some conceptual issues associated with open system dynamics, such as de-coherence and Zeno effect. Investigation has been done regarding the connection between such processes through various time scales. Preservation of quantum coherence in systems like ion traps is one of the main motivations of our work. Various conditions have been proposed under which sustainable quantum coherence has been maintained. Ion trapping like mechanism is a possible candidate for building quantum memory devices. This branch of research is of foremost interest nowadays in the light of building quantum computers. So it is important to construct the quantum computational schemes in the backdrop of open quantum systems. Considering these facts, new attempt has been taken to extend our formalism to the area of adiabatic quantum computation.

S. Roy

Theoretical Condensed Matter Physics

Spintronics or spin based electronics has received enormous attention in the last few years due to its several remarkable applications in the area of nanotechnology. In this broad area of research, one studies the quantum transport properties of the electron spins and its application. Recently one of the main challenges of the theory, generation and control of spin current, has been probed by considering mechanical rotation. The coupling of mechanical rotation with the spin of the carriers can be visualized as spin orbit coupling, a crucial factor in the understanding of "spin" physics, under certain conditions. With the help of this inertial spin orbit coupling, in the arena of spin transport, theoretical proposals for the inertial spin filter, inertial spin galvanic effect have been demonstrated. Besides the semiconductor spintronics, study of spin orbit coupling is also important from the perspective of recently discovered electron vortex beams. In resemblance to optical vortices, electron vortices too carry quantized orbital angular momentum associated with the azimuthal phase-factor in their wave-function. The geometrodynamics of electron vortex beams has been studied recently from the perspective of the geometric phase associated with the scalar electron encircling the vortex line. It has been shown that in case of electron vortex beams with tilted vortices, the temporal variation of the direction of the vortex line gives rise to the spin imbalance, known as spin Hall effect.

B. Basu

FLUID MECHANICS & APPLIED MATHEMATICS

Controlling chaos in time-delayed system using threshold control

Controlling chaos is one of the important topics in the last two decades because sometimes it is unwanted situation in biological systems, neural activity and in laser system. Two types of control technique have been established previously, namely, feedback and non-feedback control. Chaos in time-delayed systems has been controlled using clipping mechanism. It is evident that this control strategy was very simple and easily implementable in real experiments where only a single variable is accessible for measurement. No adjustment of the system parameters was required and only the occasional resetting of a single variable was necessary to control the system. One can prepare a look-up table relating a threshold value for a desired temporal pattern. Most importantly, experimentally realized the control technique using a delay chaotic circuit has been done.

D. Ghosh

Integral Equations

Work on numerical solutions of linear Fredholm and Volterra integral equations using Gegenbauer multi-wavelets and cubic-Legendre multi-wavelets has been carried out. Quadrature rules for regular, singular and hypersingular integrals in finite range has been developed for application to solution of singular integral equations using Daubechies scale function. Also Gauss-Daubechies quadrature rule has been developed.

B.N. Mandal

Noise induced synchronization in time-delayed systems

In Biological science, neural network and laser system, it was observed that two or more systems were synchronized through a common media i.e. under common noise. Noise-induced and noise-enhance synchrony in two identical time-delayed systems driven by a common noise (Gaussian noise and colored noise) has been investigated. Numerical results revealed that the critical noise intensity for synchronization differs for different colors of noise. The effect of noise on chaos synchronization when two identical time-delayed systems are unidirectionally coupled has been studied. Experimental verification of noise-induced synchrony (NIS) in coupled time-delayed electronic circuits has been done.

D. Ghosh

Synchronization in coupled chaotic systems

Design of delay coupling for targeting multiple delays in two chaotic systems has been done. We have introduced different delays in different pairs of state variables of a drive-response system. The stability condition for this multiple lag configuration was derived with the help of the Hurwitz matrix stability criterion. Basically, the delay coupling for a driver oscillator has been designed where different delays were introduced in the coupling function and retrieved the delays at a response system. The parameter mismatch and the amount of delay did not affect the stability condition. The theory of multiple delays with numerical simulations of the mismatched Rossler system and Hindmarsh-Rose neuron model has been investigated. Physical implementation of the multiple delay configurations in electronic circuit of two coupled Sprott systems has been carried out. In another work, projective synchronization in delayed neural network using unidirectional delayed scalar coupling with adaptive scaling factor has been investigated.

D. Ghosh

Water Waves

Advanced mathematical work on wave scattering by a barrier in a two-layer fluid, water wave scattering by an elastic plate floating on water with a porous bottom, construction of three-dimensional wave free potentials, water wave scattering by a rectangular trench, etc. has been carried out.

B.N. Mandal

INTERDISCIPLINARY RESEARCH

Brain Function Modeling

The Central Nervous System (CNS) diffracts the external world into internal parameters which modulate its activity. Neurons are arranged in functional areas which define specific parameters reflecting certain useful properties of parts of the world. However the activity in these areas is also modulated by intrinsic characters and internal trends. Thus the parameters which internalize the world are not realized as themselves, they only control the activity, or dually, the activity is a function of the parameters. Such intrinsically driven set of compartments have evolved to transform very specific sensory transduction concerning the external world, via specialized sensors allowing the acquisition of information concerning the external world. These sensors by acting in unison (co-variants) represented

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external properties such that they could be transformed into guided action on the world (contra-variants), implementing a reciprocal motor transformation. With evolution a multiplicity of co-variants and contra-variants co-ordinate transformations have been implemented based on the same principle. To be useful to motor intentionality, the covariant input must be translated into a contra-variant movement vector language that allows motor specification. Dynamic geometry has been developed to describe the functional states of neuronal architecture. This will help to understand the subjective experience like “qualia” and the cellular basis of cognition.

S. Roy, Rodolfo Llinas and Daniel Bennequin

Flume Laboratory

A new project on Simulation of Hawking Effect in Analogue (Fluid) Gravity Model has been started. In order to detect the Hawking process at a white hole horizon in a fluid analogue gravity system, one wave-maker of 1HP motor with resistance controller was fabricated at the flume to generate the surface waves against the flow over the bottom wave. Test runs are going on and then series of experiments will be performed. The study was aimed at studying the turbulence characteristics in a scour developed near a fixed cylinder placed transverse to the flow. The conditional statistics of the Reynolds shear stress showed a good agreement with the experimental data. Turbulent flow and bed form dynamics under flood and tidal flow conditions were studied. The results were evaluated in terms of turbulence statistics and coherent structures in the perturbed flow regions affected by waveform oriented against the flow. The spatial and temporal changes of bed form structures due to submerged cylindrical piers of different diameters associated with the near-bed Reynolds shear stress over the equilibrium deformed beds at a constant flow discharge were studied. The effect of morphology on postmortem transportation of bivalves and its taphonomic implications were studied at the ISI flume by IISER and Jadavpur University students with the permission from the Director. Fossilized shell assemblages are often the result of postmortem transportation.

S. Ghosh

Biological Sciences Division

Agricultural and Ecological Research Unit

Detection, mapping and phenoplasticity of *Alternanthera philoxeroides*: an invasive weed

The status of *A. philoxeroides* infestation in pond ecosystems of this region was monitored to throw light on the impact of its growth on the species diversity. *Alternanthera philoxeroides* is regarded as one of the worst weeds due to its invasiveness, potential for spread and environmental impacts. Twelve ponds, with varying degrees of *A. philoxeroides* infestation, were individually studied seasonally (summer, monsoon and winter) using the Quadrat method to estimate *A. philoxeroides* ‘Cover (%)’ and number of associated macrophyte species (AMS) within each quadrat. Based on the cover percent, *A. philoxeroides* infestation was categorized into 4 grades (Grade I-IV) from lowest to highest. Overall, 20 AMS, including 16 aquatic/ littoral-associated, 2 non-aquatic species along with grasses and sedges, were found to be present in the ponds studied. A negative impact of high *A. philoxeroides* infestation (Grade IV) on the overall diversity of macrophytes was evident during each season. Further classifications of AMS into native and invasive categories revealed that higher infestations of *A. philoxeroides* severely limited the number and occurrence of important native species. The presence of *Ipomoea sp.*, the dominant co-occurring native species, was drastically reduced while six out of eight minor species were completely eliminated at the highest infestation grade of *A. philoxeroides*. A native submerged plant, *Vallisneria* sp., often a desirable component of aquatic ecosystems for its ability to maintain water quality, was severely impacted at high *A. philoxeroides* covers. Some of the AMS were other invasive / problematic species, the presence of which was fairly constant over all seasons and infestation grades. This could probably be indicative of possible facilitative interactions between *A. philoxeroides* and other invasive species.

A. Dewanji, S. Bhattacharya, P.K.Ghosal, C. Medda, A. Chatterjee and A.K. Banerjee

Allelopathy in an Aquatic and neighbouring Ecosystem and the role of allelochemicals in community structure

Allelopathy in aquatic environments can influence the competition between different photoautotrophs for resources and change the succession of species. Field observations and laboratory experiments indicate that allelopathy occurs in all aquatic habitats and that all primary producing organisms are capable of producing and releasing active allelopathic compounds. Our studies have been done on *Vallisneria spiralis* and *Lemna minor* in aquatic ecosystems and on *Eclipta alba* and *Piperomia pellucida* from neighbouring ecosystems. The individual and interactive impacts of the plants on the ecosystems were also considered. *Vallisneria spiralis* Linn. (family Hydrocharitaceae), is a submerged perennial plant with high invasiveness and exerts beneficial effect on the biodiversity on the entire aquatic ecosystem by inhibiting the growth of blue green algae thereby improving the physio-chemical properties of the water. Root exudates of *Vallisneria spiralis* imparts an antagonistic effect on the growth of *Lemna minor* and determine the community structure and dynamics of the populations within the aquatic ecosystem. Statistical analysis has also been carried out to validate the results. Our simultaneous work is carried out on the chemical characterization and bioactivity of *Eclipta alba* and *Piperomia pellucida*.

S. Mandal Biswas and N. Chakrabarty

Development of Information on Agricultural and Horticultural Production and their Marketing using RS and GIS in some district of West Bengal

Marketing is the major problem in Agriculture. Attempt has been made to identify the problem and prospect of different Huts and Markets (rural) using survey methodology. Four districts namely Coochbehar, Murshidabad, Purulia and 24 Parganas of West Bengal have been selected for the study. Here we are trying to integrate the spatial data (road network, market map, accessibility etc) with the primary survey data related to local huts and markets. At the same time the opportunities of growing different crops are also studied on those districts.

P. Banik, P.K. Ghosal, A.K. Banerjee, A. Sarker and M. Das

Evaluation of different sources and levels of phosphorous on field crops in Eastern India

Different aspects of phosphatic fertilizers are gaining interest of the researchers. Studies are undertaken to evaluate the effect of different levels of water and/or citrate soluble phosphorus on crop productivity and soil health in eastern plateau area. The results indicated that the application of different levels of water soluble phosphorus has significant effect on grain yield of rice and dehusked cob yield of baby corn as well as on crop growth and yield attributing characters in comparison to citric acid soluble phosphorus.

P. Banik, S. Bhattacharya, P.K. Ghosal, D. Das, S.D. Yadav and R.C. Sharma

An investigation on antimicrobial potential of Chebulic myrobalan (fruit of *Terminalia chebula* Retz.) against methicillin-resistant *Staphylococcus aureus*

Terminalia chebula is a medicinal plant used for the treatment of different types of diseases and disorders since antiquity because of its extraordinary power of healing. Effect of hydro alcoholic extract of *T. chebula* fruits against methicillin resistant *Staphylococcus aureus* has been studied in our laboratory. Acetone extract of *Terminalia chebula* fruits which was found to be most effective against the studied bacteria over other extracts tested in our previous experiments was subjected to bioassay guided fractionation following Silica gel column chromatography, Sephadex LH-20 Column chromatography, TLC and HPLC. Bioassay guided fractionation revealed the presence of gallotannins as active constituents. These gallotannins demonstrated metal ion complexing property. Further studies are in progress.

R.R. Chattopadhyay, A. Bag and S. Gupta

Site Specific Nutrient Management (SSNM) System for submerged rice in the eastern plateau region of India

Globally about 154 million ha of rice is harvested annually with a production of about 618.4 million Mg of rice. More than 90% of this is produced and consumed in Asia. India with 43.7 million ha under rice, produces about 140 million Mg of rice annually. But in recent years it has been reported that rice yields in many parts of south Asia are declining. This may be due to conventional blanket and injudicious use of fertilizers which not only reduces nutrient use efficiency, but also causes nutrient imbalance in soil resulting in decreased crop yield. It is therefore hypothesized that rice yields and plant nutrient uptake can be significantly increased by applying fertilizers on field specific basis. This gave rise to the concept of Site Specific Nutrient Management (SSNM) System approach for rice, developed in Asia in the mid 1990s. SSNM is thus defined as the dynamic field specific management of nutrients in a particular cropping season to optimize the supply and demand of nutrients according to their difference in cycling through soil plant system. The Chotanagpur plateau in India could be an appropriate site for experimenting SSNM approach on submerged rice due to its adverse climate, water resource and soil condition, which are very poorly suited to agriculture leading to very low crop productivity. With this background the present study was conducted to increase rice productivity in the submerged acid lateritic soil of the eastern plateau through site-specific nutrient management. Experiments were conducted on rice to obtain the optimum fertilizer doses for getting maximum yield in three different plots in the same agricultural field. Based on the results, experiments were also conducted using nutrient omission plot technique to get the SSNM dose for the particular rice variety. Soil and plant chemical analyses and the statistical analyses of the field data are under progress.

P.K. Ghosal, P. Banik, S. Bhattacharya, I. Mukherjee, T.K. Sasmal, C. Medda and K. Bhattacharya

A study on yield performance of Sweet Sorghum crop (*Sorghum bicolor* L.) at different location and fertility levels for maximization of bio-fuel production in West Bengal

Sweet Sorghum (*Sorghum bicolor* (L.) Moench) is a multipurpose crop, which store sugar in its stem. It can produce grain from its ear head and the stem can produce sugary juice, which can be fermented to produce ethanol for energy purpose. Sorghum has the highest dry matter accumulation rate when considered on a day basis. Sorghum planting is more advantageous than sugarcane and sugar beet, because it needs less water, produces maximum sugar production per hectare and has short growing period. The sweet sorghum stems, containing high concentrations of sugar and it is the most important product for use as a raw material for the production of Ethanol. Sweet sorghum stalks also can be used to generate steam for production of pulp, paper, plywood, methanol and ammonia, forage and syrup. Sweet sorghum has not been studied enough in West Bengal State and it has not been cultivated commercially on a large scale. Many sorghum cultivars are grown in India, but there are no reports categorized them into different types to help the farmers select the most suitable sweet, grain or dual purpose lines. Due to necessity needed for knowing appropriate agronomic practices and cultivar in different agro-climatic and different soil condition of state of West Bengal, India, this research was designed. The objectives of the studies are located at different district of West Bengal according to their different soil type. This year (2013-14) cultivar "Madhura" is selected. Seeds were supplied by ICRISAT, Patancheru, and Andhra Pradesh. The locations were at Basirhat of North 24-Pgs., Nimpith of South 24-Pgs. Sriniketan of Birbhum and Panskura of East Midnapore district. Total treatment combinations were 32. Nitrogen (N) = 4 level (N1) 0 Kg (N2) 40 Kg (N3) 80 Kg and (N4) 120 Kg/ha: Phosphorous (P) = 2 level (P1) 0 Kg and (P2) 60 Kg/ha: Potassium (K) = 4 level (K1) 0 Kg (K2) 30 Kg (K3) 60 Kg and (K4) 90 Kg/ha. (N4 x P2 x K4 = 32). Fertilizer Sources were Urea (46%) as N, Single Super Phosphate (16%) as P and Muriate of Potash (60%) as K. All fertilizers were applied as basal dose except Nitrogen. These 32 treatment combinations replicated thrice with Randomised Block Design (RBD) for all experimental sites. Each plot size was 8 sqm. (4m x 2m) and total number of plots were 96. Various yield data such as Green biomass Yield (t/ha), Grain Yield (Kg/ha), Sugar Concentration (%) and Sugar Yield (t/ha) were collected every 20 days interval starting from 80 days after sowing and up to 140 days after sowing. It has been observed from the experiment that the green biomass Yield (t/ha) was highest 37.55 t/ha given by treatment N120P60K60 kg/ha. 1152.58 kg/ha grain yield was given by the treatment N120P60K90 kg/ha and from the same treatment combination

9.44 % of sugar concentration was observed. Whereas, sugar yield of 3.74 t/ha was given by the treatment N80P60K90 kg/ha. All the average yield data placed here at 140 days after sowing harvest i.e. final harvest.

S. Barik, S. Chanda, G.M. Saha, D. Roy, D.K. Dasgupta and B.K. Dutta

Mangrove work

The present work is to consider genetic and enzymatic polymorphism in differential salinity level and Reactive oxygen species scavenging mechanisms in some degrading mangrove species in the western part of the Sundarbans like *Heritiera fomes*, and *Xylocarpus granatum* and some luxuriously growing mangrove members in the same regime like *Bruguiera gymnorrhiza*, *Excoecaria agallocha* and *Phoenix paludosa* (considered as natural control) to compare the adaptive efficiency among them. RAPD and ISSR molecular markers were used for this genetic diversity study. Degree of polymorphism was found relatively higher in *B. gymnorrhiza*, *Excoecaria agallocha* and *Phoenix paludosa* (26.43, 24.66 and 26.4 percent respectively in RAPD & 24.36, 24.87 and 20.32 percent respectively in ISSR) than the two degrading taxa, *H. fomes* and *X. granatum* both in case of RAPD and ISSR. The percentage of band polymorphism as revealed by RAPD and ISSR analysis for those two plant species were 14.6 and 14.2 & 11.98 and 11.63 respectively. Dendrogram constructed based on the similarity matrix showed that for both the plants, least saline and highest saline zones are positioned in the same clad, which points toward relatively lesser genetic polymorphism in those two plants.

S. Das and N. Dasgupta

Palaeoecological work

Palynological evidence is recognized as a logical deduction of paleoclimatic extrapolation, as coastal vegetation is so specialized that any minor deviations in hydrological or tidal influences cause radical variations in the vegetational succession.

S. Das

Plant Anatomical work

Myoporum bontioides, A. Gray (Myoporaceae), a red list plant in Japan, is restricted to only a few East Asian countries like China, Japan and Taiwan, associated to some true mangroves. Though ontogeny and structure of glandular hairs have resemblance to typical mangroves, considering leaf micromorphology, this plant is better termed as “mangrove associate” instead of “true mangrove”.

S. Das, Yeun Po Yang and C.S. Rong

Understanding biological systems with nano tools

Nanoparticles synthesized by wet chemical method allow atoms or molecules to form self-assembled structures. High volume: surface area allows a nucleus to form and then growth of the nanoparticles take place. Atoms or molecules stay in loosely bound conditions and majority of atoms or molecules stay on the surface. For example, 1 nm size nanoparticles usually have 90% of the atoms or molecules on the surface leading to enormous increase of surface free energy. Nanoparticles often act as activation site as the excess surface free energy is transferred to the surroundings. Biological organisms maintain definite structures which contain energy deficient areas or surfaces. Nanoparticles if applied to nearby areas attack the energy deficient spots and transfer energy leading to smoothening of the surfaces. Our laboratory utilizes this phenomenon in various biological systems to generate knowledge which could be applied to production systems and processes.

A. Goswami, S. Mitra, S. Pradhan, S. Das, P. Patra, A. Bhattacharya, P. Chakraborty, A. Basu, T. Datta Majumder, S. Akbar, M. Thapa, S. Roy, S. Sarkar, A. Mondal, S. Ghosh, A. Dey, P. Kundu, S. Roy Choudhury, S. Das, D. Banerjee, J. Banerjee and I. Roy

MATHEMATICAL/STATISTICAL MODELLING

Cooperative Recovery Mechanism: A Safeguard for Minimizing Extinction Risk

The concept of cooperation is closely related to Allee effect (Allee et al., 1949), named after Prof. Warder Clyde Allee that corresponds to low per capita growth rate when the abundance is small. Sufficient observational and experimental data shows that cooperation is another fundamental principle in animal species (Allee et al., 1949). Such positive density mechanism is observed among natural populations due to some demographic forces such as mating limitations, cooperative breeding, cooperative feeding, poorer defense against predators, lower foraging efficiency, intra-specific interactions, predator-satiation etc., predominating at low densities (Dennis, 1989; Kramer et al., 2009). In view of the empirical evidences of extinction threats and the related theoretical consequences, Allee effect received much importance in ecology and conservation biology. We study the impact of the Allee effect and prey refuge on the stability of a discrete time predator-prey system. We focus on the stability behavior of the system with the Allee effect in predator, prey and both populations. Based on the combination of analytical and numerical results, we observe that, (1) the Allee effect stabilizes the systems dynamics in a moderate value of prey refuge. (2) For a large fraction of prey refuge no significant improvement in stability is observed due to Allee effect. (3) Refuge may play an important role in managing the populations which are subject to the Allee effect. The population remains stable at an intermediate level of refuge parameter, whereas at relatively low and high refuge effect, prey exhibits chaotic oscillation. Such chaotic behavior is suppressed in presence of Allee effect. The Allee mechanism and refuge are considered simultaneously on the populations and is shown to have a significant impact on the predator-prey dynamics that may be helpful in conservation of endangered species.

S. Bhattacharya, J. Chattopadhyay, S. Rana, A. R. Bhowmick and J. Pal

Eco epidemiological modeling on disease dynamics on both prey and predator population

Incidence of cholera outbreak is a serious issue in underdeveloped and developing countries. In Zimbabwe, after the massive outbreak in 2008–09, cholera cases and deaths are reported every year from some provinces. Substantial number of reported cholera cases in some provinces during and after the epidemic in 2008–09 indicates a plausible presence of seasonality in cholera incidence in those regions. We formulate a compartmental mathematical model with periodic slow-fast transmission rate to study such recurrent occurrences and fitted the model to cumulative cholera cases and deaths for different provinces of Zimbabwe from the beginning of cholera outbreak in 2008–09 to June 2011. Daily and weekly reported cholera incidence data were collected from Zimbabwe epidemiological bulletin, Zimbabwe Daily cholera updates and Office for the Coordination of Humanitarian Affairs Zimbabwe (OCHA, Zimbabwe). For each province, the basic reproduction number (R_0) in periodic environment is estimated. To the best of our knowledge, this is probably a pioneering attempt to estimate R_0 in periodic environment using real-life data set of cholera epidemic for Zimbabwe. Our estimates of R_0 agree with the previous estimate for some provinces but differ significantly for Bulawayo, Mashonaland West, Manicaland, Matabeleland South and Matabeleland North. Seasonal trend in cholera incidence is observed in Harare, Mashonaland West, Mashonaland East, Manicaland and Matabeleland South. Our result suggests that, slow transmission is a dominating factor for cholera transmission in most of these provinces. Our model projects 6340(5565{7264) cholera cases and 271(238{309) cholera deaths during the end of the epidemic in 2008–09 to January 1, 2012. We also determine an optimal cost-effective control strategy among the four government undertaken interventions namely promoting hand hygiene & clean water distribution, vaccination, treatment and sanitation for each province.

J. Chattopadhyay and T. Sardar

Biological Anthropology Unit

Women autonomy, nutritional and immunization status of their children

In India, women's decision making power in different socio-economic conditions and how far different levels of decision making power influence their children's nutritional health and immunization status has been examined. For this study, third round of National Family Health Survey data has been used, based on 39,879 women, aged (15-49) years having their last children aged (0-59) months. Women's autonomy has been assessed through the four aspects of decision making, namely on own health care, large household purchase, mobility to relatives' house or other family members' house and ability to spend husband's money. Children's nutritional health status has been assessed through 'z' score value of weight for age and height for age. Immunization status has been assessed through the criteria of one dose of BCG, 3 doses of DPT and Polio and one dose of measles taken within the 12-23 months. Socio-economic variables are type of residence, women's educational and occupational status, type of ethnic group and wealth index of the family. The study reveals that better nutritional and immunization status of children depends on the consciousness and awareness of their mother. Awareness is directly related with the mothers white coloured job and this job are dependent on women's higher education. So it inferences that autonomy of mothers has the highest effect on nutritional and immunization status of their children.

The status of Infant health in India

The infant health status in India through nutritional, immunization and morbidity pattern and its relationship with socio-demographic variables has been examined. The data has been obtained from the Third National Family Health Survey data. The sample sizes are 7562 of (0-11) months of children. For socio-demographic data, places of residence, sex of infants, ethnic composition, religion and wealth index were considered. It has been found that 23 to 28 percent infants are undernourished. 73.4 % are immunized by BCG, 18.3 % are from measles, 39.6 % from DPT (triple dose) and Polio (47.5 %). Suffering from diarrhea, fever and cough also varies from 15 to 22 percent. It is also seen that some socio-economic factors like urban areas, mother's education and wealth index has an impressive effect on reduction of under-nutrition and also on morbidity but there is no impact of socio-economy on immunization and gender discrimination also. So it proves that along with the individual effect, health infrastructure of the state is also responsible for bringing of good health among children.

Autonomy of Tribal Women in India

Autonomy of tribal women in India through decision making power on purchasing household needs, going to relatives' house, getting healthcare facilities or getting access to husband's money or even having independent authority to spend their own income has been examined . Data from NFHS-3 Survey conducted in 2005-06 have been used for the analysis. Besides zonal variations, levels of education, types of occupation, working status of women etc., and other characteristics of the households, like wealth index, sex of head of household etc. has been considered to see the influence on decision making. The results of the analysis clearly show that the degree of women's decision making power increases positively with the age of women, literacy and wealth index. This is also found to be more on female headed households and nuclear families. Women in high professional jobs may have more power in the household decision making on healthcare of members in the family and mobility to go outside, but it may not imply higher economic power. Literacy of women plays an important role in the decision making power of tribal women in India.

Socioeconomic Determinants of Iron-Deficiency Anemia among Children Aged 6 to 59 Months in India

The extent of anemia and its socioeconomic determinants among the preschool children (6-59 months old) in India have been studied. Relevant data are taken from the third round of the National Family Health Survey. The initial analysis reveals some interesting features. The most affected children are in

Research Activities

the age-group of 6 to 23 months. Beyond this age a decreasing trend is observed up to the age of 48 to 59 months. The highest and the lowest prevalence of anemia have been found to be in the central and the northeast zones, respectively. The vulnerable groups are the children of illiterate parents and those belonging to the poor families in the rural areas. Categorical logistic regression also confirms that status of literacy and wealth of parents have strong negative association with the status of anemia of the children.

Growth and Nutritional Status of Pre-school Children: A Comparative Study of Jharkhand, Bihar and West Bengal

A Comparative study of growth and nutritional status of pre-school children of three states of India namely Jharkhand, Bihar and West Bengal using third National Family Health Survey (NFHS-3) data has been done. The sample sizes of Jharkhand, Bihar and West Bengal are 951, 1373 and 1600 respectively. Data on socio-demographic background of the households like sex composition, place of residence, religion, level of education of mothers, mother's age groups and wealth index of the family are taken to see the differential effects of these variables on the child health status. It is seen that the rates of growth of mean weights and heights are far lower in Bihar and Jharkhand than in West Bengal and India. It is also seen that high rate of stunting and underweight in Jharkhand and Bihar starts from 9 months and onwards while in West Bengal and India it starts from 12 months and onwards. Percentage of undernourished children is highest in Bihar followed by Jharkhand and West Bengal. Comparatively higher growth rate of nutritional status and the low intensity of under nutrition of children are found in the socio-economic groups of male gender, urban areas, other communities and of secondary and higher educated mothers. Another notable finding is seen that only in West Bengal, reduction of under-weight is directly related with upward movement of literacy along with wealth index but in Jharkhand and Bihar, there is no impact of literacy on reducing underweight and only higher wealth index is responsible for reducing underweight and stunting.

P. Bharati

Genetics of dermal ridges in Twins and Bedouins

Qualitative and quantitative finger and palmar dermatoglyphic traits were analyzed with the aim of determining genetic effects and common familial environmental influences on a large (358 nuclear pedigrees) number of twins (MZ and DZ). Genetic analyses includes Principal Component, variance and bivariate variance decomposition analysis, Maximum Likelihood- based Variance decomposition analysis etc. The study provided evidence of strong genetic component in quantitative finger dermatoglyphic traits.

South Sinai Bedouins

To compare the pattern of dermatoglyphic differences between two isolated groups of Bedouin males, Gebeliya and Muzeina from South Sinai with a high inbreeding coefficient of 0.0908 were analyzed for qualitative and quantitative finger and palmar dermatoglyphic traits with diversity and asymmetry (40 indices). Statistical analyses include Analysis of variance, Factor, Cluster, and Mantel test. The results were compared with other populations (Indians, Jews, Chuvashians, Turkmenians etc.) and observed little differences but poorly between the groups which suggest that the same genes are responsible for the presence of different finger pattern types in different populations. Extracted factors between the two sets of dermatoglyphic traits namely "digital pattern size", "intra-individual diversity" and "bilateral asymmetry" were highly similar in the two Bedouin populations which indicate, biological validity perhaps exists of the underlying component structure irrespective of consanguineous or non-consanguineous populations. All variables (for both groups) could be mainly categorized into three main large clusters and these are similar for each population. This similarity was confirmed by the Mantel test of Matrix correlation, $r = 0.65$, the values of Z were within the level of non-significance, i.e., very good similarities in Gebeliya (0.64) and good similarities in Muzeina (0.94) traits. The levels of similarity are: $0.9 \leq r$ (very good) and $0.8 < r \leq 0.9$ (good). These results strongly suggest that a

common genetic background also exists in the Bedouin groups like other populations between two different sets of dermatoglyphic variables.

B. Karmakar

Genetics of PCOS: A Bioinformatics analysis of candidate genes and interaction of genes using using STRING and CYTOSCAPE

PCOS is a complex heterogeneous disorder with characteristic symptoms of irregular menstruation, hyper androgenism, insulin resistance, obesity and type II diabetes etc. involving biochemical pathways and a cascade of genes that are involved in the pathways. Molecular genetics studies have implicated at least about 40 genes that are related to different biochemical pathways. How these genes related and interact with others will be of importance to understand the etiology of PCOS. Analysis of bioinformatic tools of STRING and CYTOSCAPE of the known candidate genes involved in PCOS suggests a few clusters of gene-network involving interaction of specific genes. This could possibly explain varied etio-pathology of symptoms associated with PCOS.

Biological Data Base of North-East Regional Populations

NE-I data base: Created an online biological data base “NE-I db”. This is an attempt bring all the available biological information and studies on diverse northeastern regional populations published at different timings and in different journals to be available on a single web-based platform for the use of scholars, academicians etc.

T.S. Vasulu

Health status and Health Behaviour of Santals: comparison between urban and rural groups

The study aims to assess and compares health status of the Santals living in both rural and urban settlements. The study of existing health behaviour of both the Santal groups is also a part of the study objective. Health behavior study is the footstep of health sector reform. A number of subjective and objective health data have been analysed, which have been collected from both the groups and a Ph.D. thesis is under preparation. The important findings for rural group compared to urban group include—(1) both fertility and mortality is higher; (2) Physical body dimensions are lower; (3) Blood and blood pressure parameter values are lower; (4) Economically and educationally poor; (5) Physically more active; (6) Not very conscious over their health, for any health problem they depend on herbal medicine man or quack doctor; (7) hygienic practices are also poor.

Health of Stone quarry workers of Birbhum District

Stone quarrying and crushing is potentially a hazardous job, nature of the job, working condition and the environment has severe health impact on the quarry workers. The quarry workers are continuously exposed to stone dusts and noise generated during different modes of operation. Besides, the prevalence of sexually transmitted infection is high among the quarry workers. In general, the quarry workers suffer from respiratory, cardiac, hearing and vision impairment etc. The aim of the project is to (1) see the health status of the stone quarry workers and (2) to investigate the health hazards linked with the stone quarry work. In the present study, four groups of stone quarry workers have been selected – (1) Working in the quarries and residing within the quarry area (2) Not working in the quarries but residing within the quarry area (3) Working in the quarries but residing far away from quarries and (4) Working and residing far away from the quarries. Data have been collected on a reasonable sample on individuals. Data includes fertility and mortality, socio-economic pursuits, reported morbidity, anthropometry, audiometry, food habit and physical activity, blood pressure measurements and data on the estimation of haemoglobin have been collected, following standard questionnaire/ schedule and techniques.

S.K. Roy and B. Malakar

Research Activities

Diet, activity and Ageing: A Prospective Study

Research on biocultural dimensions of aging is being accomplished through analyzing already collected data on several aspects of physical and mental health of elderly of urban and rural settings. Publications so far highlights the fact that while well off educated urban elderly show evidence of healthy aging, rural elderly are having relatively more health adversities, both physical and mental.

B. Mukhopadhyay

Human Genetics Unit

Genomic and Epidemiological Studies on Common Diseases in Indian Populations

The focus of these studies is to understand the genomic and environmental contributions to common diseases in India.

Genomic Studies on oral cancer

(a) A quest for miRNA bio-marker: A track back approach from gingivo buccal cancer to two different types of precancers

Deregulation of miRNA expression may contribute to tumorigenesis and other patho-physiology associated with cancer. Using TLDA, expression of 762 miRNAs was checked in 18 pairs of gingivo buccal cancer-adjacent control and 3 pairs of precancer-adjacent control tissues. Expression of significantly deregulated miRNAs was further validated in cancer and examined in two types of precancer (leukoplakia and lichen planus) tissues by primer-specific TaqMan assays. Biological implications of these miRNAs were bioinformatically assessed. Expression of *hsa-miR-1293*, *hsa-miR-31*, *hsa-miR-31** and *hsa-miR-7* were significantly up-regulated and those of *hsa-miR-206*, *hsa-miR-204* and *hsa-miR-133a* were significantly down-regulated in all cancer samples. Expression of only *hsa-miR-31* was significantly up-regulated in leukoplakia but none in lichen planus samples. Analysis of expression heterogeneity divided 18 cancer samples into clusters of 13 and 5 samples and revealed that expression of 30 miRNAs (including the above-mentioned 7 miRNAs), was significantly deregulated in the cluster of 13 samples. Interestingly, expression of 11 and 5 of these 30 miRNAs were deregulated (more than 3-folds) in precancerous leukoplakia and lichen planus tissues, respectively. From database mining and pathway analysis it was observed these miRNAs can significantly target many of the genes present in different cancer related signaling pathways like *MAPK*, *PI3-AKT* which play important roles in expression of different molecular features of cancer. Expression of *hsa-miR-31* was significantly up-regulated in both cancer and leukoplakia and, thus, may be one of the molecular markers of leukoplakia which may progress to gingivo-buccal cancer.

(b) Genetic variations at microRNA and processing genes and risk of cancer

Genetic variations at microRNA and microRNA processing genes are known to confer risk of cancer in different populations. Here, we studied variations at 8 miRNA and 4 miRNA processing genes in 452 controls and 451 oral cancer patients by TaqMan genotyping assays. Variant genotypes at *mir-196a2* and *Ran* increased the risk of oral cancer [adjusted O.R (95% C.I) = 1.3(1-1.7) and 2.3(1.1-4.6) respectively], while, variant genotypes at *mir-34b* and *Gemin3* reduced cancer risk [adjusted O.R (95% C.I) = 0.7(0.5-0.9) and 0.6 (0.4-1) respectively]. Cumulative risk also increased by 3 times with increase in number of risk alleles at these 4 loci. In tobacco stratified analysis, *mir-29a* and *Ran* increased [adjusted O.R (95% C.I) = 1.5(1-2.3) and 4(1.1-14) respectively] and *mir-34b* decreased [adjusted O.R. (95% C.I) = 0.6(0.4-0.9)] risk of cancer, significantly. Therefore, genetic variation at miRNA and processing genes altered risk of oral cancer in this population thereby corroborating studies in other populations. But, it is necessary to validate this result in a different Indian population with larger sample size and examine the effect of these variations in tumor tissues to explain mechanism of risk alteration.

B. Roy

Epigenetic studies on Oral Cancer

Oral cancer is one of the most common malignancies in Southeast Asia, accounting for up to 30-40% of all malignancies in India. Most oral malignancies occur as squamous cell carcinomas (SCCs) and many OSCCs develop from premalignant conditions of the oral cavity. Despite the general accessibility of the oral cavity during physical examination, many malignancies are not diagnosed until late stages of the disease. Despite the significant improvements in therapeutic modalities in OSCC, 5-year survival rates are among the lowest of the major cancers and the main reason is lack of early detection. DNA methylation, a major epigenetic mechanism, is involved in various diseases including cancer. Global hypomethylation occurs at gene bodies, transposable elements and repetitive sequences, and hypermethylation occurs at promoters, which leads to aberrant transcription initiation and genome instability in cancer patients. DNA hypomethylation contribute to the development of cancer by activating the transposable elements, generating the chromosomal instability and loss of imprinting. Differentially methylated regions in the pre- and cancer tissues in comparison to the normal tissues of the same patients could be determined to investigate the possible epigenetic biomarkers during the progression of oral cancer. In our preliminary studies, many CpG Island associated gene promoters are found to be differentially methylated in the cancer tissues in comparison to the adjacent normal tissues in a small number of OSCC patients. These promoters along with the other reported differentially regulated gene promoters need to be studied in a greater number of OSCC patients to investigate the potential role of DNA methylation in the pathogenesis and progression of oral cancer in India.

B. Roy and R. Chatterjee

Genetic and epigenetic studies on Psoriasis

Psoriasis is a chronic relapsing inflammatory disease mainly affects skin and joints. Worldwide prevalence varies among different populations from 0.2 to 14%, and in India, the prevalence varies from 0.4 to 2.8%. Apart from some epidemiological studies, very few genetic association studies are performed for psoriasis patients in India. Some family based studies on western population indicated a genetic predisposition; however the exact inheritance pattern is unknown. We observed a significant association of HLA-Cw6 allele mainly in the Type I (age of onset at 30-40 yrs.) psoriasis patients, however no significant association was observed for the Type II patients (age of onset at 60-70 yrs). DNA methylation analysis from the tissues of involved and uninvolved skin in few CpG island associated promoters identified differential methylation suggesting the involvement of DNA methylation in psoriasis pathogenesis. To better understand the role of DNA methylation in the etiology, prognosis and variable severity of psoriasis, we need to perform this analysis in larger number of samples.

R Chatterjee

Genetics and Functional Genomics of Pancreatic Cancer

Over the last few decades, the study of pancreatic cancer has assumed a position of growing importance because of its increasing incidence and poor prognosis. Approximately 170,000 new cases of pancreatic cancer, or around 2.1% of all cancers, occur worldwide every year. Among these environmental risk factors, epidemiologic studies have identified only cigarette smoking, alcohol consumption, and type II diabetes as clear risk factors for pancreatic cancers. Several investigations suggest that a history of pancreatitis may increase risk of pancreatic cancer. The incidence of pancreatic cancer is low (0.5-2.4 per 100,000 men and 0.2-1.8 per 100,000 women) in most parts of India. Somewhat higher rates are seen in the male urban populations of western and northern India. No comprehensive genetics studies would be established among Indian patients population. Our hypothesis is to characterize the mutational profile of these five frequently mutated genes in pancreatic cancer in our patient population.

N. Sikdar

Research Activities

Profiling of *K-RAS*, *TP53*, *EGFR*, *CDKN2A/p16*, *INK4A*, *SMAD4/DPC4*, gene mutations in pancreatic cancer and their functional approaches

N. Sikdar

Genome-wide analysis of DNA methylation profile in pancreatic adenocarcinoma

To identify differentially methylated CpG sites globally in pancreatic cancer with respect to normal pancreas in same patient. It is the best-studied epigenetic modification and governs transcriptional regulation and silencing. We will explore DNA methylation landscapes in pancreatic cancer isolated from PANC patients and normal pancreas from same individuals. For these projects we have collaborated with several doctors from Calcutta Medical College, SSKM hospitals, Tata medical center, CMRI hospital from Kolkata. We have collected blood and tissue samples from 20 patients of pancreatic cancer and 15 chronic pancreatitis patients.

B. Roy, R Chatterjee and N. Sikdar

Statistical Genomics

The focus of these studies is to critically analyze existing statistical methodologies and to develop new methodologies for human genetics, especially for gene-mapping and genotype-environment interactions.

Statistical Methods for Analysis of Complex Traits

The focus of these studies is to analyze critically existing statistical methodologies and to develop new methodologies for human genetics, especially for gene-mapping and genotype-environment interactions.

Some novel statistical methods have been developed for association analyses of complex genetic traits. These include:

- (a) A clustering approach of mapping rare genetic variants using mutual association between variant sites.
- (b) A binomial regression approach for mapping multivariate phenotypes.
- (c) Detecting transmission disequilibrium for quantitative traits using sibship data.
- (d) Developing asymptotic distribution kernel based statistic for multilocus genetic association using longitudinal phenotype data
- (e) Developing KBAT type statistic for family data to study multilocus genetic association
- (f) Developing a test for gene-gene interaction and SNP-SNP interaction for case-control data
- (g) A new clustering method for clustering mixed type data arising in medical diagnosis
- (h) Methodological development on integrating SNP data and eQTL data in genetic association study

Analyses were performed on:

- (a) Type 2 diabetes and related quantitative precursors.
- (b) Major psychoses phenotypes including bipolar disorder and schizophrenia
- (c) Quantitative precursors such as homocysteine levels, Vitamin B12 levels for coronary artery disease.

S. Ghosh and I. Mukhopadhyay

Social Sciences Division

Economic Research Unit

This year the scientific workers of the Unit are extensively involved in research, teaching, training, consultancy and academic administration. The research is carried out both at individual and collaborative/interdisciplinary levels. These include theoretical as well as empirical research in economics and econometrics.

The topics of different dimensions of researches in the unit are as follows:

Measurements of Poverty and Gender Bias, Poverty Eradication Programmes in India, Variation in Height and BMI of Adult Indians; Polarization and Conflict, Cooperative Game Theory, Multidimensional Indicators, Vulnerability, Measures of Well-being, Poverty and Deprivation: Theory and Estimates at State and District Levels; Political Economy and International Trade; The Possibility of Metzler paradox in a Small Open Economy; Autonomy of Tribal Women in India, Socioeconomic Determinants of Iron-Deficiency Anemia among Children Aged 6 to 59 Months in India, Morphometric Variation Among the Central Indian Populations, The Status of Infant Health in India, Growth and Nutritional Status of Pre-school Children: A Comparative Study of Jharkhand, Bihar and West Bengal; Foreign Entry, Acquisition Target, and Host Country Welfare, Outsourcing: Some Strategic Aspects; The Estimation of Item Specific Intra and Inter Country Food Purchasing Power Parities: India, Indonesia and Vietnam, Household Budget Share Distribution and Welfare Implication: An Application of Multivariate Distributional Statistics; Privatization, under Pricing and Welfare in the Presence of Foreign Competition, Strategy-Proofness and Pareto-efficiency in Quasi-linear Exchange Economies, Efficient Access Pricing and Endogenous Market Structure, On that Old Rivalry: Bertrand Versus Cournot, Egalitarian Equivalence and Strategy-Proofness in the Queueing Problem, Bidding Rings: a Bargaining Approach, Bipartite Graphs and the Shapley Value, Reordering an Existing Queue; Convergence of Foodgrains Productions/ Literacy Across Indian States: A Panel Data Approach, Asymmetry in Both Mean and Variance of Returns: A Multiple –Country Study, Asymmetric Mean Reversion and Volatility with Cross-Country Volatility Dependence in Returns in Multivariate EGARCH-in-Mean Framework- the Dynamic Conditional Approach, Inflation and Inflation Uncertainty: A New Approach Incorporating Regimes and Asymmetry in the First Two Moments of Inflation, Estimation and Prediction in an ARMA (1, 1) Model in Presence of Missing Observations; Various Issues in Panel Data Models with Cross Sectional Dependence; Promises, Credulity and Integrity, Institutional Improvement with Incomplete Contracting, Group Framing in Dictator Games; Macroeconomic state of the Indian economy; Impact of MGNREGA on Livelihood of Rural Poor in India: A Study Based on National Sample Survey Data.

The details of the applied and theoretical researches in Economic Research Unit are given below:

Polarization and Conflict

Satya R. Chakravarty

Cooperative Game Theory

Satya R. Chakravarty, Manipushpak Mitra and Palash Sarkar (ASU)

Multidimensional Indicators

Satya R. Chakravarty and Maria Ana Lugo

Vulnerability

Satya R. Chakravarty and Nachiketa Chattopadhyay (SOSU)

Measures of Well-being, Poverty and Deprivation: Theory and Estimates at State and District Levels

Satya R. Chakravarty and Siddhartha Kundu

Political Economy and International Trade

A model of electoral competition and voting has been formulated which is relevant for less developed economies where it is shown that for a section of the society voting is contagious and this in turn reduces the incumbent government's incentive to put in adequate work. A model of international trade in the retail sector has also been worked on.

Abhirup Sarkar and Debasmita Basu

The Possibility of Metzler paradox in a Small Open Economy

The possibility that higher tariff might reduce the domestic price of importable and thereby contract the import competing sector (Metzler paradox) is well known in the trade theoretic literature. It also follows as a corollary that such paradox cannot happen if the country is a small open one. In a two sector trade model with equilibrium unemployment and imperfect competition in product market, it is shown that even for a small open economy higher tariff might fail to protect the import competing sector, in the sense that it contracts. Interestingly the limiting behavior (approximating it as a full employment model and with goods becoming perfect substitutes) of the model is usual one.

Brati Sankar Chakrabarti

Autonomy of Tribal Women in India

Autonomy of tribal women in India is found in this paper through decision making power on purchasing household needs, going to relatives' house, getting healthcare facilities or getting access to husband's money or even having independent authority to spend their own income. Data from NFHS-3 Survey conducted in 2005-06 have been used for the analysis. Besides getting zone wise variations we have examined whether levels of education, types of occupation, working status of women etc., and other characteristics of the households, like wealth index, sex of head of household etc., can influence the decision making. The results of the analysis clearly show that the degree of women's decision-making power increases positively with the age of women, literacy and wealth index. This is also found to be more on female-headed households and nuclear families. Women in high professional jobs may have more power in the household decision making on healthcare of members in the family and mobility to go outside, but it may not imply higher economic power. Literacy of women plays an important role in the decision making power of tribal women in India.

Susmita Bharati (SRU), Manoranjan Pal and Premananda Bharati (BAU)

Socioeconomic Determinants of Iron-Deficiency Anemia among Children Aged 6 to 59 Months in India

The extent of anemia and its socioeconomic determinants among the preschool children (6-59 months old) in India has been studied in this article. Relevant data are taken from the third round of the National Family Health Survey. The initial analysis reveals some interesting features. The most affected children are in the age group of 6 to 23 months. Beyond this age a decreasing trend is observed up to the age of 48 to 59 months. The highest and the lowest prevalence of anemia have been found to be in the central and the northeast zones, respectively. The vulnerable groups are the children of illiterate parents and those belonging to the poor families in the rural areas. Categorical logistic regression also confirms that status of literacy and wealth of parents have strong negative association with the status of anemia of the children.

Susmita Bharati (SRU), Manoranjan Pal, Suman Chakrabarty and Premananda Bharati (BAU)

Variation in Height and BMI of Adult Indians

It is well known that height and weight are interrelated, and that both are related to socioeconomic variables. The objective of this study was to assess the effect of socioeconomic variables on the heights and weights of different groups of people, formed according to different levels of heights and weights, and to see whether there are sex differences in the variations in heights and weights. Data for adults aged 15–49 years were taken from the India National Family Health Survey-3 and descriptive studies and multiple linear regression analyses carried out. A clear positive association was found for height and BMI with economic level (except for overweight females in the case of BMI). In the case of BMI, it is age that seems to be the most influential factor. Surprisingly, the observed changes in height and BMI are not as expected for short and tall or underweight and overweight people; these sometimes behave in the opposite directions to that of normal height and weight people. The basic assumption of multivariate normality is not valid due to changing relations at different height and BMI levels.

Suparna Som (SRU), Stanley Ulijaszek, Manoranjan Pal, Susmita Bharati (SRU) and Premananda Bharati (BAU)

Morphometric Variation among the Central Indian Populations

Data on 8 anthropometric characters of 6663 adult males belonging to 22 caste groups, distributed in 38 districts of Central India were taken for present investigation, to study the morphometric variation. Cephalic index, nasal index, Generalized Mahalanobis distances and its size and shape components were computed and dendrograms were drawn. Comparison of coefficient of variations shows that there exists variation in nasal breadth, nasal length, weight and hence in nasal index. But no marked variation was seen in respect of other anthropometric variables. Comparison of Mahalanobis distances leads to some close clusters among the caste groups, but many of the caste groups remained separated from other caste groups keeping their identities.

Rajesh K. Gautam, Dipak K. Adak, Manoranjan Pal and Premananda Bharati (BAU)

The Status of Infant Health in India

This paper investigates the present status of infant health in India through percentages of infants who are undernourished, not immunized or diseased and finds its relationship with socio-demographic variables. The relevant data have been obtained from the Third National Family Health Survey, which was carried out in 2005-2006 in India. The sample consists of 7562 infants (i.e., children of less than 1 year). For socio-demographic data, places of residence, sex of infants, ethnic composition, religion and wealth index were considered. Considering the different types of under-nutrition, it has been found from our data that the percentages of undernourished infants range from 22 to 28 only. There are considerable variations in the different types of immunization status ranging from 17.9% opting for measles vaccination to 73.2% taking BCG vaccination. Prevalence of morbidity also varies from 15 to 22 percent depending on the three types of morbidity considered in this paper. Among the socio-economic variables, mother's education and wealth index have been found to have profound effect on the nutritional status and also on morbidity of infants but there is no impact found on the status immunization. Thus it gives clear cut indications for the government and NGOs to take actions to ameliorate poverty and to improve the level of education, especially of female population in India.

Susmita Bharati (SRU), Manoranjan Pal and Premananda Bharati (BAU)

Poverty Eradication Programmes in India: Actions Taken and Impacts Made

Government of India has taken up many development programmes and many expert groups/task forces have been formed to look into the poverty situations and eradicate poverty in India. But, are these programmes sufficient to eradicate poverty? To answer the effectiveness of these programmes one has to resort to the surveys conducted so far to evaluate these programmes. The studies so far made on these programmes show that the rural infrastructures have been improved substantially. But these programmes failed to improve the poverty situation to that extent. The main reason is that the

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most of the programmes have transient effect on the eradication of poverty. Either these programmes should be continued indefinitely or should be replaced by programmes, which have sustained effect on the amelioration of poverty situation in India. In addition to reviewing critically the successes and failures of these programmes taken by Government of India, this paper gives a historical profile of the poverty situation in India without referring to any causal relationships of the poverty levels with the actions taken.

Manoranjan Pal, Bhola Nath Ghosh (SRU) and Premananda Bharati (BAU)

Growth and Nutritional Status of Pre-school Children: A Comparative Study of Jharkhand, Bihar and West Bengal

This paper compares the growth and nutritional status of pre-school children of three states of India namely Jharkhand, Bihar and West Bengal using third National Family Health Survey (NFHS-3) data. Data on socio-demographic background of the households like sex composition, place of residence, religion, level of education of mothers, mother's age groups and wealth index of the family are taken to see the differential effects of these variables on the child health status. It has been found that the distributions of weight and height around the means remain remarkably stable over age in those three states. It has also been found that the rates of growth of mean weights and heights are far lower in Bihar and Jharkhand than in West Bengal and India. The low growth rates of the mean values during the first year for both weight and height translate to high rates of under-nutrition and stunting. Another notable finding is seen that only in West Bengal, reduction of under-weight is directly related with upward movement of literacy along with wealth index but in Jharkhand and Bihar, there is no impact of literacy on reducing underweight and only higher wealth index is responsible for reducing underweight and stunting.

Susmita Bharati (SRU), Manoranjan Pal and Premananda Bharati (BAU)

Foreign Entry, Acquisition Target, and Host Country Welfare

The optimal mode of entry of a foreign multinational enterprise into a local market where two local firms with differing productivities are competing initially, are analysed. It is shown that Greenfield investment is chosen when the cost of setting up subsidiary and the cost asymmetry between the local firms are small, and exporting is optimal when both trade cost and technology gap are low; otherwise acquisition is preferred. It is further shown that under acquisition equilibrium the less efficient firm is acquired unless the cost of technology transfer to the integrated firm is large enough. The paper focuses on the process of selection of the target firm under acquisition by constructing sequential offer game, bidding game and repeated offer game. In the analysis the externality effect of Cournot competition is internalised. In all the cases, however, the MNC's entry reduces the host country welfare

Tarun Kabiraj and Uday Bhanu Sinha

Outsourcing: Some Strategic Aspects

A firm faces a choice between outsourcing a crucial input and producing it in-house within the vertical structure. This paper reviews the literature and discusses strategic motives behind the outsourcing decision.

Tarun Kabiraj

The Estimation of Item Specific Intra and Inter Country Food Purchasing Power Parities: India, Indonesia and Vietnam

This study introduces, for the first time, the concept of item specific purchasing power parity (PPP) between countries that marks a significant departure from exercises such as the International Comparison Program (ICP). The usefulness of the proposed procedure is illustrated by applying it to estimate, in a unified framework, intra country PPPs (i.e. spatial prices) and inter country PPPs, both item wise and in aggregate, using unit records of household food expenditures from three Asian

countries, namely, India, Indonesia and Vietnam, covering contemporaneous time periods. Formal tests of item invariance of the PPPs have been provided in this study. The results not only point to the usefulness of the concepts and procedures that have been proposed here, but they highlight the limitation of the twin assumptions of intra country constancy and item invariance of the PPPs that underline the ICP exercise. The item specific PPPs were used to provide a welfare ranking of India, Indonesia and Vietnam. As the ICP 2011 is currently under way, the significance of the present results extends well beyond the three Asian countries considered in this study.

Amita Majumder, Kompal Sinha and Ranjan Ray

Household Budget Share Distribution and Welfare Implication: An Application of Multivariate Distributional Statistics

In this study the consequence of considering “food share” distribution as welfare measure, in isolation from the joint distribution of item budget shares, is examined through the unconditional and conditional distribution of “food share” both parametrically and non-parametrically. In the parametric framework, the statistical properties of the joint distribution of household budget shares are studied through Dirichlet distribution in a three commodity set up. The consequence of considering “food share” as a welfare measure is then illustrated through the unconditional Beta density, which overlooks the household joint decision making across different consumption categories, and the conditional Beta density of “food share” derived from the joint Dirichlet distribution. The analysis, using parametric and nonparametric methods, based on household level rural data for West Bengal, India, for the year 2009-10 show significant under-representation of households by the conventional unconditional “food share” distribution in the higher range of food budget shares that correspond to the lower end of the income profile.

Manisha Chakrabarty, Amita Majumder and Jeffrey S. Racine

Privatization, Under Pricing and Welfare in the Presence of Foreign Competition

A differentiated oligopoly market is considered where a domestic public firm competes with foreign firm(s). Under fairly general demand and constant marginal costs, it is shown that partial privatization of the public firm improves welfare by cutting down public sector losses. Surprisingly, even at the optimal level of privatization the public firm's price lies strictly below marginal cost and it makes losses. In the long run, with free entry of foreign firms, partial privatization improves welfare through an additional channel: more foreign varieties. However, in the long run, under optimal privatization, below-cost pricing does not occur and the public firm earns positive profits.

Manipushpak Mitra, Arghya Ghosh and Bibhas Saha

Strategy-proofness and Pareto-efficiency in Quasi-linear Exchange Economies

A long-standing question on the structure of strategy proof and Pareto-efficient social choice functions (SCFs) in classical exchange economies (Hurwicz (1972)) is revisited in this paper. Using techniques developed by Myerson in the context of auction design, it is shown that in a specific quasi-linear domain, every efficient and strategy-proof SCF satisfying non-bossiness and a mild continuity property, is dictatorial. The result holds for an arbitrary number of agents but the two-person version does not require either the non-bossiness or continuity assumptions. It also follows that the dictatorship conclusion holds on any superset of this domain. A result using the minimum consumption guarantee result (in the spirit of Serizawa and Weymark (2003)) is also provided.

Manipushpak Mitra, Mridu Prabal Goswami and Arunava Sen (EPU)

Efficient Access Pricing and Endogenous Market Structure

How regulatory mechanisms influence the nature of competition in a network industry is investigated. In the downstream segment of the market, the seller of a differentiated retail product competes with an incumbent firm. The incumbent firm is also the owner of the essential input. The regulator cannot observe the costs of the entrant, and to maximize social welfare designs the retail prices and the

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access charge that the entrant pays to the incumbent. The optimal access charge is a uniform price that respects the criteria of transparency and non-discrimination that are imposed by the competition and regulation directives in most of the countries. New formulas for retail and access prices adhering to the Ramsey rule are derived. Since the competing firm takes the decision to enter following the choice of the regulatory regime, the nature of the retail market competition is endogenous. It can either be served by both the firms, or can have the incumbent as the monopoly supplier of the retail good.

Manipushpak Mitra, Kaniska Dam and Axel Gautier

On that Old Rivalry: Bertrand Versus Cournot

The classic comparison between Bertrand and Cournot outcomes in a symmetric differentiated oligopoly where each firm maximizes a weighted average of its own profit and welfare is considered in the study. For general utility functions, the standard Bertrand-Cournot rankings are reversed for all variables---prices, quantities, profits, consumer surplus, and welfare---provided the weight on profit is strictly less than a threshold value. Surprisingly, it is found that the threshold can be arbitrarily close to unity for two widely used utility specifications, quadratic and CES. The threshold weight increases as the degree of substitutability declines. In addition, for CES, the threshold (i) increases as the number of firms increases and (ii) irrespective of the degree of substitutability, tends to unity as the number of firms approaches infinity.

Manipushpak Mitra and Arghya Ghosh

Egalitarian Equivalence and Strategy-proofness in the Queueing Problem

The implication of egalitarian equivalence (Pazner and Schmeidler (1978)), queue efficiency and strategyproofness in the context of queueing problems is investigated. The complete class of mechanisms satisfying the three requirements is characterized. Though there is no mechanism in this class satisfying budget balance, feasible mechanisms exist. It is also shown that it is impossible to find a mechanism satisfying queue efficiency, egalitarian equivalence and a stronger notion of strategyproofness called weak group strategyproofness. In addition, it is shown that generically there is no mechanism satisfying two normative notions, egalitarian equivalence and no-envy, together.

Manipushpak Mitra, Youngsub Chun and Suresh Mutuswami

Bidding Rings: A Bargaining Approach

The problem of coalition formation in single as well as multiple indivisible goods second price auction with unit demand is analyzed in a bargaining game set up under the assumption of complete information where valuation of the participants is commonly known amongst themselves while the auctioneer is unaware of these valuations. In the single goods case, the necessary and sufficient conditions for formation of any bidding ring when players are sufficiently patient are identified. In the multiple goods case, the sufficient conditions for formation of an interesting class of coalition structures is also specified. In the multiple goods case where exactly one winner colludes with all the losers and, depending on the protocol, the remaining winners either stay alone or collude in pairs.

Manipushpak Mitra, Kalyan Chatterjee and Conan Mukherjee

Bipartite Graphs and the Shapley Value

A cooperative game-theoretic structure to analyze bipartite graphs is provided where there is a set of employers and a set of workers. Links can form between an employer and a worker and there is no link either between employers or between workers. As in Myerson (1977), a cooperation structure is represented by a set of bilateral links. However, unlike Myerson (1977) bilateral links can only be formed between some employers and some workers. In this scenario the Shapley Value is characterized.

Manipushpak Mitra, Dipjyoti Majumdar and Souvik Roy

Subgroup-additivity in the Queueing Problem

The notion of 'subgroup additivity' is defined and is used as the main axiom to investigate its implications for the queueing problem. The axiom of subgroup additivity requires that a rule assign the same expected 'relative' utility to each agent whether an agent's expected relative utility is calculated from the problem involving all agents or from its sub-problems with a smaller number of agents. Five important rules in the queueing problem are characterized, they are: the minimal transfer rule, the maximal transfer rule, the symmetrically balanced VCG rule, the pivotal rule and the reward based pivotal rule. Given some basic axioms and subgroup additivity, the characterization results can be obtained by additionally imposing either strategic axioms (like weaker versions of strategyproofness) or equity axioms (adjusted versions of egalitarian equivalence). Each strategic axiom can be replaced by an appropriate equity axiom for the characterization of all five rules.

Manipushpak Mitra and Youngsub Chun

Reordering an Existing Queue

The queueing problem with an existing initial order is analyzed. It is shown that individual rationality, strategyproofness, outcome efficiency, and budget balance are incompatible. Given this impossibility, three different directions are ventured by dropping budget balance, outcome efficiency and strategyproofness, one at a time. By dropping budget balance the class of mechanisms that satisfy individual rationality, strategyproofness and outcome efficiency are characterized. It is shown that there is no mechanism in this class that satisfies feasibility. By replacing outcome efficiency with non-triviality it is shown that fixed price trading mechanisms are the only mechanisms satisfying individual rationality, strategyproofness and budget balance when there are two agents. When there are more than two agents, outcome efficiency is replaced with appropriate bounds on the level of admissible inefficiency and the existence of median price exchange mechanism is established. By weakening strategyproofness to one-sided strategyproofness, the buyers' mechanism and the sellers' mechanism are characterized.

Manipushpak Mitra, Youngsub Chun and Suresh Mutuswami

Convergence of Foodgrains Productions/Literacy Across Indian States: A Panel Data Approach

This study attempts to understand the regional convergence- both in terms of sigma and beta convergences - of (i) per capita foodgrains production across the major foodgrains producing states of India over the period 1991 to 2011 and (ii) literacy rate, by applying the conventional methods and also modern panel data approach for convergence hypothesis including the tests based on dynamic panel models of first differenced GMM and system GMM. While in case of foodgrains production, beta convergence has been found, the computations for literacy rate are now being done.

Nityananda Sarkar

Asymmetry in both Mean and Variance of Returns: A Multiple –Country Study

Asymmetry in conditional variance of returns on stock prices/indices, often called the 'leverage effect', is well recognized although the same for conditional mean has got attention of empirical researchers relatively recently. Mean reverting behaviour of returns suggests that asymmetry in conditional mean is only likely. Financial theories have also advocated two hypotheses in support of this. These are: the time varying rational expectations and stock market overreaction hypotheses. Two models are proposed capturing both these asymmetries -TAR-EGARCH-AM and STAR-EGARCH-AM- in the framework of 'risk-return in mean' relationship. Returns data from a group of developed and important emerging economies are used to study these asymmetric effects.

Nityananda Sarkar

Asymmetric Mean Reversion and Volatility with Cross-Country Volatility Dependence in Returns in Multivariate EGARCH-in-Mean Framework- the Dynamic Conditional Approach

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Transmission of price and volatility spillovers across stock markets of different groups/blocks of countries is quite common in these days of informational efficiency. Obviously, the asymmetric nature of mean reversion and nonlinear dynamics in volatility are important considerations in studying these cross-country spillover effects. In this study, the volatility-return relationships of cross-market and own-market have been explicitly captured by the GARCH-in-Mean model. There are basically two approaches, called the BEKK and the dynamic conditional correlation (DCC) approaches. The present work is following the later approach for a group of advanced economies.

Nityananda Sarkar

Inflation and Inflation Uncertainty: A New Approach Incorporating Regimes and Asymmetry in the First Two Moments of Inflation

The role of inflation uncertainty in modelling inflation has been studied extensively. In this context, several hypotheses have been proposed the empirical validity of which have been found to be mixed. In this context some have argued on the nature of causation link from inflation uncertainty to inflation and vice versa. This work takes a look at this link along with consideration to regimes in the framework of TVAR model after introducing asymmetric reactions of news on the conditional mean and conditional variance of inflation. The proposed models are being applied to the time series data on inflation for a group of G7 and EURO countries.

Nityananda Sarkar

Estimation and Prediction in an ARMA (1, 1) Model in Presence of Missing Observations

This study is concerned with missing observations in time series in an ARMA (1, 1) model. While forecast replacement method can be used in case of pure autoregressive models, there are some theoretical problems in doing a similar treatment in case of mixed model. Attempts are being made to deal with these so that asymptotic properties of the estimator of the model parameters and the estimated predictor based on the imputed series can be studied. Initially the case of one missing observation is being considered.

Nityananda Sarkar

Various Issues in Panel Data Models with Cross Sectional Dependence

Samarjit Das

Discrete-valued Time Series

Modeling, analysis and coherent forecasting are done for discrete-valued time series data. In particular both categorical and count data are considered. Zero-inflated count data is also considered for this purpose.

Samarjit Das

Promises, Credulity and Integrity

The research experimentally examines, using dictator and ultimatum games, whether non-binding communication is cheap talk or content, and what beliefs are attached to such communication by receivers, in a framework with competitive communication

Priyadarshi Banerjee

Institutional Improvement with Incomplete Contracting

The research experimentally examines, in an environment with incomplete contracting, whether inefficiencies induced by incomplete contracting are better mitigated by an improvement in contracting institutions or by introduction of informal communication structures.

Priyadarshi Banerjee

Group Framing in Dictator Games

The research studies whether the creation of group identity through framing can affect outcomes in the dictator game, by inducing group membership both through marginal frames which merely confers group membership, or which, given group membership, change the reference point of the endowment, as well as through substantial frames which not only confer such membership but also alter the reference point of the endowment.

Priyadarshi Banerjee

Macroeconomic state of the Indian economy

The present work is on the current macroeconomic state of the Indian economy, which is going through a phase of recession. Efforts are being made to explain it and suggest measures to lift the economy out of recession and to assess the economic policies that the GOI and the RBI have adopted to get out of the impasse.

Chandana Ghosh

Impact of MGNREGA on Livelihood of Rural Poor in India: A Study Based on National Sample Survey Data

Using difference-indifference framework, an evaluation study has been made on the MGNREGA on livelihood of the rural poor in terms of its impact on food, non-food and average monthly per capita expenditure. An alternative methodology has been developed to handle the problem of identifying target households utilizing large sample survey data from a secondary source, like NSSO, and novelty of the work lies in developing this alternative methodology. The study found that households who did not take MGNREGA jobs are well off compared to the beneficiary households in terms of the study variables mentioned above. The time trend showed the overall growth impact as being stronger than the true effect of the program.

Saswati Das

Linguistic Research Unit

During the period (from April 2013 to March 2014) the Linguistic Research Unit of the Institute is continuing with its programs of research in the area of Cognitive Linguistics, Corpus Linguistics, Computational Linguistics, Language Technology, Sociolinguistics, Field Linguistics and Descriptive Linguistics.

Substantivist Lexicological Study of Bangla

A substantivist study of conceptual networks on the basis of Whole Word Morphology is in progress. Earlier work has demonstrated a connection between this inquiry and the linguistics of lexico-phrasal difficulty. The work now being done is part of a long-term exercise in the domain of conceptual structure studies with reference to the lexicon. The purpose is to develop empirical base for a corpus-based electronic lexicon for Bangla. A corpus-based electronic lexicon is an indispensable resource for research and application in Language Technology (LT) and Natural Language Processing (NLP). This type of resource is of use in machine translation, information extraction, word-sense disambiguation, semantic net, ontology, etc. Also, it has direct academic relevance in electronic dictionary and thesaurus development, language teaching (first and second language), discourse analysis, lexical semantics, and language cognition. The Electronic Lexicon envisaged in this research will be the first work of its kind for Bengali, and the enterprise may be extended to other Indian languages if corpora are available. The utility of the work is further enhanced by two specific features. First, the proposed Lexicon is of the Differentiated type in the sense of Dasgupta, Misra and Datta (2002). In a Differentiated Lexicon, the asymmetry between peripheral and kernel items drives intra-lexical glossing, and the artificial metalanguage Esperanto serves as the glossing mediator, on cognitive-

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scientific grounds provided in Dasgupta (2006). Second, the proposed Lexicon not only uses frequency within the corpus to determine the kernel-periphery boundary but also provides specific frequency data for each lexeme. This will be the first electronic lexicon for Bengali.

Probal Dasgupta

Interlexical Study of Asamiya in a Substantivist Framework

The purpose of this project is to develop the empirical base for electronic lexical resources for Asamiya. Electronic lexical resources are an essential presupposition for other sectors in research within the domains of Language Technology (LT) and Natural Language Processing (NLP). This type of resource is of use in machine translation, information extraction, word-sense disambiguation, semantic net, ontology, etc. Also, it has direct academic relevance in electronic dictionary and thesaurus development, language teaching (first and second language), discourse analysis, lexical semantics, and language cognition. The proposed lexical resources will set a precedent for Asamiya, and the enterprise may be extended to other Northeastern Indian languages for which background descriptive material is available on a similar scale. The utility of the project is further enhanced by the fact that it extends the advances in interlexical understanding attained in the context of earlier research on Asamiya, Boro and Bengali.

Probal Dasgupta

Sociolinguistics

The unit has taken up studies in linguistic (lexical and syntactic) difficulties in cognition of language in different discourse frames. The sociolinguistic dimension of linguistic difficulty has been studied within single languages, in relation to the mapping between the full conceptualization system and its basic level kernel, and across languages in the Indian context. Here the important target of study has been the place of English in the sociolinguistic fabric of India.

Probal Dasgupta

Corpus Based English Language Teaching (C-BELT) System

We have started working towards a general method called Corpus-Based English Language Teaching (C-BELT). It has been observed that the idea of teaching English language to the learners without reference to English Language Corpora (ELC) has become a non-reliable proposition, because data and information obtained from modern ELC provide authenticity and reliability towards the process of teaching English as a second language. We have proposed here to access and utilize the ELC directly in classroom situation with additional help of some corpus processing tools and techniques such as concordance, bilingual lexical databases, etc. for teaching English to the Indian learners. We have also proposed to encourage the Indian learners to extract relevant linguistic data, examples, and information from the ELC to increase their knowledge in the language as well as to enhance their communication skill in English in various interactional environments. Furthermore, we have envisaged the ELC as a highly authentic secondary resource the data and linguistic information of which may be directly utilized for the purpose of developing ELT text books, bilingual dictionaries, dictionary of idioms, phrases and proverbs, and primary and advanced grammar books for the Indian learners. We have planned to generate a lexical database of basic and graded vocabulary of English from the ELC to be used in the development of a C-BELT system for the Indian learners.

Niladri Sekhar Dash

Domain-Specific Parallel Translation Corpora of Hindi and Bengali

We have developed a Hind-Bengali parallel translation corpus keeping Hindi as the source language and Bengali as the target language. The first phase of the project (ILCI-I) has generated 50,000 parallel sentences in Bengali covering two major domains of information sharing: health and tourism. Each sentence has an average length of sixteen (16) or more words. The most vital feature of this bilingual parallel sentence database is that parallelism between the two languages (Hindi <> Bengali)

is preserved both at semantic and syntactic levels – making the corpus an indispensable resource for cross-lingual information retrieval, bilingual lexical database generation, translational equivalent extraction, core grammar development, machine translation, and cross-cultural research. The second phase (ILCI-II) has started in April 2012 and it has included additional two domains: Agriculture and Entertainment. An important output of this work is generation of a bilingual parallel lexical database that may lead to compilation of digital bilingual and multilingual dictionaries for Hind and Bengali. The corpus is now available from the TDIL Data Centre, Govt. of India.

Niladri Sekhar Dash

POS Tagging of Bengali Words in the Bengali Corpus

We have developed a POS tagset for the Bengali text called the “BIS Tagset” (Bureau of Indian Standard) as a benchmark standard to be used in POS tagging of Bengali text of all types. We have used this POS tagset to develop a POS tagged corpus of 50,000 Bengali sentences relating to health and tourism domains. An important bi-product of this work is generation of POS tagged digital lexical database for Bengali, which may be used to compile digital Bengali dictionaries and thesauruses. The database can also be used information retrieval, grammar development, machine learning, language teaching, word sense disambiguation, and other works of applied and computational linguistics.

Niladri Sekhar Dash

Digital WordNet for Bengali

We have developed a WordNet for Bengali that can stand parallel to other WordNets developed for some other Indian languages, e.g., Hindi, Sanskrit, Marathi, Konkani, Urdu, Oriya, Gujarati, Kashmiri, Tamil, Telugu, and Malayalam, etc. We have adopted an intricate interfaces of lexical structures made of synsets (i.e., set of synonyms) where semantic relations, in which synsets act as sets of synonyms to refer to similar or near similar concepts, are linked up with one-another in implicit dichotomies of semantic relations like hypernymy and hyponymy (is-a relation), meronymy and holonymy (part-of relations), and troponymy (manner-of relations), etc. expressible through their conceptual linkages. In this act of Wordnet creation, the central focus is not on the words but on the concepts word(s) are capable to denote. Based on the idea of covering a large number of senses within a generic frame, we have used the Expansion Approach, since our primary goal is to link up the Bengali synsets with the synsets of other geographically, genealogically and typologically related Indian languages and with English. So far we have completed more than 36,000 synsets and are on the process of creating more than 1000 Language Specific Synset (LSS) that will represent the uniqueness of Bengali life, living, language, people, and culture in the WordNet.

Niladri Sekhar Dash

SHELL System for Teaching English to Bengali Learners

Think of a situation when English is being reintroduced in Bengali after a gap of nearly 20 years at the primary level. At the crucial stage of reintroduction of English at primary level in West Bengal it is noted that there is neither suitable textbooks, nor good ELT resources, nor trained teachers. That means there is no academic support of any kind that is available for fruitful execution of ELT courses in the state. Keeping this state of affairs and the target learners in mind we have proposed a strategy for developing ELT textbooks in such a way that the target learners are able to learn English, at least at the initial stage, at their own ways through direct utilization and assistance of their mother tongue. Since no one is there to help them in learning English, they will help themselves in this process of learning. Therefore, we call this method as Self Help English Language Learning (SHELL) method. This new method is adopted in an experimental basis for developing text books and learning materials for the new generation of Bengali learners who are being exposed to English for the first time in life at the primary level. Let it be assumed that the target learners, for which this method is being proposed, have acquired some kind of linguistic efficiency in their mother tongue, and are now sent to primary schools to learn English as a second language. It has been also assumed that these students receive no academic help or tutorial support from their parents in the act of learning English, since these

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students are mostly first generation learners. What they can expect is a kind of passive help or guidance from their teachers only at school hours.

Niladri Sekhar Dash

Field Linguistic Survey at Giridih, Jharkhand

As a part of the internal research on minority language documentation and digitization we conducted a Linguistic Survey to collect language data (in the form of free discourse text) from nearly 6 native Khortha speakers living in Majhladih village in the district of Giridih, Jharkhand, India for developing a digital archive of the language and other linguistics properties for the speech community (25-26th Feb 2014). Ph.D. scholar Mr. Atul Aman joined me in this project of speech data collection from Khortha in storage of the data in digital form. The process of data collection involved collection of conceptually equivalent lexical items from the native Khortha speakers through direct audio and video recording. A major part of the survey included the process of digitization of lexicon, sentences, and free discourse texts through on-site direct interviews with native informants. This survey serves as a part of the process of digitization and documentation of the minority and endangered languages of the country – an important part of the research activities of the Unit.

Niladri Sekhar Dash

Bengali Pronunciation Dictionary in Electronic and Printed Form

The objective of this project is to design and develop a Bengali pronunciation dictionary in electronic form with the large lexical database obtained from a corpus of modern Bengali texts. It will become an indispensable resource for research and application in applied linguistics, language teaching, speech technology, language technology, and language processing. At present, we have collected 50,000 words (covering a major part of the present Bengali vocabulary) from a printed Bengali dictionary as well as from a large lexical database of frequently used words collected from the modern Bengali corpus. The wordlist includes all Tatsama, Tadbhava, Deshi, and foreign words of different forms and part-of-speech. These words are used in the proposed pronunciation dictionary in their lemmatized and alphabetically sorted form. The spelling of the words is settled following the proposal of the Pashchimbanga Bangla Akademi, Kolkata to avoid all kinds of linguistic dispute. Each entry word is being transliterated in Indic Roman script tagged with diacritics for all types of end users. Accepted pronunciation of Standard Colloquial Bengali (SCB) is adopted for the entry words, and this is presented in standard Bengali script for those people who know Bengali script but do not know IPA as well as in IPA for those people who know IPA but do not know Bengali script, particularly the learners of Bengali at various universities and institutes in Europe, USA, and other countries. The descriptive meaning for each entry word is provided for sense disambiguation, which is particularly useful for those homographic and homophonous homonyms (words having similar orthographic forms or pronunciation but different meanings). The speech output of pronunciation of the entry words will be available in sentence-free and sentence-bound contexts. The work of this project is partly done and will continue for next one year.

Niladri Sekhar Dash

Population Studies Unit

Contraceptive use and Fertility Preference in Indian states

Family planning Programmes have always been considered as a measure for controlling Population Growth. This study aims to assess the role of currently married women aged 15-49 years in contraceptive use and fertility preference. The study attempts to investigate the likelihood of contraceptive use and fertility preference in Indian states by some socio- economic and demographic characteristics. Logistic regression technique is applied to National Family Health Survey NFHS 3 data, (2005-06), a sample survey conducted by International Institute for Population Sciences (IIPS) Mumbai, India.

Subhash Barman

Domestic Physical Violence, Contraceptive use, and Unwanted Pregnancy in Rural India

This study attempts to examine the association between male-to- female domestic physical violence and unwanted pregnancy among women in rural Indian states. Women who experience physical violence from their husband are significantly less likely to adopt contraceptive methods and more likely to experience unwanted pregnancy. National Family Health Survey, NFHS 3 data, (2005-06), a sample survey conducted by the International Institute for Population Sciences, Mumbai, India, is used to study the relationship between domestic physical violence and unwanted pregnancy among the rural Indian women.

Subhash Barman

Impact of spacing between age at marriage and first birth on maternal and child health care in India

Birth intervals are affected by a complex range of factors, some of which are rooted in social and cultural norms, others in the reproductive histories and behaviours of individual women, and other background characteristics such as rural residence, education, standard of living, maternal age at the birth. All girls should be allowed to become physically and mentally mature before becoming mothers. In societies where many girls marry at an early age, couples should delay the first pregnancy until at least the age of 20 years. For the health of both mothers and children, parents should wait until their youngest child is at least two years old before having another baby. The study shows, there could be additional gains to child health by increasing the spacing between births to a minimum of three years. Older women are later in their child bearing process and are likely to achieve their desired family size and hence likely to have long subsequent spacing; they are also likely to be less fertile leading to long spacing.

Swati Sadhu

How developmental factors influences investment climate: a comparative study in different states of India

Apart from the common indicators, which explicitly focus on business and investment climate, there are other developmental indicators, such as household characteristics, health status and general macroeconomic indicators, which can explain the variation in business climate over the states of India. These indicators are providing important information about the places and have positive relationship with business environment. It is important to develop a methodology that can generate overall information needed for investment climate policy analyses. This study develops a combined index utilizing the above factors, which shows stronger relationship with the commonly used World Bank's index of business climate in Indian perspective. The index includes a ranking, which provide comparisons across different states of India.

Partha De

Child disability and Malnutrition

In India, particularly rural children are vulnerable to malnutrition because of low dietary intakes, infectious diseases, lack of appropriate care, and inequitable distribution of food within the household. The demographic and socio-economic factors influence the developmental delay among vulnerable children. The aim of this study is to assess the spatial distribution of nutritional status of developmentally challenged children of less than five years through Z-scores of height-for-age, weight-for-height and weight-for-age by demographic characteristics in the District of Purulia, West Bengal. Indices of nutritional status are calculated based on the WHO Child Growth Standards. The result shows that there are gender differences and age group variations in the nutritional status of children who are developmentally challenged. Under-nutrition is a severe problem with vulnerable children in rural area who suffer from developmental delay.

Partha De

Research Activities

Inequality in Child Mortality in the North Eastern States of India

The burden of socio economic inequality falls excessively on children and for this a significant proportion of infant and child deaths occur during childhood. The inequalities among different social groups lead to deprivation in various aspects in their lives. The present study concentrates on how do these disparities differ from state to state within the northeastern states of India? As a measure of inequality and to compare the disparities between different states of north eastern India, concentration curves and indices are constructed from infant and under five mortality data classified under different quintiles of wealth index from the National Family Health Survey (NFHS-3) data. The result shows that, the states may be classified into different groups according to the level of inequality in child mortalities. The states of Tripura, Manipur and Meghalaya have shown higher inequality levels compared to remaining selected states. Second group consists of Mizoram, Nagaland and Assam. Third group of states are Sikkim and Arunachal Pradesh where inequality in child mortality among different socio-economic groups are least.

Partha De

Psychological Research Unit

Cognitive Processing through PASS model and its role in determining Academic Performance of School Students of North – Eastern India

The objective of the project is to find out the role of planning, attention, simultaneous and successive processes of Cognitive functioning in determining academic performance of primary school students. The study also tries to find out the effectiveness of the reading enhancement training programme and thereby its effect on academic performance of low achievers. In this connection three districts of North – East India namely, Tripura, Mizoram and Assam were selected and 234 data were collected from 10 schools through SRSWOR. From these states, low achiever group from two schools of West Tripura district were selected for conducting the intervention program of PREP under Cognitive Assessment System. Teachers have been given training for PREP. Supervision of the training program has been done several times and PREP has been introduced for the experimental group.

Anjali Ghosh and Manjusha Adak

Construction of achievement test

Achievement test is important for validation of different psychological variables like reasoning, Instruction pattern of schoolteachers. By reviewing syllabi and textbooks of grades 8th and 9th, four Achievement tests (1st, 2nd language tests, science and arithmetic) were constructed with 60 items. Tests were administered on 200 students of Government schools. Based on item analysis, 15 items were rejected and final 45 items were found highly reliable (Kuder Richardson reliability coefficient =0.81) in terms of the internal consistency with respect to difficulty levels. Average difficulty index for 45 items is 0.55.

D. Dutta Roy and Parama Gupta

Cognitive Self-efficacy

Persons with mental illness may internalize mental illness stigma and experience diminished self-efficacy. Not everyone with a mental illness, however, suffers a loss of self-efficacy. Some people react by becoming energized and empowered, while others remain relatively indifferent and unaffected. Moreover, some patients with schizophrenia, even if have capability to perform requisite behaviors they fail to do so because they believe that they lack the ability. But do these beliefs have anything to do with social functioning? Do these beliefs can effect relation between well-established relation between cognitive function and social functioning? For this reason path analysis by Baron and Kenny (1986) meditational method was employed .It was found that cognitive self-efficacy interferes with the way cognitive impairment can influence the social functioning outcomes and symptoms severity.

Shivani Santosh and D. Dutta Roy

Innovative Self-efficacy of School Teachers

Teachers with innovative self-efficacy are able to bring innovation in teaching pedagogy. One 50-item Likert type rating scale was constructed to assess five domains of Innovative Self-efficacy. The scale was administered to 200 (male=96 and female=104) secondary school teachers of both private and government schools. Principal component Analysis (PCA) was done which generated five factors and accounted for 56.53% of common variance. Internal consistency of each factor of the innovative self-efficacy scale was tested by Cronbach's Alpha and it ranged from 0.71 to 0.84. Internal consistency of total score was found to be 0.93. Further results revealed that innovative self-efficacy is positively correlated with innovative work behaviour, suggesting validity of the questionnaire.

Anurupa Kundu and D. Dutta Roy

IPA in understanding Diabetes

Successful adaptation to any illness needs to consider psychosocial factors that can influence illness - related cognition and resultant behaviour. Objective of the study is to explore role of illness cognition and social support in diabetes. The study undertook the technique of Interpretative Phenomenological Approach (IPA). Semi-structured interview was employed on five diabetic patients between 18-30 years of age, diagnosed with either type of diabetes (Type I and II) and with minimum one-year of living with the disease. Some psychosocial stressors were found. Data analysis is going on.

Shravanti Adhikari and D. Dutta Roy

Reasoning ability across different demographic conditions

The present study examined differential reasoning patterns of students across different demographic conditions. A 60-item verbal reasoning test battery was constructed to assess five reasoning abilities namely, Similarities, Anagram, Syllogistic reasoning, Data sufficiency and Data coding. It was administered to 622 boys and 372 girls of grades 8th – 10th of different religion and caste and studying in different medium of instructions. Results revealed significant mean differences by grades, age, gender, religion, caste and medium of instruction.

Sumona Datta and D. Dutta Roy

Predictors of motor insurance

Motor insurance is a contract between the vehicle owner and the motor insurance company, where the latter agrees to indemnify any loss that may have been incurred by vehicle owner due to involvement of own car in road accidents, thefts, or damages etc. State wise number of motor insurance policies was collected from DATA ANALYTICS REPORT 2011-12: LIFE AND NON LIFE by Insurance Information Bureau (IIB) of India. State wise population, area, literacy rate, number of road accident cases were collected from census and records of National Crime Records Bureau (NCRB). Step wise multiple regression analysis suggests that linear combination of road accident, population and literacy in accounted for 82%variance of motor insurance policies. Findings are important for policy determination and motor insurance awareness generation programs.

D. Dutta Roy and Pankaj Saha

Job satisfaction of agent in insurance sector

Insurance agents are the key personnel of insurance companies. Current studies examine the job satisfaction of insurance agents with respect to five job characteristics proposed by Hackman and Oldham. The characteristics are task variety, task identity, task significance, autonomy and feedback. Results revealed that agents perceived limited skill development, though the tasks were different. They felt that their job was specialized and they could not complete one job. They were ambiguous in their job satisfaction.

D. Dutta Roy and Debashree Sinha

Research Activities

Customer Satisfaction in Life Insurance Corporation

Objective of the study was to examine customer satisfaction of Life Insurance Corporation. One Likert type rating scale with 25 items was constructed to assess five areas of satisfaction like security, loyalty, agent, premium and processes. Result show that the customers are overall satisfied with life insurance. They are highly satisfied with the procedure involved in the policy than the premium amount. They were satisfied with company security and agents' behavior. But the study did not reflect much high result in case of company loyalty.

D. Dutta Roy and Anamika Ghosh

Parenting style and academic achievement of the school students

The aim of the study is to develop a parenting style questionnaire because parents have the main responsibility for socializing their children and they cannot avoid having an impact on their children's personality, character and overall academic achievement. Exploratory research has been undertaken to develop the questionnaire to be administrated among the parents to identity relevant factors of parenting style. Separate questionnaire has been prepared and administered to a sample of parents and children to elect children's view about relevant factors like parental authority, disciplinary practices, permissiveness, authoritative / flexible etc. Reliability of the Parenting style Questionnaire has been measured by Cronbach's α . Now, the impact of parenting style on academic achievement will be observed.

Rumki Gupta and Jayeta Dhara

Self- esteem and Coping strategies in University students

The objective of the present study is to assess self-esteem and coping capability of University students. Data collection has been done among 150 students of Education Department of University of Calcutta and State University, Barasat. It is seen that there is no significant difference between male and female student regarding self – esteem. But there is a significant difference between male and female students regarding coping strategies. Male students have more coping skills than female students.

Himani Bhattacharya

Role of Career stages, Self-efficacy and School Environment on Job Satisfaction of School Teachers

The aim of the research work was to explore the role of career stages, self-efficacy, and school environment on job satisfaction of schoolteachers selected from different Government aided schools of Kolkata. The aim of the study was also to see the effect of different demographic variables (e.g. age, gender, school, duration of teaching experience) on job satisfaction of schoolteachers. Results showed that five career stages share positive relationship with job satisfaction. Self-efficacy and school environment also have strong positive relationship with job satisfaction. Total school environment score and self-efficacy were found to be primary predictors of job Satisfaction. The four career stages namely, career entry, stabilization, stocktaking and conservatism were also found to be strong predictors of job satisfaction. It implies that schoolteachers believing about their own capability, perceiving good school environment and their commitment to teaching profession can build satisfaction, love and respect towards their profession.

Rituparna Basak and Anjali Ghosh

Sampling and Official Statistics Unit

Simultaneous estimation of several survey population parameters in complex surveys by Bayesian and classical methods

The problem of estimating the totals of some variables in a survey population can be improved using efficient model-based estimators of small area totals. Chaudhuri, Bose and Ghosh (2005) examined the relative accuracy in simultaneous estimation of total numbers of rural earners separately by several different principal unorganized non-agricultural industries in a given district in India. As village wise earning members vary appreciably, the methods of borrowing strength in estimation by the synthetic version of generalized regression method and the Empirical Bayes procedure were used in Chaudhuri et al. (2005). Towards the above problem, presently as a competitor, the method of Hierarchical Bayes technique is investigated.

Kajal Dihidar

Generating randomized response by inverse mechanism

In the context of estimating the sensitive population proportion in a community, following the pioneering work of Singh and Grewal we examine how their inverse approach of revising Warner's and Kuk's techniques of directly eliciting a randomized response fares as a viable competitor. We consider sampling by general schemes admitting positive inclusion probabilities for single and paired persons facilitating estimation. Our live-data based numerical presentations suggest Singh and Grewal's (2013) approach as quite promising.

Kajal Dihidar and Arijit Chaudhuri (ASU)

Protection of privacy in generating randomized response by inverse mechanism

Protection of privacy is to be importantly considered while estimating the sensitive population proportion or population mean by randomized response technique. It has been observed by many researchers that protection of privacy behaves in the reverse way of the efficiency of an estimator. In the present study of estimating sensitive population proportion using randomized response by inverse mechanism the behavior of privacy protection is being studied under unequal probability sampling of respondents.

Kajal Dihidar

Estimating population mean with missing data in unequal probability sampling

The problem considered here is to estimate the population mean with missing data, once it has been deemed impossible to recover the missing values. The essential requirement of frequently used logistic regression model is that this requires values of the explanatory variables of the model to be known for all non-respondents. But very often this requirement is not met. So, following Bethlehem's (2012) approach where the response probabilities can be estimated by some weighting adjustment technique without having the individual data of the non-respondents, and considering the doubtful nature of nonresponse regarding possible existence of relationship with any of the covariates, in the present study, the unbiased estimators for population total/average of a variable of interest and variance estimator are being derived for general unequal probability sampling scheme. The derived estimators are being compared with the usual estimators through numerical simulations.

Kajal Dihidar

DATA Link Initiative: Connecting Data Users and Data Producers for Evidence-based Development Policy

The current proposal aims to seek funding for developing the concept of the Data Link Initiative, an interactive web-portal comprising of relevant data from various socio-economic sectors and sources in India. The overall aims of the concept are: (1) promote a culture of evidence-based policy, (2) increase awareness of availability of development data, (3) promote a culture for critical appraisal of available datasets (4) identifying data gaps and limitations in existing datasets (5) create a vibrant on-line/offline forum for interaction between data producers and data users (6) Identify potential research questions on important development issues.

Sandip Mitra, Sharon Buteau and J. Mukhopdhyay

Research Activities

Microfinance in Agriculture

The study has been continuing for last four years. We conduct a randomized experiment where small farmers in West Bengal received microloans designed to enhance the cultivation of potatoes. In one design (TRAIL), a local trader-lender was incentivized to recommend borrowers to the lender, who then offered individual liability loans to a random subset of those recommended. In the other approach (GBL), the lender offered joint liability loans to self-formed groups of five borrowers, with mandated high frequency group meetings and savings targets. TRAIL loans induced borrowers to expand potato cultivation and farm incomes by 20-30%, whereas there were insignificant effects for GBL loans. This was because TRAIL borrowers were more productive and lower-risk. The TRAIL scheme had higher repayment and take-up rates than GBL, but significantly lower administrative costs.

Sandip Mitra, Dilip Mookherjee, Pushkar Maitra,
Sujata Visaria and Alberto Mota

Programs to Enhance Credit Access and Crop Marketing Success of Poor Farmers: A Field Experiment in West Bengal, India

This study consists of a pilot survey of a random sub-set of phorias (middlemen) and larger traders who operate in 72 villages of West Medinipur and Hugli districts and their corresponding potato markets. Our goal is to understand the nature of contractual relations between farmers and phorias on the one hand, and between phorias and wholesale traders that they sell to on the other hand. The surveys will enable us to obtain systematic information on market structure, trader costs and profits, entry barriers, contractual relations across successive layers of the supply chain, and the nature of competition at each layer. Eventually the hope is that we will obtain a richer understanding of the organization of these bottom-most layers of the supply chain, that will both explain magnitudes of observed margins and pass-through of external price shocks to farmer earnings, as well as enable us to predict the effect of various policies intended to enhance efficiency of the supply network and pass-through to farmers. We are also interested in examining impacts of the scheme on the contractual relationship between farmers and traders. These will enable us to evaluate the benefits and costs of different credit interventions, as well as the benefits and costs of credit, relative to informational interventions.

Sandip Mitra, Dilip Mookherjee, Pushkar Maitra,
Alberto Mota and Sujata Visaria

Rural health in India: Understanding the inequalities

Rural population is often considered as a homogeneous population. The wide diversity among rural population is often ignored when health related issues are considered. The study emphasizes that heterogeneous composition of rural population leads to improper implementation of rural health facilities, which in turn leads to poor health conditions. It is argued that wide divergences in rural sector should be understood to roll out any such policy for the rural sector in particular. The study is empirical in nature and uses NFHS data for analysis.

Sandip Mitra and Moumita Poddar

Investment Climate --- a micro level analysis across different states of India

General perception about indicators of Industrial climate of a country has been mixed. Many argue that Macro Economic indicators predominantly reflect the industrial environment of a nation at a particular point of time. The views of the entrepreneurs as potential investors are often captured to understand the industrial climate of a country. However, the ground reality is often ignored. The household level characteristics contributing to the human development and social welfare are crucial to explain industrial climate of a country. In a federal state like India where the disparities across various states are considerable, the microeconomic factors play a greater role. Such studies augment the macro picture in a comprehensive manner. Current study in a way attempts to explain industrial

climate through a micro-level analysis. It reasserts a World Bank study based on perception of entrepreneurs.

Sandip Mitra and Partha De (PSU)

Corporate social responsibility in developing countries

Current study based on earlier data tries to understand the dynamics of benefit delivery in CSR villages. In addition attempts are being made to find out to what extent hamlet level characteristics matter in determining the standard of living and distribution of benefits.

Sandip Mitra and Subhra Saha

Developing a possible operational risk measure for banking activities: an application of Bayesian probabilistic network – as part of BASEL mandated operational risk management

Basel accord on capital adequacy norms for financial and banking sector has included operational risk as a specific risk for which separate capital has to be provided. One of the requirements for designing a risk management model that would adequately explain the operational risk faced by the bank, and consequently provide capital to face the risk, is collection of loss data. The major problem with any model of operational risk is that these data are inadequate. Without a credible loss history database, most of the advanced risk analysis and measurement techniques cannot be implemented. Bayesian Belief Networks or BBNs provide an elegant solution to this problem. They combine both qualitative and quantitative information for arriving at loss estimates. BBNs are causal networks and are particularly useful for analyzing causes that contribute to operational risks. As with scenario Analysis, one can calibrate one or more causal risk factors in the network and analyze its impact on the loss estimate, under causal Analysis, new evidence of operational losses is used to calculate updated probabilities (also referred to as posterior probabilities) of all the causal factors. The Bayesian process of statistical estimation is one of continuously revising and refining our subjective beliefs about the state of the world as more data become available. As part of this continuing research, a preliminary framework as mentioned above has been developed and a pilot application made.

Amitava Sarkar

Reviewing empirical evidence on some “Stylized Facts” in financial markets with high frequency data

High frequency financial time series are characterized by some unique regularity, known as the stylized facts. Some of the major stylized facts are: conditional volatility; volatility persistence or long memory; fat tails; volatility clustering; and nonlinearity and chaos. Financial time series are, mostly, non-linear in nature and are often characterized by chaotic dynamics. The ongoing research reviews some major theoretical and empirical works discussing the above stylized facts, focusing mainly on volatility, long memory and chaos and extends investigation to high-frequency time series data, especially in foreign exchange and stock markets.

Amitava Sarkar

Research on Poverty Analysis

An axiomatic approach to the measurement of multidimensional poverty and material deprivation is being worked out. The distinction between multidimensional poverty and material deprivation we follow is the one that has been endorsed by the European Union. A multidimensional poverty index takes into account all dimensions of well being, including non-material attributes such as communing with friends, whereas a material deprivation index is concerned with functioning failures/deprivations related to material living conditions.

Nachiketa Chattopadhyay

Sociological Research Unit

Invisible workers of mining and quarrying sector

Women's participation in the formal mining industry in India was roundabout 5%. At all India level, as per NSSO, 2009-10, if the definition of proprietary and partnership which was defined as informal sector was taken, it was seen that 54.4% of all workers in the mining sector were in the informal sector mining. In rural area, distributions of informal sector male and female workers are almost same that is 63% while in urban area female percentage was higher (35%) than male workers (24%). If job contract was one of the indicators then 26% of the workers (27% of male and 21% of females) were in the informal sector in mining sector that had no job contract. In absolute numbers, mining sector had 1.36 million of informal sector workers (who do not have job contract) out of which 1.1 million males and 0.2 million females were working as informal sector workers. Taking regular wage and salary jobs as the best quality employment, women were at a large disadvantage as compared to men. Therefore, it might be concluded that actual number of women miners who comprised a large segment of artisanal miners remained invisible. Invisibility of women miners was giving rise to consequent inequality in payment of minimum wages and other social security issue that were paid leave maternity leave, provident fund, etc. The magnitude of invisibility of women miners should be made visible so that large number of unorganised sector workers within the mining sector could be brought within social security net.

Molly Chattopadhyay

Occupational segregation and gender wage gap

Using data from NSSO following NCO-68 from 1993-94 to 2004-05 gender wage gap and segregation in post-liberalization regime was explored. There is no major change in female labour force participation across two years; by weekly status over 70 percent of females are in agriculture. Excluding agriculture, amongst non-agricultural occupations, both male and female participation is highest in production related work (>40%). Gender segregation is highest in service and production related workers (0.50). Lowest segregation (<0.20) is observed in clerical, sales and mining sector. Highest absolute wage gap is found in professional technical, administrative, service, mining and production related workers, more importantly wage gap is increasing in these occupations while clerical, sales and agriculture represents low wage gap. Wage gap (relative) is quite high; it decreased by only one percent from 0.42 to 0.41 from 1993-94 to 2004-05. In explaining gender wage gap, whether it is due to gender composition of occupations or due to earning gap, it is seen that as a whole gender composition between occupations plays more important role than earning gap within occupations though there are variations. Therefore, it can be said that despite sectoral variations increase in gender ratio has not resulted in decreased segregation and decreased wage gap.

Sonali Chakraborty and Molly Chattopadhyay

Gender Inclusivity in Information Communication Technology: Some Policy Indication

Here it is discussed about the role of women in Information Communication Technology (ICT) with some suggestions and policy implication for the development of women in ICT. The paper address policy makers to focus more on gender planning and gender sensitive priorities towards gender inclusive information sector, i.e., policy towards women should shift from equality to equity.

Bhola Nath Ghosh and Asmita Bhattacharya

Ethnicity: A Continuum on Education

The role of education in different ethnic groups in closed and open society in India is discussed.

Bhola Nath Ghosh and Sujata Chakraborty

Poverty eradication programmes in India: Actions Taken and Impacts Made

This research work discussed different Poverty eradication governmental programmes (State and central), which were taken and what were the impact of the programmes among the peoples specially poor women. In addition to reviewing some important methodological points about the measurement of empowerment and some studies, which were made on women's empowerment, the present paper briefly discusses the role of Government towards promoting the empowerment of women and the historical facts revealing the situation of women over the past few decades.

Bhola Nath Ghosh, M. Pal (ERU) and P. Bharati (BAU)

Process of Development of Women in Rural Jharkhand

The nature and extent of empowerment of rural women in the state of Jharkhand is discussed. It is observed that all the human development indicators (income, education and health) for women are extremely low, which is, due to discrimination and deprivation in occupation, education and lack of either healthcare facilities or awareness. These areas need special attention for the desired welfare of whole population of the area. The discussion made here indicates that empowerment requires full participation of those who are empowered in the formulation, implementation and evaluation of the action strategies. Hence any strategy for women's empowerment must aim at creating the power among men and women to collaborate with each other in order to achieve their fullest potentials as human beings, which must lead both the sexes to enjoy freedom with dignity. Such an atmosphere may be created only when women's collectives along with men, civil society, NGOs governmental agencies and programmes and the social work profession would establish a meaningful partnership with another. Among the indirect measures of empowerment, education in particular is important and plays a positive role in enhancing different dimensions of empowerment.

Bhola Nath Ghosh

Social Network Analysis Approach for Studying Caste, Class and Social Support in Rural Jharkhand and West Bengal: An Empirical Attempt

In Jharkhand, without having any effective measure of land reforms and the Panchayats as well as the absence of peasant mobilization, Total Literacy Campaign or organized women's movement, major portion of the people having dependence upon the market forces have, no doubt, extended their livelihoods to various distant urban-industrial job markets. Unlike in Jharkhand, in West Bengal, economic and political / organizational changes have been taken place. Redistribution of land through land reforms, increase of wage rate and rise of Gram Panchayat have been as a source for the rural poor in Bengal. As a result, there is competition among the landowners to retain labourers and the landowners' authority has been weakened. Under the circumstances, in the present research work, an attempt has been made to study the pattern of social networks of people in the two regions concerning social stratification by caste/ community composition, occupational class, ownership of land and their inter-face among themselves.

Anil K. Choudhuri and Rabindranath Jana

Variation in Height and BMI of Adult Indians

It is well known that height and weight are interrelated, and both are related to socio-economic variables. The study was to assess the effect of socio-economic variables on the heights and weights of different groups of people, formed according to different levels of heights and weights, and to see whether there are sex differences in the variations in heights and weights. A clear positive association was found for height and BMI with economic level (except for overweight females in the case of BMI). In case of BMI, it is age that seems to be the most influential factor. Surprisingly, the observed changes in height and BMI are not as expected for short and tall or underweight and overweight people; these sometimes behave in the opposite directions to that of normal height and weight people. The basic assumption of multivariate normality is not valid due to changing relations at different height and BMI levels.

Suparna Som, Stanley Ulijaszek, Manoranjan Pal (ERU),
Susmita Bharati and Premananda Bharati (BAU)

Women autonomy, nutritional and immunization status of their children

In India, women's decision making power in different socio-economic conditions and how far different levels of decision-making power influences their children's nutritional health and immunization status has been examined. For this study, third round of National Family Health Survey data has been used based on 39,879 women, aged (15-49) years having their last children aged (0-59) months. The study reveals that better nutritional and immunization status of children depends on the consciousness and awareness of their mother. Awareness is directly related with the mothers white coloured job and this job is dependent on women's higher education. So it inferences that autonomy of mothers implied on mother's education and autonomy has the better impact on nutritional and immunization status of their children.

S. Bharati, M. Pal (ERU) and P. Bharati (BAU)

The status of Infant health in India

The infant health status in India through nutritional, immunization and morbidity pattern and its relationship with socio-demographic variables has been examined. The data has been obtained from the Third National Family Health Survey data. The sample sizes are 7562 of (0-11) months of children. It has seen that 23 to 28 percent infants are undernourished. 73.4 percent are immunized by BCG, 18.3 percent are from measles, 39.6 percent from DPT (triple dose) and Polio 47.5 percent. Suffering from diarrhoea, fever and cough also varies from 15 to 22 percent. It is also seen that some socio-economic factors like urban areas, mother's education and wealth index has an impressive effect on reduction of under-nutrition and also on morbidity but there is no impact of socio-economy on immunization and gender discrimination also. So it proves that along with the individual effect, health infrastructure of the state is also responsible for bringing of good health among children.

S. Bharati, M. Pal (ERU) and P. Bharati (BAU)

Autonomy of Tribal Women in India

Autonomy of tribal women in India through decision making power on purchasing household needs, going to relatives' house, getting healthcare facilities or getting access to husband's money or even having independent authority to spend their own income has been examined. Data from NFHS-3 Survey conducted in 2005-06 have been used for the analysis. The results of the analysis clearly show that the degree of women's decision-making power increases positively with the age of women, literacy and wealth index. This is also found to be more on female-headed households and nuclear families. Women in high professional jobs may have more power in the household decision making on healthcare of members in the family and mobility to go outside, but it may not imply higher economic power. Literacy of women plays an important role in the decision making power of tribal women in India.

S. Bharati, M. Pal (ERU) and P. Bharati (BAU)

Socioeconomic Determinants of Iron-Deficiency Anemia among Children Aged 6 to 59 Months in India

The extent of anemia and its socioeconomic determinants among the preschool children (6-59 months old) in India has been studied. Relevant data are taken from the third round of the National Family Health Survey. The initial analysis reveals some interesting features. The most affected children are in the age group of 6 to 23 months. Beyond this age a decreasing trend is observed up to the age of 48 to 59 months. The highest and the lowest prevalence of anemia have been found to be in the central and the northeast zones, respectively. The vulnerable groups are the children of illiterate parents and those belonging to the poor families in the rural areas. The result also confirms that status of literacy and wealth of parents have strong negative association with the status of anemia of the children.

S. Bharati, M. Pal (ERU), S. Chakroborty and P. Bharati (BAU)

Growth and Nutritional Status of Pre-school Children: A Comparative Study of Jharkhand, Bihar and West Bengal

A Comparative study of growth and nutritional status of pre-school children of three states of India namely Jharkhand, Bihar and West Bengal using third National Family Health Survey (NFHS-3) data has been done. It is seen that the rates of growth of mean weights and heights are far lower in Bihar and Jharkhand than in West Bengal and India. Percentage of undernourished children is highest in Bihar followed by Jharkhand and West Bengal. Comparatively high percentage of better nutritional status and low intensity of under nourished children are found among the male gender, urban areas, other communities and of secondary and higher educated mothers. Another notable finding is seen that only in West Bengal, reduction of under-weight among children is directly related with upward movement of literacy of mother and wealth index but in Jharkhand and Bihar, there is no impact of literacy of mother on reducing underweight of their children and only higher wealth index is responsible for reducing the underweight and stunting.

S. Bharati, M. Pal (ERU) and P. Bharati (BAU)

Studying various aspects of social networks with socio-economic changes in a rural area: A case study from West Bengal

In West Bengal, economic and political / organizational changes have been taken place between two time points 1970 and 1998. Redistribution of land through land reforms, increase of wage rate and rise of Gram Panchayat have been as a source for the rural poor in Bengal. As a result, there is competition among the land owners to retain labourers and the land-owners' authority has been weakened. Under the circumstances, by applying different measures, the present paper has attempted to empirically study several characteristics of social network among the rural people, which may be useful to a decision-maker for understanding the changes in relational pattern.

Rabindranath Jana and Anil K. Choudhuri

Distributional Aspects of Some Statistics in Weighted Social Networks

Social network researchers often have to consider the weight (in the sense of strength or intensity of interaction) of each tie of a network. But a digraph cannot represent the data on weights of the ties in a network. Instead, a multidigraph has to be used in such cases. Then, imposing some conditions and assumptions, we have introduced four multinomial-type probabilistic models for weighted social networks and studied the distributional aspects of some statistics (like number of sources, numbers of sinks, and number of isolates).

Rabindranath Jana and Srijib B. Bagchi

Economics and Planning Unit, Delhi

Planning unit faculty has, as in the past, continued to work on the cutting edge of economics research, both in theory, as well as empirical analysis. Research in mechanism design and auction theory, long strength of the unit, continues. Faculties in applied theory have worked on micro-finance, credit constraints in human capital accumulation and income distribution. Political economy, capital accumulation and growth have been the subjects of macroeconomics research.

In experimental economics, research in the unit has analysed collective action, bargaining and the consumer impacts of product labeling. Agricultural fires and air pollution, and climate change and electricity demand and the impacts of climate change on the poor in India are some of the environmental issues on which empirical research has been conducted. In development economics, there has been work on gender bias in labour markets, labor force participation of women, schooling decisions and on various facets of MGNREGA,

Area of Research by the members of the unit:

Research Activities

Social Identity and Inequality: The Impact of China's Hukou System

Farzana Afridi, Sherry Xin Li and Yufei Ren

Female Labour Force Participation and Child Education in India: Evidence from the National Rural Employment Guarantee Scheme

Farzana Afridi, Abhiroop Mukhopadhyay and Soham Sahoo

Women Political Leaders, Corruption and Learning: Evidence from a Large Public Program in India

Farzana Afridi, Vegard Iversen and M.R. Sharan

The Role of Design in School Subsidy Programs: Evidence from Mid-day Meals in India

Farzana Afridi, Bidisha Barooah and Rohini Somanathan

School Feeding Programs and Classroom Performance

Farzana Afridi, Bidisha Barooah and Rohini Somanathan

Electoral Competition and Corruption

Farzana Afridi, Amrita Dhillon and Eilon Solan

Women and Work in Rural India

Farzana Afridi, Taryn Dinkelman, Kanika Mahajan and Abhiroop Mukhopadhyay

Micro-finance, committee formation in network industries, conflict and terrorism

Prabal Roy Chowdhury

Growth of the service sector, especially the business-service sector

Satya P. Das

Growth models of structural change and tax policy, human capital accumulation, unbalanced growth in India, endogenous growth models with investment specific technological change, and a small open economy (SOE) RBC model of the Indian business cycle

Chetan Ghate

Mechanism design, especially when the private information of agents is multidimensional and transfers are allowed

The objective is to understand and characterize the set of possible mechanisms in such settings.

Debasis Mishra

The Political Economy of the National Rural Employment Guarantee Scheme

Abhiroop Mukhopadhyay

Regulation of private technologies in agriculture, Labour markets and the Poor, Supply chains and economic development, Food based safety nets, Food security and international trade

Bharat Ramaswami

- (a) Public versus Private Provisioning: Role of Education and Political Participation**
- (b) Financing Higher Education: Comparing Alternative Policies**
- (c) Education Financing Policy: Income Contingent Loans and Educational Poverty Traps**
- (d) Inequality, Neighbourhoods and Welfare of the Poor**

Tridip Ray

Characterization of incentive compatible random social choice functions on domains

Arunava Sen

Climate impacts on Indian electricity demand, wheat yield, and the income of the poor

In all cases, it has been found that there have already been significant negative impacts.

E. Somanathan

Economic Analysis Unit, Bangalore

The Economic Analysis Unit (EAU) is engaged in research on aspects of socio-economic development using quantitative methods. The research includes studies of incomes of small farmer, on caste and exclusion and on agrarian relations in different parts of the country. Work done over the last few years has been compiled in a book titled Dalit Households in Village Economies. Special attention has been paid to the nature of official statistics in India. Madhura Swaminathan prepared a report on gender gap in official statistics, at the request of the National Statistical Commission. V. K. Ramachandran has undertaken an internally funded project on evaluating official statistics on land holdings.

A new statistical domain has emerged in rural India as a consequence of the Constitution (73rd Amendment) Act, 1992, a domain based on the needs and constitutional functions of the gram panchayat. With the creation of a new structure of local government, a new political institution, the contemporary village panchayat, requires statistical databases for the development functions that have been allocated to it. In the formulation of the Expert Committee on Basic Statistics for Local Level Development (BSLLD), "the Gram Panchayat should consolidate, maintain and own village level data." An all India seminar was held to discuss panchayat-level statistical databases. The main document for the seminar was the draft manuscript for a book with the working title A New Statistical Domain in India: Statistical Data Bases in Gram Panchayats

Jun-ichi Okabe, Aparajita Bakshi and Niladri Sekhar Dhar

Statistical Quality Control and Operations Research Division

The Division comprises of eight SQC & OR Units located at Bangalore, Chennai, Coimbatore, Delhi, Hyderabad, Kolkata, Mumbai and Pune and the Central SQC (CSQC) Office located in the main campus at Baranagore. The CSQC Office functions as the office of the elected Head of the Division and co-ordinates various activities of the Division.

The activities of the division consist of consultancy and training, research with a focus on the applied one, academic teaching including conducting M.Tech. (QROR) programme at Kolkata and Part-Time Certificate Course at Bangalore and Hyderabad. The faculty members of the division also teach in other academic programmes like B.Stat. and M.Stat. Supervision of Ph.D. thesis along with the dissertation and project work by M.Tech. (QROR) and M.Stat. students are another part of the responsibilities discharged by the divisional members.

The activities of the Division under different headings are furnished in the following.

SQC and OR Unit, Kolkata

Properties of weak generalized positive subdefinite

A new class of weak generalized positive subdefinite (WGPSBD) matrices to address a subclass of non-convex quadratic programming was introduced, for which under appropriate assumptions, the solution set of a linear complementarity problem is the same as the set of Karush–Kuhn–Tucker-stationary points of the corresponding quadratic programming problem. This extends the application of the solution procedure by Lemke’s method and hence it will address for obtaining solution of many real life problems.

Development of pivotal algorithm for Scarf’s generalized linear complementarity problem

Scarf introduced a generalization of the linear complementarity problem to accommodate some more complicated real life problems as well as to diversify the field of applications. In this study, a solution procedure based on pivotal algorithm for Scarf’s generalized linear complementarity problem was developed.

Solution procedure of some dynamic game models

In this study some dynamic game models are being considered that have future potential applications. For example, many industrial companies contribute to the pollution of the environment. Governmental bodies try to measure the damage caused by this pollution and in case of over pollution a tax will be raised. The companies have to decide every year whether to spend money for new technologies in order to reduce the pollution. The concept of generalized PPT was used for computing value vector and optimal stationary strategies in stochastic games.

Properties of PPT based matrix classes

The principal pivot transform (PPT) is a fundamental concept introduced by Tucker for developing many theories and algorithms in optimization theory and plays an important role in the study of matrix classes. Some new generalized version of PPT based matrix classes was introduced. These classes are important from algorithmic point of view. The identification of these PPT based matrix classes motivates further application in matrix theory.

Optimal procedure for selecting media

A study was carried out to consider a simplified procedure for media selection problem and formulates it as a binary programming model. An initial model is extended to include various strategic preference specifications and these are implemented by adding logical constraints. The aim is to construct a model to determine which media should be selected so that all audiences are reached.

Minimization of interference during bandwidth allocation

As a result of the growing number of mobile communication systems, there is an increasing need to allocate and reallocate bandwidth for point-to-point communications. During these operational periods the volume of traffic usually changes significantly, which causes point-to-point capacity and interference problems. An optimal bandwidth allocation procedure was obtained for which some measure of total interference is minimized.

Goodness-of-Fit Test based on censored data

There exist a number of censoring schemes for life testing experiment in reliability study. There are a number of works on parametric inference for different life distributions based on censored data. This raises the issue of goodness-of-fit of a particular parametric model based on censored data. Although

modified test statistics have been used under different censoring schemes (not all), the asymptotic distribution has not been considered for these statistics except Type-I censoring case. In this work, a non-parametric test for goodness-of-fit has been proposed based on Type-II and hybrid censored data. The limiting distribution of the test statistic has been derived in terms of standard Brownian Bridge on $[0, 1]$.

Software Reliability Modeling with Periodic Debugging Schedule

Most of the software reliability models assumed that there are finite (unknown) number of errors in the software, say v , and are specified by the failure (detection of an error) intensity. It is also assumed by all these models that the errors are removed as and when they are detected. In many practical situations, it is not the case. Usually, there are some prefixed time points when debugging of errors takes place. This design of software testing is known as 'periodic debugging schedule'. This kind of periodic debugging schedule may be necessary when subsequent versions of the software are released at different times and testing continues with the most recent version. A method of estimation of v has been proposed under the assumption that incidence of all errors follow independent identically distributed Poisson processes with a common but unknown rate λ . Under the Poisson assumption, the maximum likelihood (ML) estimators of v and λ as well as their asymptotic distributions have been obtained.

Determination of optimum replacement plan

In this work, an optimum replacement plan is proposed for a CNC machine based on maintenance data of an organization. It is observed that Non-homogeneous Poisson process is appropriate for the failure process. Parameters of the NHPP are estimated by maximum likelihood method. Different cost models are considered for determination of optimum replacement plan.

Proportional Reversed Hazard Geometric Extreme Distribution

Different lifetime distributions are proposed in literature in the context of reliability study. Recently Louzada et al. (Statistics, 2012) proposed a new three-parameter distribution with decreasing, increasing and unimodal hazard functions. They have provided several properties of the distribution, and discussed different inferential issues. In this work, a more general version of the model is proposed using the proportional reversed hazard model and it is observed that the proposed model can be obtained following the approach of Marshall and Olkin (Biometrika, 1997). The proposed model is a very flexible model, and it has nice physical interpretations. The probability density function and hazard function can take different shapes. The maximum likelihood estimators of the unknown parameters cannot be obtained in closed form. EM algorithm is applied to compute the maximum likelihood estimators of the unknown parameters.

Abhijit Gupta, Amitava Bandyopadhyay, Anup Dewanji (ASU), Arup K. Das, Biswabrata Pradhan, Debasis Sengupta (ASU), Dipak K. Manna, Samir K. Neogy (SQC&OR, Delhi), Sudipta Das, Buddhananda Banerjee, Ritwik Bhattacharya, Ankita Dey and Vivek Jaiswal

On testing exponentiality against NBAFR alternatives

In this article, we propose an interesting approach for testing exponentiality against NBAFR alternatives. A measure of deviation from exponentiality has been derived on the basis of an inequality which we have proved. A test statistic has been constructed using density estimators and its asymptotic normality established. The consistency of the said test is also proved.

Aditi Pal, M. Mitra and M.Z. Anis

Inference and optimum censoring scheme under progressively type-I interval censoring

This work considered inference for the unknown parameters of inverse Gaussian distribution based on progressive type-I interval censored data. Because of the complicated nature of data and the

Research Activities

distribution, the maximum likelihood estimates (MLEs) could not be obtained in closed form. Maximum likelihood estimates were obtained using EM algorithm. A real data set was analyzed for illustration. The performance of the estimators was investigated by a simulation study. Bayes estimation of the parameters was also considered. There was no closed form of Bayes estimates. Bayes estimates were computed by Metropolis-Hastings algorithm. Finally, method of obtaining optimum life testing plan was proposed. The minimum cost associated with the experiment was being considered as optimality criteria.

Annesha Purakayastha, Biswabrata Pradhan and Ritwik Bhattacharya

Study on Some Implementation Issues of TQM in Higher Education and Other Service Sectors and Gap Analysis by Lean Management

Guidance has been provided to Mr. Debaprayag Chaudhuri for Ph.D. in Engineering at Jadavpur University. He has obtained the degree of Doctor of Philosophy (Engineering) in the convocation of Jadavpur University on December 24, 2013. The scope of this work primarily centers on evaluation of degree engineering colleges in West Bengal by adopting six sigma metrics. The weak areas have been identified, benchmarking has been done and corrective measures have been suggested to attain the benchmark. In addition, a few financial institutions have been evaluated with regard to TQM implementation that helped to build up appropriate model to provide faster and better service to the customer.

Arup Ranjan Mukhopadhyay

Impact of Noise Quality due to Highway and Related Infrastructure Development: A Case Study of Construction of Second Vivekananda Bridge and Its New Approach Road

Guidance has been provided to Mr. Tarun Roy on the above topic for Ph.D. in Engineering at Jadavpur University. He has submitted his thesis on the above topic on September 3, 2013. In this thesis, empirical data based studies have been carried out on honking and its influence on noise pollution and assessment of noise environment during construction of the Second Vivekananda Bridge and its new approach roads. The studies have dealt with extensively the measures of noise pollution in terms of equivalent sound energy level (Leq) as well as the noisiest situation that has been termed as L₁₀.

Arup Ranjan Mukhopadhyay

Study on Some Challenging Issues in Implementing Lean Six Sigma

Guidance has been provided to Mr. Ashok Sarkar, Technical Officer (Gr. I), SQC & OR Unit, Mumbai, for Ph.D. in Engineering at Jadavpur University. He has submitted his thesis on the above topic on August 6, 2013. This work is primarily concerned with improvement of service quality by appropriately identifying and reducing non-value adding activities, waste, work-in-progress inventory level etc. to build up appropriate process modeling and measures in Lean Six Sigma.

Arup Ranjan Mukhopadhyay

Identifying Critical Success factors and Effectiveness Measurement System of Six-Sigma Initiatives in Business Processes

The first phase of this research deals with developing a model for Six-Sigma project selection having clear linkage with business objectives and then showcasing a few successful Six-Sigma projects in various business processes including occupational safety. The second phase of the research identifies critical success factors for effective implementation of Six-Sigma practices in industries. The last phase covers the development of a fuzzy measurement system for evaluation of project effectiveness. This research work has deliverables like (i) Methodology for selection of right Six-Sigma projects; (ii) Development of Six-Sigma methodologies for accident prevention in industry; (iii) Identification of Critical Success Factors for a successful Six-Sigma project; and (iv) Methodology for measuring effectiveness of Six-Sigma projects. Seven papers have been published jointly in this endeavour of research work so far.

Prasun Das, B.K. Bhattacharya and Sanjit Ray

Inference for the component and system lifetime distribution of a k-unit parallel system based on system data

In this paper, we consider the inference for the component and system lifetime distribution of a k-unit parallel system with independent components based on system data. The components are assumed to have identical Weibull distribution. We obtain the maximum likelihood estimates of the unknown parameters based on system data. The Fisher information matrix has been derived. We propose β -expectation tolerance interval and β -content γ -level tolerance interval for the life distribution of the system. Performance of the estimators and tolerance intervals is investigated via simulation study. A simulated dataset is analyzed for illustration.

Biswabrata Pradhan, S. Roy and M.Z. Anis

Tests of non-monotonic stochastic aging notions in reliability theory

Testing of various classes of life distributions has been a subject of investigation for more than four decades. In this study we restrict ourselves to the problem of testing exponentiality against non-monotonic aging notions. We model non-monotonic aging using the notions of bathtub failure rate, increasing and then decreasing mean residual life and new worse than better than used in expectation classes. The different tests of exponentiality against these alternatives are discussed in detail.

M.Z. Anis

On C_{pk} assessment in the presence of tool wear

Process capability indices are routinely used in manufacturing industries for process monitoring. A basic assumption while using process capability indices is that there are no assignable causes of variation present. However, when variation due to an assignable cause is present and is tolerated, the conventional methods of capability measurement become inaccurate. In this article, we suggest an estimate of C_{pk} assuming that the process capability changes dynamically. We obtain an exact form of the sampling distribution in the presence of a systematic assignable cause. We discuss the problem of testing whether a given process is capable. The critical values for different sample sizes are obtained based on the sampling distribution. An example involving tool wear problem is presented.

M.Z. Anis and I. Basak

A family of tests for exponentiality against IFR alternatives

In this paper we consider the problem of testing exponentiality against IFR alternatives. A measure of deviation from exponentiality is developed and a class of test statistics are constructed on the basis of this measure. It is shown that the test statistic is an L-statistic. The asymptotic as well as the exact distributions of the test statistics are obtained and the test statistics are proved to be consistent. The Pitman efficiency has also been studied.

M.Z. Anis

Tests for exponentiality against NBUE alternatives: a Monte Carlo comparison

Testing of various classes of life distributions has been addressed in the literature for more than 45 years. In this paper, we consider the problem of testing exponentiality (which essentially implies no ageing) against positive ageing which is captured by the fairly large class of new better than used in expectation (NBUE) distributions. These tests of exponentiality against NBUE alternatives are discussed and compared. The empirical size of the tests is obtained by simulations. Power comparisons for different popular alternatives are done using Monte Carlo simulations. These comparisons are made for both small and large sample sizes. The paper concludes with a discussion in which suggestions are made regarding the choices of the test when a particular alternative is suspected.

M.Z. Anis and K. Basu

Optimum progressive censoring schemes using variable neighbor search (VNS) approach

At time zero, n testing units are put on a life test with a predetermined integer m ($1 \leq m \leq n$) representing the number of failures is to be observed. For a given choice of n and m , the number of all possible progressive censoring schemes is $\binom{n-1}{m-1}$ and it is quite large for moderate values of n and m . For small n and m , the optimum solution can be obtained by all possible searches. There exists a number of works in the literature on determination of optimum solution for small n and m . However, for large n and m , there does not exist any algorithm to obtain the optimum solution. This work considers near optimum solution with respect to two different optimality criteria using variable neighborhood search (VNS) approach. It is observed that the VNS approach gives exact solution for small n and m .

Ritwik Bhattacharya, Biswabrata Pradhan and Anup Dewanji

Weighted Weibull Distribution: Properties and Estimation

We take a closer look at the weighted Weibull distribution. First, we study the structural properties of the probability density function, hazard rate and mean residual lifetime functions of this distribution. We put forward the estimation for the parameters of the weighted Weibull distribution via maximum likelihood estimation technique. We also obtain expected Fisher's information matrix as well as discuss the existence and uniqueness of the maximum likelihood estimates. With regard to Bayesian inference of the unknown parameters, we are using importance sampling technique to calculate Bayes estimates and the corresponding highest posterior density intervals. We perform a data analysis for illustrative purposes.

S. Dey, T. Dey and M.Z. Anis

Work done under the project "Diversity and Inclusion" at TCS

The gender, cultural, economic and ethnic diversity of employees of IT-BPO sector in India is very large. The wide diversity poses a serious challenge and it is important to understand its impact on feeling of inclusion / exclusion of individuals and eventually on organizational performance. In this project attempts are being made to quantify diversity as well as feeling of inclusion / exclusion of individuals. An overall model connecting diversity, the feelings and performance is being proposed. Three different dimensions of diversity, namely identity, value and knowledge was identified. Questionnaires were designed to measure these diversities in Indian context. A pilot survey was conducted and the questionnaires were validated. Data collection plans to measure performance is being designed and a survey covering entire TCS India is being planned.

Amitava Bandyopadhyay, Ranjan Sett and D K Manna

Work done under the project "Improvement of Data Quality in the Indian Oil and Gas Sector" at PPAC, Ministry of Petroleum and Natural Gas

In this project a comprehensive system was designed to ensure quality of oil and gas data received by PPAC from different companies in the public and private sector with respect to five major characteristics, namely timeliness, completeness, accuracy, relevance and configurability. Measures for timeliness and completeness have been proposed and statistical systems were designed using the concepts of stationarity, and internal / external integrity checks to improve accuracy. A system for balancing quantities of import, extraction, processing and consumption was worked out. The system of data was redesigned using relational concepts to improve configurability. Finally a web based software system was designed and implemented to facilitate smooth running of the system.

Amitava Bandyopadhyay and Ranjan Sett

Work done under the project "Optimization and Reliability"

Early estimation of the possibility of detecting defects in a test case is important as well as challenging. This enables test managers to allocate resources judiciously. However, not much work has been done in this area. In this project attempts were made to estimate the yield of a test case by assessing its complexity. From software engineering standpoint three major variables, namely number of transactions, number of verification points and number of interfaces were identified to quantify the complexity of test cases. All these variables were operationally defined and measures were proposed. It was noted that these variables correlate very well with the yield of test cases and it was possible to develop a model to estimate the test case yield.

Amitava Bandyopadhyay

Work done under the project "Optimization and Reliability"

Estimating the number of defects that may leak after testing a large customized software product is an important problem that has not been adequately addressed. The factors impacting the complexity of testing a customized product are very different from the variables that impact the complexity of a test case or a use case. In this project variables impacting testing complexity were identified from the perspectives of customization complexity, development constraints and testing constraints. A set of variables could be identified and the operational definitions could be worked out. The identified variables were found to have high impact on defects leakage. A software product was developed in R to facilitate implementation of the proposed model.

Amitava Bandyopadhyay and Arunima Pandey

Work done under the project "Issues of Data Quality Assessment System for HMIS of Health & Family Welfare Department, West Bengal"

Recognition of the importance of healthcare information systems to be capable of generating reliable data is growing. Recent studies of HMIS, Govt. of W.B. have reported suboptimal data quality hindering efforts to strengthen service delivery. The scope of this project study was on assessment of data quality based on available database in HMIS portal, preparation of DFD for all levels and building linkage towards data compilation and reporting, carrying out detailed studies pertaining to data quality and their impact on data quality components, suggesting/recommending possible changes for possible upgradation of HMIS system and highlighting scope for future work in five critical areas.. Various RHs, BPHC and SCs of sample Blocks of Howrah and Jalpaiguri districts were visited by the project team. Both the interim and final reports have been submitted in time.

Prasun Das, Susanta Kr. Gauri, Sharmistha Biswas and Sougata Kar

Work done under the project "Detection of Surface Defects in Cold Rolled Steel Products and Evaluation of Classifiers"

This project describes the classification schemes to be developed for real time visual Inspection of cold rolled steel surface defects being observed in Tata Steel Cold Rolling Mill. The proposed classification schemes aim at detecting three classes of surface defects. One of the major concerns of this work is to detect and identify the defects in the images. To develop the classification schemes eventually, three broad phases of study, namely, image segmentation of defect areas and computations of gray level co-occurrence texture features; feature extraction and selection using algorithms based on image processing techniques; and defect image classification using discriminant analysis for dimensionality reduction by minimizing feature redundancy have been adopted in a sequential manner. The classifiers used are based on Mahalanobis minimum distance method and ANN approach. The study is ongoing subject to availability of more and more good quality of defect images.

Prasun Das and Madhur Rawat

Research Activities

Work done under the project "Assessment of Technical Parameters for Improvement of Higher Education Performance of the Provincialised Colleges in Assam (Collaborative)"

As a pilot phase of this collaborative project, 16 Provincialised Colleges of Assam University, Silchar, spread over 5 districts of South Assam, have been considered. The objective is to assess the perceptions of different stakeholders (faculties, students, administrators and supporting staff) on the technical parameters and the current performance level for the possible improvement of higher education performance. Questionnaires have been designed, in consultation with the VC of Assam University; Director-CDC, Assam University; ACTA and Principals of colleges under AUS, on the technical parameters and the current performance level (for ex., passing rate, teacher-student ratio, administrative issues, Paper setting, moderation & evaluation, Faculty/student development). The scales, thus developed, have been validated by extant literatures and as well as statistical measures. The survey, almost over, is taking inputs from stakeholders selected using sampling theory, both in quantitative (questionnaire) and qualitative (personal interview) form. The findings of the study will be disseminated jointly through project reports/publications.

Prasun Das and et all.

SQC and OR Unit, Delhi

Mathematical Programming, Linear Complementarity Problem(LCP) and its generalizations, Optimization problem in graph theory, Matrix Theory (Study of Matrix Classes useful in Complementarity, Optimization and Game Theory), Non-cooperative games, Algorithms for Stochastic Games.

S.K. Neogy

Design of Experiments – Static Characteristics, Dynamic Characteristics and Categorical Characteristics in a multi response processes.

Rina Chakravorty

SQC and OR Unit, Bangalore

Identifying critical success factors and effectiveness measurement system of Six Sigma initiatives in business processes

PhD thesis on above research work was submitted to Bengal Engineering and Science University, Shibpur and on the basis of recommendation of the Board of Examiners and on satisfactory performance in the PhD viva voce examination, the PhD degree was awarded with effect from 5th July 2013.

Sanjit Ray

Model for Business Process Improvement through Statistical Techniques

A PhD thesis was prepared and submitted to M.G. University, Kottayam, Kerala, on the above subject and the same is under evaluation.

E.V. Gijo

Designing and developing a methodology for controlling critical sub processes in software development life cycle

As part of designing and developing a methodology for controlling critical sub processes in software development life cycle to achieve software quality and reliability goals, a study on existing methods is carried out. A model is developed to arrive at an optimum test stopping criterion based on software reliability modelling and Taguchi methods, and tested at different information technology companies around Bangalore. A model for estimating defect density of embedded system software using

Bayesian belief networks is developed and tested at different information technology companies around Bangalore.

Boby John

SQC and OR Unit, Chennai

Multiple Response Optimization

The research problem is to develop a methodology for optimization of multiple responses where one or more response variables are categorical.

Surajit Pal

Game Theoretic Applications to Network

G. Ravindran

Complementarity Problems on Symmetric Cones

G. Ravindran

SQC and OR Unit, Coimbatore

Music and muscle relaxation technique on pain, anxiety and physiological parameters among cardiac surgery patients

An attempt is made to study the effectiveness of Music and muscle relaxation technique using statistical approach by developing pain scales accordingly. To assess the pain numerical pain intensity scale and to assess the anxiety, spielberger anxiety scale were used. This scale consists of 20 statements which have both positive and negative statement and this is four points Likert Scale as a tool of measurement. This metric was used for analyzing the pain and anxiety. Physiological parameters such as heart rate, respiratory rate, blood pressure, and tissue oxygenation were collected for a set of Coronary Artery Bypass Graft (CABG) patients. This was measured using cardiac monitor and pulse oximetry. The objective of the study was to establish the significance of non-pharmacological management for CABG patients in reducing the pain and anxiety. The study showed that music and muscle relaxation technique have effect on pain and anxiety; and music therapy was found to be more effective than muscle relaxation technique.

A. Rajagopal and K. Raji

Alternative inoculant for SiMo –CG iron in the production of THC for commercial vehicle

As the cost of this inoculant material was high and availability was also scarce finding an alternative Inoculants without affecting the properties of THC was studied through statistical experimentation. Ferro Silicon (FeSi – Base) was taken for experimentation. The magnesium loss was studied at the First pouring (FP) and Last pouring (LP) of the mould when alternative inoculant was used – suspected to be the critical to quality. A Design of Experiment (DOE) with half fraction factorial was carried out for alternative inoculate Ferro silicon magnesium. Analysis showed that pouring temperature and quality of cerium were found to be significant. Based on this, optimum level of alloy % at 0.20 – 0.25 %, pouring temperature at 1400 – 1420° C and cerium at 200 grams yielded the maximum CG% confirming to the specification. A pilot study confirmation between the alternative inoculation FeSi and present inoculation (Sr-Base) was done. It was established that no significant difference seen on the characteristics of CG%. Thus the issue of alternative inoculant gradually enabled a saving of almost Rs.8 lakhs annually.

A. Rajagopal and M.Krishna Prasanth

Research Activities

SQC and OR Unit, Hyderabad

Linear Complementarity Problem, Decision Support Systems, Six Sigma, DOE, SPC, Text Data Mining, Generalized Gaussian Distributions (GGD)

G.S.R. Murthy, A.L.N. Murthy, G.M. Rao, S.M. Subhani and P. Bhimasankaram

SQC and OR Unit, Mumbai

Model Development for Coal Allocation

One of the major issues faced by the power generation companies is high coal transportation/ handling cost influencing unit power generation cost. The constraints in power scenarios are coal mine location, power plants, coal quality, boiler capacity, environmental regulations etc. Most of the organizations are carrying this activity by trial and error method. In order to study the overall process and associated constraints this project has been taken up. Initial visits were made to a couple of power plant and the constraints are understood and listed. The model is under development.

Sagar Sikder, Ashok Sarkar and Ashis Kumar Chakrobarty

Library, Documentation and Information Sciences Division

The Library, Documentation and Information Science Division comprises

- Central Library, Kolkata
- ISI Delhi Centre Library, Delhi
- ISI Bangalore Centre Library, Bangalore
- ISI Chennai Centre Library, Chennai
- ISI North-East Centre Library, Tezpur
- Prasanta Chandra Mahalanobis Memorial Museum and Archives, Kolkata

The Division is perhaps the most important central facility of the Institute.

Central Library, Kolkata

The Central Library occupies a unique place in academic and research activities of the Institute. The Central Library moved to its present location in 1978, and it occupies 5 floors (60000sq.ft) of a ten-storied building at Calcutta. The Central Library seeks to:

- Meet the informational, educational, recreational, and cultural interests and needs of the user community by providing timely access to print and non-print resources appropriate to those needs.
- Encourage and facilitate reading, literacy and lifelong learning by supplying resources in a variety of formats designed to interest, inform, and enlighten.
- Protect the public's right to know by providing equal access to information needed for informed and effective daily living, decision making, problem solving and thoughtful participation in civic/community affairs.
- Provide the highest quality service and to organize and display the collection for easy, open access by all.
- Maintain publication exchange programme of the Institute with regional, international, national, and foreign institutions and organizations.
- Continue to function as the Eastern Regional Library of the National Board of Higher Mathematics [NBHM], Department of Atomic Energy, Government of India since 1989.

Over the years, the ISI Central Library has attained the distinction of being one of the richest libraries in India in the areas of mathematics, statistics, economics, theoretical computer science and related areas. To achieve the goals of the Library, following activities were undertaken during the year under report:

Collection Development

The Library maintains an excellent collection of books, journals, reports, rare and special collection, government publications, data-books, theses and other documents/ materials in print and electronic formats. During the year under report, the library accessioned 759 books purchased from ISI budget and 918 books purchased under CPDA grant, while 10 books were received on complimentary basis. Added 09 book to the project collection. The Library also accessioned more than 1500 bound volumes of journals and subscribed to 540 scholarly journal titles in print. More than 52 journal titles were received as complimentary and 97 titles in exchange with Sankhya. The library received and processed more than 8000 loose issues of journals. It classified and catalogued 1580 new books and filed 1650 computer printed catalogue cards. It also processed 50 titles of government reports/data-books etc.. Beside this, the library has added a collection of 200+ books, mainly in English, Bengali and Hindi on literature, humanities, travel, health and recreation in its Statistical Workers' Circulating Library. In addition to this, the library has about 32000 reprints.

E-Resources

The library has a good collection of electronic resources on different media and has access to several online journals/databases. During the year under report, the library has added 1 eBook database containing more than 100000 ebooks, 15 CDs books and CDs on statistical data. The library has provided the online access to about 2500+ full-text journals. It has renewed the online database like MathSciNet, ScienceDirect, and SpringerLink through consortia. It has also subscribed to the IEL online of the IEEE/IEE publications, ACM Digital Library and Current Index to Statistics (CIS) on Web. The library has also subscribed to few statistical data sources, which are on CDs.

Publications Exchange Programme

The library maintains the publication exchange programme of 'Sankhya - the Indian Journal of Statistics' with 57 national and 23 international institutions/organizations. The 23 international agencies are from various countries of the world such as Bangladesh, Belgium, Brazil, Canada, China, Taiwan, Croatia, Czech Republic, Denmark, France, Hungary, Italy, Japan, Pakistan, Poland, Romania, Russia, Slovakia, Spain, Switzerland, Thailand, UK, and USA. In exchange Library has received 97 titles during the reporting period.

Membership

Membership of the ISI-Library is restricted to persons with post-graduate or equivalent academic qualification and interested in the objectives of the Institute. Faculty members, research scholars, students, research associates, visiting scientists, ISEC trainees, project-linked staff, project assistants, ISI-employees, outside students and the Institute members are eligible for the membership of the Institute Library. However, they have to apply for the membership of the library and receive a bar-coded Library Card. During this period, library membership was given to 289 persons and 917 readers were given special permission to use the library for a short period of time. Currently the total number of library member rose to 3517. Total number of members including staff, students and research scholars of the Institute rose to 960 in its workers' circulating library.

Services

The ISI-Library, since its inception has been providing a variety of library and information services to its users. The services presently being provided include:

Research Activities

Web-OPAC: Members use this facility to browse and search the database to see the status of a document including their own transactions.

Document Delivery Service: About 100000 books and other documents were issued to the user on loan and reference. Publications from Government of India and other International Organization and data CDs, were issued to users for reference purpose. The Library provided 2500 pages of reprints and 25000 soft copies from different full text database /journals. It provided email-based reminder services like 7-day advance alert, long overdue notices and check-in information. 15000 books were circulated from the workers' circulating library.

Inter-library loan: 22 Books and journals were borrowed from other libraries, while 36 books and journals were lent to other libraries.

Current Awareness Service: 12 monthly lists of current additions to the library were made available online.

Self-Photocopying Service: The library provided the Self-photocopying service in its periodical section, which was available everyday throughout the library hours. During this period 18000 pages were photocopied from the journals.

Electronic Document Delivery Service: Full-text articles and/or bibliographical data were provided from online resources. Besides electronic document delivery, 25000 pages of printouts were also supplied against demand.

Online Full-Text Access to Journals/ Database: During the period under review, the library has provided services from more than 2500+ online journals and major databases like MathSciNet, Econlit, ScienceDirect, Springer Link, IEL Online (IEEE/IEE Electronic Library), ACM Digital Library, CIS on WEB, OUP journal online consortia: The online access is available through campus-wide network.

Reprographic & Photographic Service: During the year, it provided around 420225 pages of photocopies, 597 graphic designs, 6508 scanned items, 1184+ pages of color and b/w pages of print outs, 19440 pages of color photocopies, and 831 spiral bindings 728 pages were laminated.

Documentation Service: A searchable bibliographic database has been prepared on scientific contributions made by the ISI scientists on all subject fields since 1934. The entries are currently being subjected to editing.

General Enquiry Assistance & Consultation Service: Assistance extended to 213 external visitors including participants of the Winter School, NBHM Nurture Programme, Summer School and visiting students of different institutions.

Special Initiatives:

Consortia arrangements: During the reporting year, the Library has further strengthened the consortia initiative to enhance the electronic collection and online access to scholarly resources to cope up with the increasing subscription cost and diminishing budget.

Preservation and conservation: Completed binding of more than 1000 physical volumes of journals. Lamination and de-acidification of 8 rare books of 2000 pages were completed, fumigated 12 books, and photocopied rare and out-of-print books.

Institutional Repository (IR): A prototype of IR of ISI has been created. Currently it covers scientific writings of Professor P.C. Mahalanobis, full-text of 3000+ ISI research papers, full text of all convocation addresses, ISI Annual Report from 1933 to 2008 and 300 Ph.D theses.

Digitization

10 books were digitized. 15886 frames of microfilm/fiche were digitized. These will be made available on the Web after the completion of the work.

Library, Delhi

The Indian Statistical Institute, Delhi Centre, maintains an academic library, which aims to be a leading library in the fields of Economics, Mathematics, Statistics, Operations Research and Statistical Quality Control. The library caters mainly to the needs of bonafide students, scholars and staff of the Institute. However, it is also open for reference to academic and research users of other educational and scientific institutions of the city and its neighboring regions. It is one of the modern libraries with an extensive collection of books, journals, CDs, reports, government publications and other documents in print and electronic formats. The ISI Delhi Centre library also act as one of the NBHM regional library of northern India and provides information resources to support academic and research activities in the areas of Mathematics, and allied subject areas. Some of the main activities of the library during the period under review were as under:

Collection Development

Books: The library accessioned 119 new books and 178 bound volumes during the year under report from the ISI and NBHM funds. The library also received 90 books as gift from different sources. Thus raising the current library stock both books and bound journals to 49484 volumes.

Journals: During the period under review 271 journals, both foreign as well as Indian have been renewed. 23 journals on gratis and 10 journals in exchange are being received in the library from various sources.

Online Resources: The library has provided online access to more than 800 journals including EconLit full text access and SIAM online journals, Current Index to Statistics, MathSciNet, IAOR, Science@Direct, SpringerLink, J-STOR, Oxford Journals, Taylor & Francis, IEEE, INFORMS, AMS, IMS, Sankhya and many others.

CDs: The library has more than 500 CDs of different reference books and journals including databases.

Exchange Programme

Exchange program established with seven scientific institutions in the regions of China, Korea, Netherlands, Poland, Spain and Vietnam for getting their publications in exchange to our journal 'Sankhya'- Indian Journal of Statistics and "Texts and Readings in Mathematics" (book series).

Library Services

Circulation services: During the period April 1st 2013 to March 31, 2014, total 156 members, availed the lending facilities as permanent members of the library, whereas more than 500 users availed reference facilities of the library. More than 4000 publications have been circulated among the members.

Reprographic services: During the period under review more than 15000 pages have been Xeroxed and made available to users of the library and outsiders. Xerox facilities were also provided to research scholars of neighboring Institutes under NBHM programme.

Research Activities

Electronic document delivery service: In addition to Xerox facilities, more than 2000 Full texts articles (PDF files) were provided to the users.

Current awareness service: The following lists were brought out regularly from the library:

- a) Monthly list of current periodicals
- b) New additions of books

Web-OPAC Facility: The users have been given LibSys Web OPAC access facilitates 24X7 over the Internet.

Web Enable Library Services: The library providing web enables library service to users. The library web site contains information about the library its collection, services, rules, list of electronic journals, Catalogues, databases, telephone directories, and online requisition forms etc. The contents of library web pages are regularly updated to serve the internal and external needs of users.

Union Catalogue of Serials

The Indian Statistical Institute Delhi Centre library has developed this Union Catalogue of Serials database with a view to promote the new improved access to journal holdings among the users. The database stored the serial holdings information of 3 ISI Libraries i.e. Kolkata, Delhi and Bangalore. The tool provides a web based central access point to all print and electronic journal holdings information and can be search under Journal title, Keywords, ISSN, Item types, Alphabetical browse (A-Z) or even Library wise serial holdings.

Library, Bangalore

Indian Statistical Institute Bangalore Centre Library is aiming to be identified as a model library in the Indian academic scenario. The Library is providing many modern library services using internet and they are popularly known as web based information services. ISI Bangalore Centre Library has initiated applications where in users are made more interactive. The library has developed a very distinguished collection in different knowledge domains namely Mathematics, Statistics, Economics, Quality Management & Operations Research, Library & Information Science, Computation & Artificial Intelligence. And so on various services are designed to meet the information needs of the faculty members, students, research scholars and visiting scientists. Walk-in users from the other institutions are also permitted to use the library.

The following activities were undertaken / and is being undertaken by the library to achieve the aim during the period April 2013 – March 2014.

Collection Development

In order to meet the user needs and maintain the good collection, books were brought on approval at regular intervals in the library from various publishers. Book exhibition was also conducted to buy books. The library purchased 543 Books during this period. The library subscribed to 352 Journal titles, 16 journal titles were subscribed from NBHM grants. Additionally library has subscribed to IEL ONLINE, which gives access to journal and technical reports published by IEEE. The Library has 39 E-Books from world scientific publishing.

Library Collection: Total no of Books 29,717 and Bound Volume 16,857 are in library.

Technical Processing: Total number of books classified and catalogued during this period is 700

Membership: More than 100 registered users enjoyed the library facilities and the services. Also these facilities were extended to around 800 walk-in users during this period.

Current Content Service: Content pages of around 1400 journals have been scanned to provide this service at ISIBC.

Circulation Service: Around 1600 books and 430 journals were circulated during this period. 600 loose issues of journals were issued to users overnight.

Inter-library Loan Service: ISI Bangalore Centre Library has been identified as one of the best libraries in the select fields of study. As a result and also due to good liaison amongst the local libraries, the library has been involving itself in providing inter-library loan service.

Document Delivery Service: Under this service around 400 documents in pdf format were downloaded and supplied to the registered users from e-versions of the journals.

Reprographic Service: During this period 29,790 photo copies were supplied to the library users.

Web based Library Services: The library has devised various services using World Wide Web. They are all accessible at <http://www.isibang.ac.in/library>. Full text online journals were accessed through this website. Most of the journals we get from ISI consortia. The library also provides access to various Abstracting and Indexing services.

Infrastructure:

- Five New Book racks were bought.
- 65 Chair were bought for library user (study area)

Library Software:

Library Software Libsys is upgraded to Version 7.

Library, Chennai

Academic Library for Indian Statistical Institute Chennai (ISIC) was started in 2011 to cater to the information needs, adding to the existing library of SQC & OR unit at ISIC. This budding library aims to an ultimate collection in the fields of Statistics, Applied statistics, Mathematics, Computer Science, Statistical Quality Control and Operation Research making it prototypical in functioning, administration and unique in collection. Various services are provided for an efficient usage of library facilities by the students, faculty members, visiting scientists and research scholars.

Collection Development:

The Library maintains an excellent collection of books, journals, magazines, question papers, multimedia resources etc. During the year 2013-2014, 600 books were added raising the collection to 2300 books and 3 books were received as donation to the library. Around 10 online, 4 print journals and 16 magazines were subscribed. More than 50 books are procured for recreational reading, proficiency development and personality development to improve the performance of library users. Regular displays are planned on every second and fourth Wednesday of a month between 2.00 p.m and 4.00 p.m to help users get recent publications in hand.

Membership:

ISIC library has restricted access to postgraduate students, research scholars, faculty members and visiting scientists 12 Organizations to around 25. Indian Institute of Technology, Madras (IITM), and other reputed academic 12 Organizations situated in the vicinity hold a good collection of resources in fields relevant to our users. Membership has been renewed with IITM Library, under library membership scheme.

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Services:

Lending and document delivery service: Around 250 documents were delivered during the period 2013-2014 showing the active participation of the users. Automation of library has been initiated and on completion will provide web-OPAC services. Technical Processing: Around 1500 books have been classified during the period 2013-2014. Other services like Inter-Library Loan, content service, reprography service and document delivery service are initiated.

Web based library services:

It has remote access to more than 2000 e-journals accessible through ISI Kolkata Library procured under ISI Consortia.

Library, Tezpur

It started functioning in mid 2011. During this period, it has added 600 books, 13 journals, 4 newspapers and 2 magazines. It has more than 400 circulations. Automation of library has been initiated. It has online access to more than 2000 e-journals. Total allocation was Rs 25.73 lakhs.

Collection Development: In order to meet the Collection development needs, books were displayed on approval basis at regular intervals in the Library for procurement, from various publishers. The Library purchased certain books during this period of report.

Membership: The library caters mainly to the needs of students, scholars and faculty members of the Institute. Total number of members is 20.

Circulation Service: Around 500 books and other materials were circulated during this period.

Inter-Library Loan Service: Received number of books from Central Library, Kolkata on inter library loan to meet the immediate needs of the students and faculty members.

Web Based Library Services: It has remote online access to more than e-journal 2000 e-journals. They are all accessible at <http://www.isical.ac.in/~library/ajournals.html>. Most of them were made accessible on account of ISI Consortia.

Prasanta Chandra Mahalanobis Memorial Museum and Archives

The Museum and Archives carried out regular up keeping programme for 752 exhibits through 91 panels and a collection of artifacts related to Professor. Mahalanobis displayed in the ground floor, chatal, and Professor's residence along with the pest control programme for the whole building of Amrapali. Among other programmes a new project on 'Arrangement and description of archival collection of P.C. Mahalanobis Memorial Museum & Archives' with three year duration has been initiated from the month of July to continue the development of archival record management system. Under the project over 2,500 photographic documents and above six hundred letters, manuscripts etc. has been identified, sorted and listed.

The work of three panels for the proposed new gallery on Rabindranath Tagore and Prasanta Chandra has been completed. Contributed in the exhibition on 'Prasanta Chandra and Brahma Samaj' organized by Sadharan Brahma Samaj on the occasion of Maghotsav through study and preparation of the text material and selecting and providing all the display documents from the archival collection. A customized browser based cross platform software has been developed through agency to showcase the archival metadata with proper retrieval procedure maintaining the standard of existing archival system.

Besides the general visitors, eminent persons and scientists and students from schools, colleges and universities were among the visitors of the museum. Scholars and researchers from different field consulted our archival collection for reference.

Center for Soft Computing Research: A National Facility

Moving Object Segmentation from Video Images

Change detection for video surveillance applications in compressed video

Change detection is an important low-level image processing operation that identifies changes in the state of a scene/object by observing it at different times. The number of applications that use a change detection stage is very large and includes automatic video surveillance, automatic traffic monitoring, remote sensing, and medical diagnosis, to mention a few. Most digital images and video sequences today are both stored and transmitted in compressed form. This widespread compressed status of visual information in current multimedia systems promotes a large interest in the design and implementation of image and video processing algorithms that operate directly in a compressed video. In our work, a new method is presented for background subtraction in bitstreams encoded in H.264. Based on the motivation derived from the facts as outlined above, we contribute towards substantial savings in terms of computational and memory requirements, with performance comparable to those of the current state-of-the-art. Contributions are also made in which the proposed method is shown to work in real-time consistently under variable as well as constant bitrate encoding options.

B. Dey and M.K. Kundu

Rough Sets in Video Tracking

Moving object detection and tracking from video sequences have been an important task in computer vision. There are several approaches to solve it, e.g.: based on some prior knowledge, based on background estimation. Our aim is developing different methodologies and algorithms demonstrating applications of granular computing and rough sets to video tracking and analysis. Different tasks that are considered include supervised video tracking, unsupervised video tracking, and providing quantitative measures for performance evaluation. Rough sets, rough-fuzzy sets, neighborhood rough sets are used, among others, as paradigms for dealing with uncertainty. Gray, Color or R-G-B and R-G-B-D video sequences are used as input data.

D. Chakraborty and S.K. Pal

Remote Sensing Image Analysis

Hyper Spectral Image Processing in Remote Sensing

Hyperspectral sensors acquire a set of images from hundreds of narrow and contiguous bands of electromagnetic spectrum from visible to infrared regions. A hyperspectral imagery can be viewed as an image cube where the first two dimensions indicate the size of the image and the third one specifies the band number of the imagery. The computational complexity and curse of dimensionality are two major difficulties for classification of hyperspectral imagery due to the presence of large number of bands. In such a scenario, dimensionality reduction is an important task of hyperspectral image processing. Band selection and band extraction are two main approaches for dimensionality reduction. Depending of availability of label patterns, band selection and band extraction can be categorized as supervised and unsupervised ones. An unsupervised band elimination method has been proposed which considers both correlation among bands and discriminating capability of each bands. This method iteratively eliminates one band from the pair of most correlated neighbouring bands depending on discriminating capability of the bands. Correlation between neighbouring bands is

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calculated over partitioned band images. Capacity Discrimination is used to measure the discrimination capability of a band image.

A. Datta and A. Ghosh

Change Detection in Remotely Sensed Images

Change detection is a process of detecting temporal effects of multi-temporal images. This process is used for finding out changes in land covers over time by analyzing remotely sensed images of a geographical area captured at different time instants. Changes can occur due to natural hazards (e.g., disaster, earthquake), urban growth, deforestation etc. Traditionally, two approaches are used for change detection process: supervised and unsupervised. In change detection, collection of labeled pattern is costly and time consuming. Under this circumstance, a few labeled patterns can be collected from experts. Here, applicability of supervised approaches is rare and if unsupervised approaches are used for analysis, then these few labeled information is unutilized. To handle this problem, semi-supervised and active learning approach can be used to make full utilization of a few labeled patterns along with the abundant unlabeled patterns. Both the learning approaches are attacking the same problem by following different roadways. Under this scenario, purpose of our research work is two-fold: at first new algorithms are developed using artificial neural networks (ANNs) under semi-supervised and active learning mode so that ANNs can utilize a few labeled information along with plenty of unlabeled patterns during learning and then these new methodologies are used for betterment of change detection on multi-temporal and multi-spectral remotely sensed images. In initial phase, some of the semi-supervised clustering algorithms (e.g., COP-KMeans, Seeded-KMeans and Constrained-KMeans) are applied for change detection. Thereafter, modified self-organizing feature map neural network under semi-supervision is used for the future improvement of the change detection process. A neural approach has also been developed for improvement of change detection using radial basis function neural network and multilayer perceptron under two different active learning frameworks, namely uncertainty sampling and query-by-committee strategy. Then, some investigation is carried out with the supervised neural networks for change detection. Here, ensemble of multilayer perceptron neural networks (MLP) is used to minimize the effort of the optimal architecture selection for MLP. As already mentioned, the usability of supervised methods is infrequent in change detection due to unavailability of labeled patterns. Hence, an ensemble of semi-supervised classifiers can be utilized instead of using either a single classifier or ensemble of classifiers in pure supervised learning paradigm. A change detection technique is developed by integrating both the semi-supervised and ensemble learning in a single platform. Here, multilayer perceptron, elliptical basis function neural network and fuzzy k-nearest neighbour techniques are used as the base classifiers and 'maximum combination rule' is used as a combiner.

A. Ghosh

Image Co-segmentation

Image Co-segmentation refers to the simultaneous segmentation of similar regions from two (or more) images. It aims to segment common objects from a collection of images given by the user. A co-segmentation approach addresses the co-segmentation problem from two aspects, i.e., single image segmentation and common objects segmentation. The single image segmentation technique extracts some uniform and homogeneous regions with respect to texture or color properties, and the common objects segmentation is concerned with the segmentation of objects with similar features. The application of image co-segmentation lies in the following field such as in the creation of a visual summary from photo collections, image retrieval, extractions of pathologies such as lesions from brain image volumes. There are various models of active contour based method; among this dual active contour is the most popular one and is extensively used for image segmentation. An image co-segmentation technique using the dual active contour model is developed to extract meaningful common objects in different images. This method has an advantage that it can integrate global shape information, thus guide the contour into an appropriate minimum. Thus it reduces the misclassification of the regions in the images and extract out the common objects from the images more accurately.

S. Bandyopadhyay and A. Ghosh

Granular Computing

The components fuzzy logic (FL), artificial neural networks (ANN), rough sets (RS) and recently granular computing (GC), in soft computing paradigm, are complementary, rather than competitive. Based on this realization, a new methodology, fuzzy rough granular neural network (FRGNN), involving a 3-dimensional linguistic vector, initial connection weights and target value, is formulated for identifying salient features of data. Each feature of the data is used to develop granulation structures and the input vector and the target value of the network are defined using those granulation structures, based on the concept of fuzzy sets. The same granulation structures are also presented to a decision system, which helps in extracting the domain knowledge about data in the form of dependency factors, using the notion of new fuzzy rough set. These dependency factors are assigned as the initial connection weights of the proposed network. It is then trained using minimization of a novel feature evaluation index in an unsupervised manner. The application and effectiveness of FRGNN has been demonstrated on real life data sets including microarray gene expressions.

A. Ganivada, S.S. Ray and S.K. Pal

Network Mining

Fuzzy Granular Social Networks - Model and Application

Social network data has been modeled with several approaches including Sociogram and Sociomatrices, which are popular and comprehensive. Similar to these models we developed a novel modeling technique based on granular computing theory, which provides a uniform framework to model social network data. In this model, each granule is represented using fuzzy sets. The model is named Fuzzy Granular Social Network (FGSN). Familiar measures of network viz. degree, betweenness, embeddedness and clustering coefficient are redefined in context of this new model. Uncertainty of FGSN has been calculated using the fuzzy entropy measures. Experiments have been performed to observe the applicability of the model in the social network domain. For the purpose, a well known problem of social network, target set selection, has been selected. Through experiments, we show that the model can be used for the problem solving approach within social network analysis. In addition to the applicability, the basic comparative study shows that the results are satisfactory and improving as compare to the similar measures of Sociogram representation.

S. Kundu and S.K. Pal

Community Detection in Social Networks

The prosperity of Web 2.0 and social media brings about many diverse social networks of unprecedented scales, which present new challenges for more effective graph-mining techniques. One of the most relevant features of networks representing real systems is community structure, or clustering. As most of networks demonstrate strong community structures, one basic task in social network analysis is community detection i.e., the organization of vertices in clusters, with many edges joining vertices of the same cluster and comparatively few edges joining vertices of different clusters. Now-a-days most popular social friendship network is Facebook. We are interested to detect communities, and predict future communities and links between two members by their mutual information. Multiple dimensions like, common friends, common groups, common interest are considered, and after that apply some Reward or Penalty function to calculate the membership of two members for being connected or disconnected.

S. Seth and S.K. Pal

Kinship Verification

'Kinship verification' implies the classification of image pairs as "related" or "non-related" in terms of kinship (a relationship between two family members who are biologically related and have genetic overlap). This has application in fields like image annotation, crime investigation etc. We have been

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working on proposing a model for kinship verification which uses multiple discriminative and complementary feature representations so that we can acquire abundant information about the face, apply combination of different feature selection methods like mRMR, Random Subset feature selection, Statistical Dependency etc. to select the best features suited for this task and then use combination of multiple classifiers for better classification. The results obtained are encouraging.

D.D. Mohanty and S.K. Pal

Bio-informatics

micro RNA and RNA Analysis

MicroRNAs (miRNA) are one kind of non-coding RNAs which play important roles in gene expression and cancer. A threshold based method to check the condition (normal or cancer) of miRNAs of a given patient is developed. The threshold is determined in a supervised manner, using weighted average interclass distance between the normal and cancer miRNA expressions. The efficiency of the method as compared to related ones is demonstrated on human breast, colorectal, melanoma lung, prostate and renal cancer data sets in terms of Matthews Correlation Coefficient (MCC) and Receiver Operating Characteristic (ROC) curve. Determining the three-dimensional structure of RNA, given its nucleic acid sequence, is invaluable in understanding the role of the molecule in the cell, creating new drugs and understanding genetic diseases. In this regard, the application and importance of soft computing techniques like artificial neural networks (ANN), fuzzy sets (FS), and genetic algorithms (GAs) to analyze and interpret RNA sequence data for predicting RNA secondary structure have been investigated. The learning ability of ANN and searching potential of GAs have been found to be mainly utilized in the process.

J.K. Pal, S.S. Ray and S.K. Pal

Computing With Words (CWW) and Artificial General Intelligence (AGI)

Envisioning the complementary role of CWW in natural language processing, our study on Z-number based CWW highlighted its capability of semantic-summarization and speaker-subjectivity-encapsulation of a sentence; operators and procedures for these mechanisms have been proposed. This study led to the design of a methodology based on Shannon's and Bayes' theorems for text granulation and extraction of context-sensitive relevant sentences for faster processing. The results of these investigations are currently being extended to include AGI-principles of 'self' and 'consciousness' towards the construction of a cognitive – "intuitive, thinking and understanding" model of understanding and Machine Intelligence Quotient (MIQ) measurement, for man-machine symbiosis.

R. Banerjee and S.K. Pal

Cognitive Vision

It is well known that the visual information entering the brain from the eyes can be separated into three channels known as the Magnocellular, Parvocellular & Koniocellular pathways. The Parvocellular pathway carries much more detail than the Magnocellular pathway, but the Magnocellular pathway can carry information much faster than the Parvocellular pathway. An algorithm has been designed, that is inspired by a two-pass model of attentive vision according to which the visual process is divided into two stages. In the first stage, called 'vision at a glance', the brain first interprets the contents of the Magnocellular pathway. If it can find sufficient detail in this stage then it ignores the contents of the Parvocellular pathway. If it cannot find sufficient detail then it enters the second stage, which is called 'vision with scrutiny'. At this stage the brain examines the contents of the Parvocellular pathway to find further details in those regions where sufficient details were not found. In our model we implement the Magnocellular and Parvocellular pathway using the M and P filters respectively in a Difference of DoG (DDoG) model.

K. Ghosh

Computer and Statistical Services Centre

Throughout the year CSSC managed the central computing facilities of ISI, Kolkata. It served approximately 700 users. Software packages available at the centre are – R, ArcGIS and MatLab. The centers at Bangalore and Tezpur were also given access to Matlab software.

All the centres (Delhi, Bangaluru, Chennai and Tezpur) of the institute are connected with CSSC by 10 mbps Point to Point connection. The infrastructure of the institute's servers, software, Network (wire and wifi), Network and Internet security, IP Telephones, Video conferencing, e-library and internet facilities (NKN - 1 gbps and TATA – 200 mbps) are managed by the CSSC and used by the all the centers of the institute as a LAN. The video conference meetings and classes (M.Tech. in Computer Sciensce and PGDA of ISI Tezpur) are organized by the CSSC throughout the year. The Video conference facilities have been used in 90% days of the year 2013-2014 through web based (<http://www.isical.ac.in/~cssc>) booking.

CSSC provided statistical and numerical consultancy services to scientists and research scholars, including non-ISI scientists. Members of CSSC took part in teaching different courses of the institute and also supervised project work of non-ISI students studying MCA, B-Tech, etc.

R.C. Bose Centre for Cryptology and Security, Kolkata

Attribute-Based Encryption

We obtain Functional Encryption (FE) schemes for finite languages from standard static assumption, viz., Decisional Linear (DLIN) assumption. These finite languages are described by Deterministic Finite Automata (DFAs). We have obtained 2 schemes. Our first scheme is ciphertext-policy functional encryption (CP-FE), where a key is labeled with a string w over a fixed alphabet and a ciphertext C is associated with a DFA M over the same alphabet. The key can extract the message from the ciphertext C if the DFA M accepts the string w . We obtain our second adaptively secure FE scheme in key-policy flavor from DLIN assumption. Both the schemes are shown to be secure in the standard model.

Rana Barua and Tapas Pandit (SMU)

Stream Ciphers

Our recent work on stream cipher reveals new weaknesses of RC4 when used in IEEE WiFi WPA protocol. Motivated by the work of AlFardan et al. (2013), we first prove the interesting sawtooth distribution of the first byte in WPA and the similar nature for the biases in the initial keystream bytes towards zero. As we note, this sawtooth characteristics of these biases surface due to the dependence of the first two bytes of the RC4 key in WPA, both derived from the same byte of the $\backslash IV$. Our result on the nature of the first keystream byte provides a significantly improved distinguisher for RC4 used in WPA than what had been presented by Sepehrdad et al. (2011-12). Further, we revisit the correlation of initial keystream bytes in WPA to the first three bytes of the RC4 key. As these bytes are known from the IV , one can obtain new as well as significantly improved biases in WPA than the absolute biases exploited earlier by AlFardan et al. or Isobe et al. We notice that the correlations of the keystream bytes with publicly known $\backslash IV$ values of WPA potentially strengthen the practical plaintext recovery attack on the protocol.

Goutam Paul, Sourav Sen Gupta, Subhamoy Maitra (ASU) and Santanu Sarkar

Quantum Computing

We study a modified version of CNOT attack as well as a symmetric incoherent attack on recently proposed Fully Device Independent (FDI) Quantum Key Distribution (QKD) protocol [Vazirani & Vidick,

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2012] and identify interesting dichotomy between these two attacks on the protocol. The modified CNOT attack provides the full information about the raw key introducing an additional error probability of $1/(6\sqrt{2})$ on the remaining bits that are not used as key bits. In the symmetric incoherent attack, Eve can obtain the information about a secret key bit with probability $1/2 + \sqrt{D(1-D)}$, where the noise parameter increases by $D/6$ due to this eavesdropping [D being the bit-error probability in the channel], but the the average error on the rest of the bits, that are not used as key bits, does not change.

Goutam Paul and Arpita Maitra (ASU)

Steganography

An LSB-based image steganography algorithm hides information in the least significant bits of the pixel intensities of a cover image. But such a method has a very low embedding capacity compared to a multi-bit embedding scheme. The latter is very challenging in the sense that the possibility of a large change in the pixel value of the cover image becomes very high and only a few algorithms based on multi-bit embedding exist in the literature. We improve the multi-bit embedding technique of Park et al. (2005), and achieve higher capacity of embedding (at most 5 bits per pixel) and higher embedding efficiency (at most 5.33) into an image with lower distortion. We compare our performance with existing techniques and support our claim with theoretical and experimental results.

Goutam Paul and Imon Mukherjee

Key Management in Wireless Sensor Networks

We propose a hybrid key management scheme for Hierarchical WSN. In this scheme, the resource constrained sensor nodes use symmetric key cryptographic schemes using polynomials for secure communication. The clusterheads which are more powerful and can communicate using public key cryptographic schemes. We use an onion routing based scheme for anonymous routing across cluster heads. The computation and communication costs of the proposed hybrid scheme are better than existing results.

Sushmita Ruj and Kouichi Sakurai

Cloud Security

We address two problems, in the first problem, we address access control schemes for cloud computing. We propose a new decentralized access control scheme for secure data storage in clouds that supports anonymous authentication. In the proposed scheme, the cloud verifies the authenticity of the server without knowing the user's identity before storing data. Our scheme also has the added feature of access control in which only valid users are able to decrypt the stored information. The scheme prevents replay attacks and supports creation, modification, and reading data stored in the cloud. We also address user revocation. Moreover, our authentication and access control scheme is decentralized and robust, unlike other access control schemes designed for clouds which are centralized. The communication, computation, and storage overheads are comparable to centralized approaches. In the second problem we provide cloud security services using crowd sourcing. Security-as-a-service is an emerging area in cloud computing. Traditionally, security approaches are service provider-centric and provider-driven. In this paper, we propose a model for security-as-a-service using "crowdsourcing". Though crowdsourcing has been used to provide specific security services like browser security, detecting phishing attacks, detecting cybersecurity threats, there has been no work which provides a unified framework to provide different types of security verification. Dispersed computing power of devices is used to perform security verifications. This is done by subscribers in a collaborative way, using their idle resources, in exchange of certain incentives. Our architecture guarantees anonymity of users who request service and the crowd who contribute in verification by using virtualization concepts and virtual machines. Moreover, we propose an approach for managing

these security verification jobs, subscribers in a fault tolerant manner. To the best of our knowledge, we are the first to propose a unified security-as-a-service framework using crowdsourcing, thus introducing a new research problem. We discuss a number of applications, challenges and problems of crowdsourcing in security verification. We have written a book chapter on security of cloud data.

Sushmita Ruj, Rohit Verma and Rajat Saxena

Security and Fault Tolerance in Smart Grids

We model smart grids as complex interdependent networks, and study targeted attacks on smart grids for the first time. A smart grid consists of two complex networks: the power network and the communication network, which are interconnected. Occurrence of failure/attack on one network triggers failure in the other and propagates in cascades across the networks. Such cascading failures can result in disintegration of either of the networks. Earlier works considered only random failures. In practical situations, an attacker is more likely to compromise nodes selectively. We study cascading failures in smart grids, where an attacker selectively compromises the nodes with probabilities proportional to their degrees; high degree nodes are compromised with higher probability. We mathematically analyze the sizes of the giant components of the networks under attack, and compare them with the sizes in random attacks. We show that networks disintegrate faster for targeted attacks compared to random failures. A targeted attack on a small fraction of high degree nodes disintegrates one or both of the networks, whereas, both the networks contain giant components for random attack on the same fraction of nodes.

Sushmita Ruj, Zhen Huang, Amiya Nayak and Arindam Pal

3. PROJECTS

Internally Funded Projects

Ongoing Projects

Sl. no.	Name of the project	Principal Investigator(s)	Unit(s) involved
Applied Statistics Division			
1.	Understanding of Genes and Genomes through Fractals and Mathematical Morphology	Pabitra Pal Choudhury	ASU, Kolkata
2.	Strategic Network Formation and Evolution	Sourabh Bhattacharya	BIRU
3.	Some Applications of The Density Power Diverge in Statistical Inference	Ayanendranath Basu	BIRU
4.	Robust Speaker Identification	Smarajit Bose	BIRU
Computer and Communication Sciences Division			
1.	Algorithmic and Architectural Design Issues of Microfluidic Nano-Biochips for Bioassay Execution (MICROBE)	B.B. Bhattacharya	ACMU
2.	Distributed Computation in pervasive Computing Environment (DCPC)	Nabanita Das	ACMU
3.	Extending the scope of formal Verification with Assertion Mining from Simulation Traces (ASMT)	Ansuman Banerjee	ACMU
4.	Power and Bandwidth Management in Wireless Networks (PoBaMa-II)	Bhabani P. Sinha	ACMU
5.	The QoS improvement through internetworking of WALN and UMTS networks (HybridUMTS-WALN)	Sasthi C. Ghosh	ACMU
6.	Visibility with diffuse reflections: bounds and algorithms (Visility DifRef)	Arijit Bishnu	ACMU
7.	Script Identification from Handwritten Documents	U. Pal	CVPR
8.	Analysis of Tagore's handwriting	B.B. Chaudhuri	CVPR
9.	Automatic real word error detection and correction	B.B. Chaudhuri	CVPR
10.	Design and development of a multimodal biometric system	Bhabatosh Chanda	ECSU
11.	Video scene segmentation and classification	Bhabatosh Chanda	ECSU
12.	Design & Implementation of Online Atmospheric Pattern Detection & Global change monitoring System.	N.C. Deb & S. Pal	ECSU
13.	Computational Intelligence approaches for finding Synergy Networks from Gene Expression Data	Nikhil R. Pal	ECSU
14.	Detection of mass and calcification in digital mammogram	Dipti Prasad Mukherjee	ECSU

Projects

15.	DNA Computing based on Splicing Operation	Kumar S. Ray	ECSU
16.	Automated Surveillance System Using Hidden Markov Model	Kumar S. Ray	ECSU
17.	Development of Nature-Inspired Metaheuristics for Large Scale Engineering Optimization in Dynamic Environments	Swagatam Das	ECSU
18.	Development of Computational Methods for Analyzing Biochemical Pathways as Integrated Systems	R.K. De	MIU
19.	Moving Object Detection and Tracking from Complex Video Sequences	A. Ghosh	MIU
20.	Network Analysis of Biomolecules for Disease Therapeutics	S. Bandyopadhyay	MIU
21.	Improving the Learning Methodologies in Text Mining.	C.A. Murthy	MIU
22.	Fuzzy Opinion Mining in Social Networking.	D.P. Mandal	MIU
23.	A Computational Approach for Human Gene Function Prediction and Network Analysis.	S.S. Ray	MIU
24.	Development of mathematical morphology based via cartograms	B.S. Daya Sagar	SSIU, Bangalore
25.	Pattern classification with granular neural networks	Saroj K. Meher	SSIU, Bangalore
26.	Human depth EEG processing for epilepsy and cognition	Kausik K. Majumdar	SSIU, Bangalore
Physics and Earth Sciences Division			
1.	Sedimentology of the Triassic mud-dominated fluvial systems	P. Ghosh	GSU
2.	Fault zones, fractals and crustal deformation in the Eastern Himalaya	Dilip Saha	GSU
3.	Tectonics of metabasalt-metagranite association in a geochemical approach	Dilip Saha	GSU
4.	Evolution of carbonate platform through time: examples from PG Valley, Chattisgarh and Cuddapah basins	S. Patranabis-Deb	GSU
5.	Community structure and ecology of the Mesozoic non-marine tetrapods of the Gondwana basins of peninsular India	D.P. Sengupta	GSU
6.	Study of gastropod diversity from the Indian fossil record (Mesozoic-Cenozoic) with special emphasis on phylogenetic systematics, evolutionary trends and palaeoecological interactions.	S.S. Das	GSU
7.	A Study of Neogene and Quaternary successions of eastern Himalayan foreland basin	T. Chakraborty	GSU
8.	Precision Cosmology using combined dataset of CMB Lansing and SN1a	Supratik Pal	PAMU
9.	Simulation of hawking effect in effect in analogue (fluid) gravity model	Subir Ghosh	PAMU

Projects

Biological Sciences Division			
1.	Field testing, Biosafety assays and Agronomic evaluation of nanocides and nanofertilizers.	A. Goswami	AERU
2.	Detection, mapping and phenoplasticity of <i>Alternanthera philoxeroides</i> : an invasive weed.	A. Dewanji	AERU
3.	Management strategies for rice cultivation in the eastern plateau: Field experimental and crop modelling approach.	P. Banik and J. Chattopadhyay	AERU
4.	Allelopathy in an Aquatic and neighbouring Ecosystem and the role of allelochemicals in community structure.	S. Mandal Biswas	AERU
5.	Cooperative recovery mechanism: A safeguard for minimizing extinction risk.	S. Bhattacharya	AERU
6.	Site Specific Nutrient Management (SSNM) System for submerged rice in the eastern plateau region of India.	P.K. Ghosal	AERU
7.	Antioxidant scavenging and corresponding gene regulation in some mangroves of Sunderbans.	S. Das	AERU
8.	A study on yield performance of Sweet Sorghum crop (<i>Sorghum bicolor</i> L.) at different location and fertility levels for maximization of bio-fuel production in West Bengal	S. Barik	AERU
9.	Health of Stone quarry workers of Birbhum District	S.K. Roy	BAU
10.	Genetic variations at microRNA and processing genes and risk of cancer	B. Roy	HGU
11.	Genetic and epigenetic studies on Psoriasis	R. Chatterjee	HGU
12.	On integrating several data sources in genetic association study	I. Mukhopadhyay	HGU
Social Sciences Division			
1.	The Biaxial Syntax of Inflected Clauses in Assamese and Bangla	Probal Dasgupta	LRU
2.	Biaxial Study of Bangla Lexicosyntax	Probal Dasgupta	LRU
3.	Bengali Pronunciation Dictionary in Printed and Electronic Form	Niladri Sekhar Dash	LRU
4.	Cognitive processing through PASS model and its role in determining academic performance of school students in North – Eastern India	Anjali Ghosh	Psychology Research Unit
5.	Differential Validity of Computer Programming Abilities,	D. Dutta Roy	Psychology Research Unit
6.	Parenting style and academic achievement of the school student	Rumki Gupta	Psychology Research Unit
7.	Strategic Network Formation and Evolution	Diganta Mukherjee	SOSU
8.	Data Gap in Gender Statistics: Women in Mining Industry	Molly Chattopadhyay	SRU
9.	Gender Issues and Empowerment of Women in rural West Bengal	Bhola Nath Ghosh	SRU
10.	Dynamics of Land use Pattern in North Chhotnagpur Plateau: A Micro-level study	Hari Charan Behera	SRU

Projects

11.	A micro level study of Television (TV) watching and childhood obesity in Kolkata city of West Bengal, India (2013-2015)	Susmita Bharati	SRU
12.	Migration, Social Networks and their impact on rural household of Jharkhand (2013-2015)	Rabindranath Jana	SRU
13.	Persistence of Dowry in West Bengal	Prabal Roy Chowdhury, Shyamlal Chowdhury (Univ. of Sydney) & Indrani Roy Chowdhury (Jamia Millia Islamia)	EPU
14.	Evaluating the Consumption Effect of Trade Liberalization	Bharat Ramaswami & Sutirtha Bangyapadhyay	EPU
15.	Policy design in Behavioral Settings	Bharat Ramaswami & Subrato Banerjee	EPU
16.	A field experiment on labour productivity in an Indian garment factory	Farzana Afridi, Amrita Dhillon (Kings College) & Vegard Iversen (University of Manchester)	EPU
17.	Women and Work in Rural India	Farzana Afridi, Abhiroop Mukhopadhyay, Kanika Mahajan & Taryn Dinkelmann (Dartmouth College)	EPU
18.	The Role of R & D in Firm Transformation.	Farzana Afridi, Susan Thomas (IGIDR) & Renuka Sane	EPU
19.	Climate Change and Industrial Productivity: The Effects of Temperature on Worker Productivity	E. Somanathan, R. Somanathan (DSE) & A. Sudarshan (Harvard & IFMR)	EPU
20.	The Macroeconomic Implications of Education: Moving Beyond Labour Productivity	Tridip Ray & Mausumi Das (DSE)	EPU
21.	An Empirical Examination of Consumption Externalities	Abhiroop Mukhopadhyay, Monishankar Bishnu	EPU
22.	Competition Dynamics and Sustainability of Micro Finance Institutions	Prabal Roy Chowdhury, Indrani Roy Chowdhury (Jamia Millia Islamia) & Brishti Guha (Singapore)	EPU

Projects

		Management University)	
23.	The Quantity – Quality Trade-off in Education Outcomes: Evidence from the Right to Education Act in India.	Abhiroop Mukhopadhyay , Nishith Prakash & Elizabeth Kaletski (University of Connecticut)	EPU
24.	Does Selective Price Regulation of Pharmaceuticals Improve Welfare?	Abhiroop Mukhopadhyay, Kensuke Kubo (Institute of Developing Economics) & Prachi Singh	EPU
25.	Problems and Prospects of Financing Higher Education in India: Efficacy of Students Loans	Tridip Ray	EPU
26.	Evaluating Official Statistics on Land and Livestock holdings	V.K. Ramachandran & Madhura Swaminathan	EAU
Statistical Quality Control and Operations Research Division			
1.	Optimization and Reliability Modeling	Biswabrata Pradhan	SQC & OR Unit, Kolkata, SQC & OR Unit, Delhi & ASU, Kolkata
2.	Assessment of Technical Parameters for Improvement of Higher Education Performance of the Provincialised Colleges in Assam (Collaborative)	Prasun Das	SQC & OR Unit, Kolkata
3.	Consultancy with Indian Oil Company limited	Rina Chakraborty	SQC & OR Unit, New Delhi
4.	Study to identify key parameters leading to failure of BPO/outsourcing deals	Boby John	SQC & OR Unit, Bangalore
5.	Reducing TDS at common effluent Treatment Plant (CETP) Tirupur	A. Rajagopal	Arulpuram CETP Tirupur
6.	Developing a framework for maintenance schedule of turbine from pressure pulsating curve and scope for improving the sensitiveness of the parameters at Srisaillam Hydropower Station	A. Rajagopal	Srisaillam Hydropower Station
7.	Development of model for coal allocation	Sagar Sikder	SQC & OR Unit, Mumbai & SQC & OR Unit, Kolkata
Library, Documentation and Information Sciences Division			
1.	Arrangement and description of archival collection of P.C. Mahalanobis Memorial Museum & Archives'	Krishna Bhattacharyya	Library, Kolkata

Completed Projects

Sl. No.	Name of the project	Principal Investigator(s)	Unit(s) involved
Theoretical Statistics and Mathematics Division			
1.	Winter School in Probability	Krishanu Maulik and Parthanil Roy	Stat-Math Unit, Kolkata
2.	Subfactors and Planar algebras	Shamindra Kumar Ghosh and Paramita Das	Stat-Math Unit, Kolkata
Computer and Communication Sciences Division			
1.	Physical Design for 3D IC's	Susmita Sur-Kolay	ACMU
2.	Reconfiguration Problems	Subhas C. Nandy	ACMU
3.	Partitioning and Covering Problem of Polygon in 2D	Sandip Das	ACMU
4.	Online Bangla Cursive Handwriting Recognition	U. Bhattacharya	CVPR
5.	Pronominal Anaphora Resolution in Bangla	U. Garain	CVPR
6.	Incorporation of knowledge for analyzing biological data	S. Mitra	MIU
7.	Development of Gene Selection Algorithms from Microarray Data: Fuzzy-Rough and Neighborhood Rough Set Based Approaches	P. Maji	MIU
8.	A study on application of semi-supervised clustering for analysis of remote sensing images and microarray data.	B. Uma Shankar	MIU
9.	Use of computational intelligence approach for content based retrieval, fusion and data security for medical image and video using biometric signatures.	M.K. Kundu	MIU
Physics and Earth Sciences Division			
1.	Channel dynamics in the Sundarban estuarine system: a study from the Basanti-Gosaba region, South 24-Parganas	Chandan Chakraborty	GSU
2.	Evolution of dolomite formations in the Cuddapah basin: Numerical estimation constrained by field proxies	Amlan Banerjee	GSU
3.	Formation and Characterization of Reverse Micelles or Water-in-oil Microemulsions in Ionic Liquids (ILs)	Bidyut K. Paul	GSU
Statistical Quality Control and Operations Research Division			
1.	Develop a methodology to estimate the software quality and establish its linkage with the intermediate stages of defect removal in the software development life cycle to quantitatively manage the software development process.	Boby John	SQC & OR Unit, Bangalore
Library, Documentation and Information Sciences Division			
1.	Indexing, Digital Imaging and Online hosting of Photo	Nibedita Ganguly	Library,

Projects

	images in ISI Repository		Kolkata
2.	Digital Repository of Contribution of ISI Scientist-Phase II (1988-)	Ashis Kumar Pal	Library, Kolkata
3.	Digital processing/redeployment of official statistics collections	Bhomra Chatterji	Library, Kolkata
4.	Updating Library Online Catalogs (Books, Journals and non-book materials) for MARC 21 compliance.	Tapan Kumar Mandal	Library, Kolkata

Externally Funded Projects

Ongoing Projects

Sl. no.	Name of the project	Principal Investigator(s)	Unit(s) involved	Funded by
Theoretical Statistics and Mathematics Division				
1.	Non Commutative Geometry groups and non-Commutative probability	Debashish Goswami	Stat-Math Unit, Kolkata	DST
2.	J.C.Bose Fellowship	Arup Bose	Stat-Math Unit, Kolkata	DST
3.	Harmonic Analysis on Riemannian Symmetric spaces Damek-Ricci spaces Homogenous Tress	Rudra P. Sarkar	Stat-Math Unit, Kolkata	NBHM
4.	Risk Analysis, Ruin and Extremes (RARE)	Krishanu Maulik & Parthanil Roy	Stat-Math Unit, Kolkata	Marie Curie Research Staff Exchange Fellowship from the 7 th European Community Framework Programme
5.	J.C. Bose Fellowship	R. B. Bapat	Stat-Math Unit, Delhi	DST
6.	J.C. Bose Fellowship	Rajendra Bhatia	Stat-Math Unit, Delhi	DST
7.	DST-CONACYT Indo-Mexican Joint Project on Diophantine Equations With Product of integers in Arithmetic Progressions, INT/Mexico/P-I/12012	Shanta Laishram	Stat-Math Unit, Delhi	DST
8.	SERC Fast Track Scheme for Young Scientist in Mathematical Sciences on "Exponential Diophantine Equations: Resolution of some well known Diophantine equations"	Shanta Laishram	Stat-Math Unit, Delhi	DST
9.	INSPIRE faculty award, from the Department of Science and Technology.	Arijit Chakrabarty	Stat-Math Unit, Delhi	DST
10.	On groups admitting expansive automorphisms	C.R.E. Raja and H. Glockner	Stat-Math Unit, Bangalore	DAAD

Applied Statistics Division				
1.	Design and Development of Database and Analytical Tools for Microarray Data on <i>Leishmania donovani</i> Parasite	Ashis SenGupta	ASU, Kolkata	Ministry of Science & Technology, Government of India
2.	Study and investigation of machine learning algorithms for ECG signals	Rituparna Sen	ASU, Chennai	Intel Technologies
Computer and Communication Sciences Division				
1.	New Techniques of Fast Image Compression Based on Human Vision Systems and Geometric Data Structures.	B.B. Bhattacharya & M.K. Kundu	ACMU & MIU	Intel Corporation, USA
2.	Delay Fault Modeling and Test Generation for Power Supply Noise	S. Sur-Kolay & B.B. Bhattacharya	ACMU	Intel Corporation, USA
3.	Design for Manufacturability aware Global Routing	S. Sur-Kolay	ACMU	IBM, USA
4.	Parallel H.264 Codec Implementation	S. Sur-Kolay, B.B. Bhattacharya & A. Banerjee	ACMU	Texas Instruments, India
5.	Lithography Aware Physical Design for Below 20nm Process Technology	S. Sur-Kolay	ACMU	GITA/DST/TWN/P-43/2013
6.	IBM University Relations	A. Banerjee	ACMU	IBM University Relations
7.	Unrestricted Research Grant	A. Banerjee and K. Maulik	ACMU & SMU	Microsoft Research India
8.	Multilingual Word Spotting for Degraded Documents	U. Pal	CVPR	Indo French Centre for the Promotion of Advanced Research (IFCPAR)
9.	Development of Online Handwriting Recognition System for Indian Languages – Phase II	S.K. Parui	CVPR	DIT, Government of India
10.	Cross-Lingual Information Access System (CLIA) – Phase II	M. Mitra	CVPR	DIT, Government of India
11.	Development of Robust Document Analysis & Recognition System for Printed Indian Script Phase-II	B.B. Chaudhuri	CVPR	DIT, Government of India
12.	Sentiment Analysis & Development of a Prototype System for Telecom Industry	S.K. Parui	CVPR	Tech Mahindra
13.	Development of a Dependency Parser for Bengali	U. Garain	CVPR	Society for Natural Language Technology Research (SNLTR)
14.	Digital Image Reconstruction of Indian Cultural Heritage with Focus on Hampi Ruins	B. Chanda	ECSU	DST

Projects

15.	Analysis and Modelling of Atmospheric Pollutant Over Indo Gangetic Plain	S. Pal & N.C. Deb	ECSU	CSIR
16.	Mood Estimation of TV Viewers	Dipti Prasad Mukherjee	ECSU	Qualcomm, USA
17.	RADIOMICS	S. Mitra	MIU	Maastricht University
18.	Processing and Analysis of Aircraft Images with Machine Learning Techniques for Locating Object of Interest	A. Ghosh	MIU	US-ARMY
19.	Erasmus Mundus Action 2 Project India for EU II	A. Ghosh	MIU	European Commission
20.	Rough-Fuzzy Computing and Multiresolution Image Analysis for Segmentation of Brain Tumor from Magnetic Resonance Images	P. Maji	MIU	Indian National Science Academy
21.	agINFRA	A.R.D. Prasad & Devika P. Madalli	DRTC, Bangalore	European Union Commission
22.	ITPAR	A.R.D. Prasad & Devika P. Madalli	DRTC, Bangalore	DST/ University of Trento, Italy
Physics and Earth Sciences Division				
1.	Depositional models and sedimentation history of Proterozoic sedimentary basins of Peninsular India	Sarvani Patranabis-Deb	GSU	De Beers Group
2.	Ganga River Basin Environment Management Plan	T. Chakraborty & P. Ghosh	GSU	Ministry of Environment and Forests
3.	Vertebrate microfossils from the Tiki Formation of the Rewa Gondwana basin: an integrated study on Upper Triassic biodiversity	Saswati Bandyopadhyay	GSU	DST
4.	Jurassic Gondwana Vertebrates of India: An Integrated Study on Palaeobiology	Debarati Mukherjee	GSU	SERB, DST
Biological Sciences Division				
1.	Development of information on Agricultural and Horticultural production using RS and GIS technology in some district of West Bengal	P. Banik	AERU	DST, Govt. of West Bengal
2.	Effect of Different sources of Water soluble Phosphetic Fertilizers in Eastern plateau area	P. Banik	AERU	Rashtriya Chemicals and Fertilizers Ltd. (Govt. of India)
3.	An investigation on antimicrobial potential of chebulic myrobalan (fruit of Terminalia chebula Retz.) against methicillin resistant Staphylococcus aureus	R.R. Chattopadhyay	AERU	DST, Govt. of West Bengal
4.	Designing and Studying Mode of action and biosafety of nanopesticides	A. Goswami	AERU	ICAR, Govt. of India & World Bank

Projects

5.	Genetic manipulation based enhancement of microbial nitrate and phosphate remediation for waste water treatment	A. Goswami	AERU	DST, Govt. of West Bengal
6.	Understanding the Molecular Basis of Nanoparticle-induced Transformations in Viral Morphology and their Biological Functionalities	A. Goswami	AERU	Rashtriya Chemicals and Fertilizers Ltd. (Govt. of India)
7.	Commercial scale production of Nanopesticides and Nanofungicides for Indian Agro-industry	A. Goswami	AERU	DST, Govt. of West Bengal
8.	Development of nano-tool based sucrose sensor for phenotyping of soil moisture deficit stress tolerance in rice	A. Goswami	AERU	ICAR, Govt. of India & World Bank
9.	Eco-epidemiological System with Allee effects	J. Chattopadhyay	AERU	ICAR, Govt. of India
10.	Determination of Functional response through under selective predation through experimentation and modelling	J. Chattopadhyay	AERU	DBT, Govt. of India
11.	Health status and health behaviour of Santals: Comparison between urban and rural groups	S.K. Roy	BAU	ICMR
12.	Physical Growth, Body Composition and Nutritional Status of the Bengali School aged Children, Adolescents and Young adults of Calcutta: Effects of Socioeconomic Factors on Secular trends.	P. Dasgupta	BAU	The Neys van Hoogstraten Foundation, The Netherland
13.	Studies on expression and analysis of miRNA genes in oral cavity cancer and precancer: Significance in marker development and pathogenesis	B. Roy	HGU	DBT, Govt. of India
14.	Genome Wide Association Study of Chronic Pancreatitis	S. Ghosh	HGU	DBT, Govt. of India
15.	A comprehensive genomic and genetic characterization of pancreatic cancer in Indian patient population	N. Sikdar	HGU	DBT, Govt. of India
16.	Evidence theory based uncertainty analysis of ground water flow and contaminant transport	I. Mukhopadhyay	HGU	Department of Atomic Energy Govt. of India
Social Sciences Division				
1.	The Diagnostic Survey of Closed Industrial under Micro & Small Scale Enterprises, West Bengal	Pulakesh Maiti	ERU	Govt. of West Bengal
2.	Linkages between Disperse Urbanization and Rural Industrialization: A case Study from West Bengal	Subhendu Chakraborty	ERU	South Asia Network of Economic Research Institutes (SENI)
3.	Evaluation Study on Border Area (BADP) Cluster – B	Buddhadeb Ghosh	ERU	Planning Commission, Government of India

Projects

4.	Evaluation Study on Border Area (BADP) Cluster – C	Buddhadeb Ghosh	ERU	Planning Commission, Government of India
5.	Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA): Himachal Pradesh, Jammu & Kashmir and Uttarakhand	Buddhadeb Ghosh	ERU	Planning Commission, Government of India
6.	Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA): All Indian Coordination Report	Buddhadeb Ghosh	ERU	Planning Commission, Government of India
7.	Indian Language Corpora Initiative- Bengali-2 (ILCI-2)	Niladri Sekhar Dash	LRU	DIT, Government of India
8.	Study of Corporate Social Responsibility under IISCO	Sandip Mitra	SOSU	IISCO, SAIL
9.	Dream Building	Sandip Mitra	SOSU	Warwick (ESRC Grant)
10.	Reviewing the existing system of compilation of trade indices	Nachiketa Chattopadhyay	SOSU	DGCI & S, Government of India
11.	Reviewing the existing database management system of trade data	Prasanta Pathak	SOSU & ECSU	DGCI & S, Government of India
12.	Comprehensive Handloom Development Programme in Dakshin Dinajpur District	Diganta Mukherjee	SOSU	Directorate of Textiles, Government of West Bengal
13.	Gram Jhalak assignment for Deoghar District for creating GP wise poverty index, 2013 – 14.	Diganta Mukherjee	SOSU	Deputy Development Commissioner Deoghar District, Jharkhand
14.	Setting up of Workstation at the Indian Statistical Institute, Kolkata, for Research on Micro-Data from Census, 2013 – 14.	Diganta Mukherjee	SOSU & Library Unit, Kolkata	Office of Registrar General & Census Commissioner
15.	Accountability of Local Governments in West Bengal	Sandip Mitra	SOSU	State Finance Commission
Statistical Quality Control and Operations Research Division				
1.	Assessing impact of Diversity on Feeling of Inclusion and Performance of Organizations in IT-BPO Sector	Amitava Bandyopadhyay	SQC & OR Unit, Kolkata	TCS
2.	Developing Intelligent System for Steel Defects Characterization	Prasun Das	SQC & OR Unit, Kolkata	Tata Steel, Jamshedpur
3.	Six Sigma Training & Implementation	Sanjit Ray	SQC & OR Unit, Bangalore	Madura Clothing & Aditya Birla Nuvo Ltd.
4.	Six Sigma Training & Implementation	U.H. Acharya, K.K. Chowdhury, A.R. Chowdhury, Sanjit Ray, E.V. Gijo & et al.	SQC & OR Unit, Bangalore	TVS Motors Hosur

Projects

5.	Six Sigma Training & Implementation	P.K. Perumallu	SQC & OR Unit, Bangalore & Pune	HAL Engine Division
6.	Facilitation and guidance for statistical modelling	Boby John	SQC & OR Unit, Bangalore	Hewlett Packard
7.	Six Sigma Training & Implementation	K.K. Chowdhury	SQC & OR Unit, Bangalore	Bharat Electronics
8.	Six Sigma & Other Statistical Techniques	A.R. Chowdhury Somnath Ray & E.V. Gijo	SQC & OR Unit, Bangalore	HMA
9.	Six Sigma Training & Implementation	A.R. Chowdhury Somnath Ray Sanjit Ray	SQC & OR Unit, Bangalore	ITC, Bollaram & ITC, Kovai
10.	Facilitation and guidance for statistical modelling	Boby John K.K. Chowdhury	SQC & OR Unit, Bangalore	Infosys
11.	Module-wise Training on Statistical Techniques	A.R. Chowdhury Somnath Ray Sanjit Ray E.V. Gijo	SQC & OR Unit, Bangalore	Biocon Ltd.
12.	Material Development DFSS Projects	S. Rath	SQC & OR Unit, Pune	ARAI, FID, Chakan
13.	Six Sigma Initiative	S. Rath	SQC & OR Unit, Pune	Technova Imaging Systems Ltd.
14.	Training Program on Six Sigma Black-belt	S. Rath	SQC & OR Unit, Pune	Maersk
15.	Training Program on DFSS	S. Rath	SQC & OR Unit, Pune	Genpact
16.	Training Program on QFD and DFSS	S. Rath	SQC & OR Unit, Pune	Premium Transmission Limited

Completed Projects

Sl. no.	Name of the project	Principal Investigator(s)	Unit(s) involved	Funded by
Computer and Communication Sciences Division				
1.	Computational Methods for Micro RNA Target Detection and its Role in Cancer Development.	S. Bandyopadhyay	MIU	DST
2.	Computation in brain: neurons, astrocytes, synapses in a small network	Kausik K. Majumdar	SSIU, Bangalore	DST
Physics and Earth Sciences Division				

Projects

1.	Nellore schist belt and Proterozoic tectonics of southeastern margin of India	Dilip Saha	GSU	DST
2.	Water wave scattering and associated mathematical techniques.	B.N. Mandal	PAMU	National Academy of Sciences India (NASI)
Social Sciences Division				
1.	Indradhanush WordNet Development for Bengali Language	Probal Dasgupta & Niladri Sekhar Dash	LRU	DIT, Government of India
2.	Final Evaluation of Special Adult Literacy Programme of Tripura State.	Anjali Ghosh	Psychology Research Unit & SRU	Government of Tripura
Statistical Quality Control and Operations Research Division				
1.	Six Sigma Black Belt Training & Projects	Arup Ranjan Mukhopadhyay	SQC & OR Unit, Kolkata	ITC, Munger
2.	Six Sigma Black Belt Training & Projects	Arup Ranjan Mukhopadhyay	SQC & OR Unit, Kolkata	PWC, Kolkata
3.	Issues of Data Quality Assessment System for HMIS	Prasun Das	SQC & OR Unit, Kolkata	National Rural Health Mission, Dept. of Health & Family Welfare, Govt. of West Bengal
4.	Training on SQC	P.K. Perumallu	SQC & OR Unit, Bangalore	AVTEC
5.	Quality Control- Basics Training	U.H. Acharya & Somnath Ray	SQC & OR Unit, Bangalore	NADP Nagpur
6.	Six Sigma Green Belt Program	A.R. Chowdhury, Somnath Ray & E.V. Gijo	SQC & OR Unit, Bangalore	LM Wind Power
7.	Process Improvement Training and Implementation	P.K. Perumallu	SQC & OR Unit, Bangalore	Centum Rakon
8.	Three day Training on Statistical Techniques	A.R. Chowdhury & E.V. Gijo	SQC & OR Unit, Bangalore	Biocon Ltd.
9.	Six Sigma Green Belt Program	A .R. Chowdhury & E.V. Gijo	SQC & OR Unit, Bangalore	TESCO
10.	Program on statistical techniques for Information technology (IT) analytics	Boby John	SQC & OR Unit, Bangalore	Honeywell Technologies
11.	Six Sigma Green Belt Certification	Surajit Pal	SQC & OR Unit, Chennai	Ninestars Information Technologies
12.	Training on Problem Solving Tools	Surajit Pal	SQC & OR Unit, Chennai	Sundaram BNP Paribas – Fund Services

Projects

13.	Training on Statistical Quality Control and Sampling Techniques	Surajit Pal	SQC & OR Unit, Chennai	ITES, Chennai
14.	Design and Development	A. Rajagopal	SQC & OR Unit, Coimbatore	Shiva Tex Yarn Ltd, Karanampettai
15.	Cheiyar, Mining- Quality System implementation	A. Rajagopal	SQC & OR Unit, Coimbatore	SRC Projects, Palladam
16.	General Training programme on Six Sigma Green Belt and Black Belt including Project Guidance at Office	A. Rajagopal	SQC & OR Unit, Coimbatore	Participants
17.	Increasing utilization by minimizing Breakdown Maintenance	A. Rajagopal	SQC & OR Unit, Coimbatore	Bannari Amman Spinning Mills Ltd., Dindigul
18.	Elimination of Edge crack defect in Bonded Lined shoe assemblies	A. Rajagopal	SQC & OR Unit, Coimbatore	TVS Brakes India Ltd., Padi, Chennai
19.	Brazing Process Optimization for Hose Ends	A. Rajagopal	SQC & OR Unit, Coimbatore	TVS Brakes India Ltd., Padi, Chennai
20.	Cost reduction in Inoculation -Si Mo CG Iron - Turbo charger parts	A. Rajagopal	SQC & OR Unit, Coimbatore	TVS Brakes India Ltd., Padi, Chennai
21.	Quality & Process Improvement	G. MuraliRao	SQC & OR Unit, Hyderabad	Quislex Legal Services Pvt Ltd.
22.	Statistical Concept & Tools for QM	G.S.R. Murthy & A.L.N. Murthy	SQC & OR Unit, Hyderabad	Birla Tyres Ltd., Laksar
23.	Statistical Methods	A.L.N. Murthy	SQC & OR Unit, Hyderabad	ITC Ltd. – PSPD, Bhadrachalam
24.	Lean Six Sigma Green Belt	A.L.N. Murthy & G. MuraliRao	SQC & OR Unit, Hyderabad	Participants
25.	Design and Analysis of Experiments	G MuraliRao & A.L.N. Murthy	SQC & OR Unit, Hyderabad	Coromandel International Ltd.
26.	Six Sigma Green Belt	S.M. Subhani & P. Mandal	SQC & OR Unit, Hyderabad	Participants
27.	Six Sigma Black Belt	S.M. Subhani & P. Mandal	SQC & OR Unit, Hyderabad	Participants
28.	Six Sigma Black Belt	G. MuraliRao	SQC & OR Unit, Hyderabad	FactSet India Pvt. Ltd.
29.	Statistical Process Control and Design of Experiments	S.M. Subhani & P. Mandal	SQC & OR Unit, Hyderabad	Wockhardt Research Centre, Aurangabad

Projects

30.	Six Sigma Green Belt	S.M. Subhani & P. Mandal	SQC & OR Unit, Hyderabad	Indian Statistical Institute, Hyderabad
31.	Statistical Techniques for ISO17025	S.M. Subhani & P. Mandal	SQC & OR Unit, Hyderabad	Intertek Laboratories, Sharjah, UAE
32.	Statistical Techniques for ISO17025	S.M. Subhani & P. Mandal	SQC & OR Unit, Hyderabad	Intertek Laboratories, Fujairah, UAE
33.	Six Sigma (Define & Measure)	S.M. Subhani & Ashim Roy Chowdhury	SQC & OR Unit, Hyderabad	ITC Ltd., Bollaram, Hyderabad
34.	Six Sigma (Analyze)	S.M. Subhani & Ashim Roy Chowdhury	SQC & OR Unit, Hyderabad	ITC Ltd., Bollaram, Hyderabad
35.	Statistical Process Control	S.M. Subhani	SQC & OR Unit, Hyderabad	Bharat Dynamics Ltd., Hyderabad
36.	Six Sigma Implementation	A. Sarkar	SQC & OR Unit, Mumbai	Larsen & Toubro Ltd
37.	Six Sigma Implementation	A. Sarkar	SQC & OR Unit, Mumbai	Aditya Birla Management Corporation Pvt. Ltd.
38.	Training on Advance Statistical techniques for Black Belt	A. Sarkar	SQC & OR Unit, Mumbai	Equate Petrochemicals Ltd, Kuwait
39.	Training on Statistical Process Control	S. Sikder	SQC & OR Unit, Mumbai	JSPL, Barbil
40.	Training on Statistical techniques	A. Sarkar	SQC & OR Unit, Mumbai	JSPL, Raigarh
41.	Six Sigma Green Belt Training	A. Sarkar	SQC & OR Unit, Mumbai	XIMB, Bhubaneswar
42.	Six Sigma Project Guidance	A. Sarkar	SQC & OR Unit, Mumbai	HDFC Bank
Center for Soft Computing Research				
1.	Statistical, Structural and Soft Computing based Techniques for Pattern Recognition: Theory, Algorithms and Applications to Bioinformatics	S.K. Pal	Center for Soft Computing Research	Indo-Brazil collaborative project, DST, New Delhi

North East Projects

Ongoing Projects

Sl. no.	Name of the project	Principal Investigator(s)	Unit(s) involved
Biological Sciences Division			
1.	Genetic epidemiology of Malaria and prevalence of Hb E in northeast regions of the country	T.S. Vasulu	BAU

4. SYMPOSIA, CONFERENCES, WORKSHOPS, LECTURES AND SEMINARS ORGANISED

Symposia and Conferences

Conference on “*New Directions in Probability*”: Stat-Math Unit, Bangalore, May 30-June 04, 2013.

8th Meeting on “*Lectures on Probability and Stochastic Processes*”: Stat-Math Unit, Bangalore, December 06–10, 2013.

International Conference “*IWOTA 2013*”: Stat-Math Unit, Bangalore in collaboration with and held at Indian Institute of Science, December 16–20, 2013.

Symposium on “*Complex Analysis and Hyperbolic Metrics*”: Stat-Math Unit, Chennai, January 26, 2014.

Symposium in “*Statistics*”: ASU, ISI Chennai, April 13, 2013.

Symposium on “*Statistical Science Symposium*”: ASU, Chennai, February 06-07, 2014.

International Workshop on “*Open Science and Open Data*”: DRTC, Bangalore in collaboration with Creative Commons, USA, October 07, 2013.

International Conference on “*Knowledge Modelling and Knowledge Management*”: DRTC, Bangalore in collaboration with Department of Science & Technology, Govt. of India, November 20-12, 2013.

5th International Conference on “*Pattern Recognition and Machine Intelligence*”: MIU, Kolkata, December 10-14, 2013.

5th World Congress on “*Paraconsistency*”: jointly organized by PAMU and Centre for Soft Computing Research, Kolkata, in collaboration with Acaemica Brasileira de Filosofia and BRICS, February 13-17, 2014,

National Conference on “*Quantum Correlations: Foundation and Applications*”: PAMU, Kolkata in collaboration with Vidyasagar College for Women, Kolkata, March 04–05, 2014.

3rd International Conference on “*Complex Dynamical Systems and Application*”: PAMU, in collaboration with AERU, Kolkata, March 10-12, 2014.

National Conference on “*Recent Trends in Research on Biological Anthropology in the Eastern and North-Eastern India*”: BAU, Kolkata, November 21-22, 2013.

Workshops on “*Large Scale Survey and Regression Techniques*”: ERU, Kolkata in collaboration with and held at Department of Statistics, Gauhati University, Assam, March 12-14, 2014.

Symposium on “*Mental Health Care Insurance*”: Psychology Research Unit, Kolkata, February 24, 2014.

Annual International Conference 2013 of Comparative Education Society of India on “*Education, Diversity and Democracy*”: SOSU, Kolkata, in collaboration with Department of Economics, University of Calcutta, Institute of Development Studies, Kolkata and Pratichi, December 28-30, 2013.

National Conference on “*Inter disciplinary Researches in Social Sciences with respect to Eastern India*”: SRU, Kolkata and Giridih held at Giridih Branch of Indian Statistical Institute.

Conferences and Seminars

9th Annual Conference on “*Economic Growth and Development*”: EPU, Delhi, December 19-21, 2013.

Conference on “*Indian Macroeconomic Policy*”: EPU, Delhi, February 14, 2014.

All-India Conference on “*Statistical Databases in Gram Panchayats*”: EAU, Kolkata, November 7, 2013.

Conference on “*Annual Six Sigma Conference and Case Study Presentation Contest*”: SQC & OR Unit, Bangalore, held at Atria Hotel, Bangalore, February 13-14, 2014.

Conference on “*Continual Medical Education on Medical Statistics*”: SQC & OR Unit, Hyderabad in collaboration with Nizam’s Institute of Medical Sciences, Hyderabad, March 15, 2014.

Conference on “*Confluence of Minds and Ideas: Brajendranath Seal, Rabindranath Tagore and Prasanta Chandra Mahalanobis*”, Library, March 13, 2014.

International Conference on “*Museum in Motion: Ideas Issues and Challenges*”: P.C. Mahalanobis Memorial Museum & Archives, Library, Kolkata in collaboration with Department of Museology, University of Calcutta, March 24-25, 2014.

Workshops and Training Programmes

Training Programme on “*Research Methods*” (under the Ministry of Statistics & Programme Implementation training to NASA trainees): Stat-Math Unit, Kolkata, August 5-10, 2013.

Advanced Instructional School on “*Algebraic Combinatorics*”: Stat-Math Unit, Bangalore, June 24–July 13, 2013.

Discussion Workshop on “*Side Channel Cryptanalysis*”: Stat-Math Unit, Delhi, January 29-31, 2014.

Workshop on “*ISI Mathematics Day*”: Stat-Math Unit, Bangalore, December 14, 2013.

Training Program on “*Statistics (for doctoral students)*”: Stat-Math, Chennai, held at Tirunelveli University, September 12-13, 2013.

Advanced Training Programme on “*Statistics (for College Teachers and Research Scholars in Statistics)*”: Stat-Math, Chennai, held at Pondicherry, November 18-22, 2013.

Orientation program on “*Statistics*”: Stat-Math, Chennai, held at Farooq College Calicut, Kozhikode, December 20-24, 2013.

Training Programme on “*Application-oriented Statistical Training*” (under North-East Training Programme): ASU, Kolkata, held at Mizoram University, Mizoram, November 18-23, 2013.

Training Programme on “*Statistical Data Analysis*” (under North-East Training Programme): ASU, Kolkata, November 25-29, 2013.

Training Programme on “*Data Mining*” (under North-East Training Programme): ASU, Kolkata, held at Dibrugarh University, Assam, February 03-07, 2014.

Winter School on “*Bayesian Analysis*”: ASU, Kolkata, February 24-28, 2014.

Training Program on “*Geographical Information Systems (GIS) software ArcGIS10.2*”: ASU, Kolkata, in collaboration with NIIT GIS team, Kolkata, March 12, 2014.

Conferences and Seminars

Training Programme on “*Statistical Data Analysis*” (under North-east Training Programme): BIRU, Kolkata, held at Dibrugarh University, Assam, November 26-30, 2013.

Training Programme on “*Data Analysis for Business Research*” (under North-east Training Programme): BIRU, Kolkata, held at Assam University, Silchar, December 12-14, 2013.

Summer School on “*Statistical Theory and Applications*”: BIRU, Kolkata, March 24-28, 2014.

Workshop on “*Algorithms for Mobile and Pervasive Computing*” (under North-East Programme): ACMU, Kolkata held at NIT, Agargala, February 24–26, 2014.

1st Workshop on “*Networks & Distributed Algorithms*”: ACMU, Kolkata, March 13–14, 2014.

Workshop on “*Nano-Electronics & Biochips*”: ACMU, Kolkata, March 18–19, 2014.

Workshop on “*Digital Restoration of Heritage Paintings and Artifacts*”: ECSU, Kolkata, August 13-14, 2013.

Workshop on “*The National Conference on Brain and Consciousness (NCBC-2013)*”: ECSU, Kolkata, September 20-21, 2013.

Workshop on “*Computational Information Processing*” (Under North-East Training Program): ECSU, Kolkata, held at North Eastern Hill University, Shilong, Meghalaya, December 03-06, 2013.

16th Workshop on “*Computational Information Processing (Theme: Nature Inspired Computing)*” (Under North-East Training Program): ECSU, Kolkata, March 26-28, 2014.

Winter School on “*Pattern Recognition and Image Processing (for North-East only)*”: MIU, Kolkata in collaboration with Tripura University, held at Tripura, March 25-29, 2014.

Workshop on “*Image Pattern Analysis and Applications*”: SSIU, Bangalore in collaboration with Amrita School of Engineering, Bangalore, November 09-10, 2013.

Workshop on “*Spatial Information Analytics: Mathematical Morphological Interpolations and Pattern Recognition*”, SSIU, Bangalore in collaboration with IEEE GRSS Bangalore Chapter and Centre for Knowledge Analytics and Ontological Engineering (KANOE), February 28, 2014.

Training Programme on “*Symmetric Key Ciphers*”: CSU, Chennai, April 04-07, 2013.

Training programme on “*Vertebrate evolution and phylogeny*” (for students of Earth Science Department, Indian Institute of Science Education and Research, Kolkata): GSU, Kolkata, April 10, 2013.

Meeting of “*Brain storming session on the implication for Ganga River Basin Management*”: GSU, Kolkata, June 19-21, 2013.

National Workshop on “*Nonlinear Dynamics and Applications (for North-East students only)*”: jointly organized by PAMU and AERU, Kolkata, in collaboration with Department of Physics, Tezpur University, March 13-15, 2014.

Workshop on “*Cross-Learning Evaluation (National Agricultural Innovation Project, World Bank & ICAR)*”: jointly organized by AERU and SOSU, Kolkata, December 03-04, 2013.

Conferences and Seminars

Workshop on “*Human Genetics: Techniques and Statistical Analyses*”: HGU, Kolkata held in Agartala University, Tripura, November 25-28, 2013.

Training Programme on “*Econometrics (for ISS Officers)*”: ERU, Kolkata, February 03–14, 2014.

Training Programme on “*Translator’s Orientation Programme in Bangla (for the National Translation Mission)*”: LRU, Kolkata, in collaboration with Central Institute of Indian Languages, Ministry of Human Resource & Development, Govt. of India, July 01-05, 2013.

Workshop on “*Computational & Cognitive Linguistics (WCCL-2014)*”: LRU, Kolkata, March 19–21, 2014.

Workshop on “*Fairy Tale Test: A Projective Personality test*”: Psychology Research Unit, Kolkata, January 14, 2014.

International Workshop on “*Official Data*”: SOSU, Kolkata, July 11, 2013.

Course on “*Research Methods (for Senior Government Officials)*”: SOSU, Kolkata, August 5-10, 2013.

Executive Training Programme on “*Statistical Data Analysis (for teachers, educators and programmers from government colleges of Madhya Pradesh)*”: SOSU, Kolkata, September 23-27, 2013.

2nd Workshop on “*West Bengal Growth*”: SOSU, Kolkata, December 26-27, 2013.

1st Workshop on “*Official Statistics in the North East India*”: SOSU, Kolkata, in collaboration with Department of Statistics, Gauhati University, Guwahati, January 02-04, 2014.

Training Program on “*Sample Survey Methodology and Estimation (for ISS Probationary Officers - 34th Batch)*”: SOSU, Kolkata, January 06-17, 2014.

Training Programme on “*Basic Demographic Techniques for ORGI officers in eastern India*”: SOSU, Kolkata, January 13-24, 2014.

3 Weeks Training Program on “*Macro and Microeconomics (for ISS Probationers)*”: EPU, Delhi, May 13–31, 2013.

2nd Workshop on “*Macroeconomics Workshop*”: EPU, Delhi, September 27, 2013.

Workshop of Indian Statistical Institute-Warwick on “*Economics*”: EPU, Delhi, February 24-28, 2014.

Workshop on “*Reliability Theory, Survival Analysis and Related Topics (Research Scholars Meet)*”: SQC & OR Unit, Kolkata, February 19-21, 2014.

Training Programme on “*Six Sigma Green Belt*”: SQC & OR Unit, New Delhi, April 23–25, 2013.

Training Programme on “*Six Sigma Green Belt*”: SQC & OR Unit, New Delhi, July 29–01, 2013.

Training Programme on “*Six Sigma Black Belt 1st*”: SQC & OR Unit, New Delhi, August 06–08, 2013.

Training Programme on “*Six Sigma Black Belt 2nd*”: SQC & OR Unit, New Delhi, September 10–13, 2013.

Training Programme on “*Six Sigma Green Belt*”: SQC & OR Unit, New Delhi, September 25–27, 2013.

Conferences and Seminars

Training Programme on “*Six Sigma Black Belt 3rd Module*”: SQC & OR Unit, New Delhi, October 28–31, 2013.

Training Programme on “*Six Sigma Black Belt 4th Module*”: SQC & OR Unit, New Delhi, November 25–27, 2013.

Training Programme on “*Six Sigma Green Belt*”: SQC & OR Unit, New Delhi, December 02-03 & 05, 2013.

Training Programme on “*Six Sigma MasterBlack Belt 1st*”: SQC & OR Unit, New Delhi, January 13–17, 2014.

Training Programme on “*Six Sigma Green Belt*”: SQC & OR Unit, New Delhi, February 04–06, 2014.

Training Programme on “*Six Sigma Master Black Belt 2nd*”: SQC & OR Unit, New Delhi, February 10–14, 2014.

Training Programme on “*Statistical Technique at International Centre for Automotive Technology*”: SQC & OR Unit, New Delhi, held at Manesar, Gurgaon, January 20-23, 2014.

Training Program on “*Design for Six Sigma (DFSS-01)*”: SQC & OR Unit, Bangalore, April 08-13 2013.

Certification Program on “*Six Sigma Black Belt (BB-16)*”: SQC & OR Unit, Bangalore, April 22–28 & June 08–16, 2013.

Certification Program on “*Six Sigma Green Belt (GB-17)*”: SQC & OR Unit, Bangalore, May 4, 6 & 9–12, 2013.

Certification Program on “*Six Sigma Green Belt (GB-18)*”: SQC & OR Unit, Bangalore held at Kolkata, May 18–20 & 24–26, 2013.

Training Program on “*Statistical Techniques for Data Mining & Business Analytics (DMBA-11)*”: SQC & OR Unit, Bangalore, May 27–29, 2013.

Certification Program on “*Six Sigma Green Belt (GB-19)*”: SQC & OR Unit, Bangalore, July 13–15 & 19–01, 2013.

Training Program on “*Problem Solving using Design of Experiments (DOE-01)*” July 16–18, 2013.

Certification Program on “*Six Sigma Master Black Belt (MBB-21)*”: SQC & OR Unit, Bangalore, July 21-August 04, 2013.

Training Program on “*Statistical Techniques for Data Mining & Business Analytics. (DMBA-12)*”: SQC & OR Unit, Bangalore, August 29–31, 2013.

Certification Program on “*Six Sigma Green Belt (GB-21)*”: SQC & OR Unit, Bangalore, July 13–15 & 19–21, 2013.

Certification Program on “*Six Sigma Green Belt (GB-20)*”: SQC & OR Unit, Bangalore, held at Kolkata, August 10–12 & 16–18, 2013.

Certification Program on “*Six Sigma Black Belt (BB-17)*”: SQC & OR Unit, Bangalore, August 19–25 (Phase-I) and September 21–29 (Phase-II), 2013.

Conferences and Seminars

Certification Program on “*Six Sigma Green Belt (GB-22)*”: SQC & OR Unit, Bangalore, September 07–09 & 13–15, 2013.

Certification Program on “*Six Sigma Green Belt (GB-24)*”: SQC & OR Unit, Bangalore, September 07–09 & 13–15, 2013.

Certification Program on “*Six Sigma Green Belt (GB-23)*”: SQC & OR Unit, Bangalore, held at Kolkata, October 19-21 & 25–27, 2013.

Certification Program on “*Six Sigma Green Belt (GB-25)*”: SQC & OR Unit, Bangalore, November 09–11 & 15–17, 2013.

Certification Program on “*Six Sigma Green Belt*”: SQC & OR Unit, Bangalore, held at Guwahati December 05–08, 2013.

Certification Program on “*Six Sigma Black Belt (BB-18)*”: SQC & OR Unit, Bangalore, December 16–22, 2013 (Phase-I) & February 01–09, 2014 (Phase-II).

Certification Program on “*Six Sigma Green Belt (GB-26)*”: SQC & OR Unit, Bangalore, January 04–06 & 10–12, 2014.

Certification Program on “*Quality Development Program at North-East States*”: SQC & OR Unit, Bangalore, held at Tezpur University, January 30–February 02, 2014.

Certification Program on “*Six Sigma Master Black Belt (MBB-22)*”: SQC & OR Unit, Bangalore, February 16–March 02, 2014.

Certification Program on “*Six Sigma Green Belt (GB-27)*”: SQC & OR Unit, Bangalore, held at Kolkata, February 22-24 & 28 and March 01-02, 2014.

Certification Program on “*Six Sigma Green Belt (GB-28)*”: SQC & OR Unit, Bangalore, held at Kolkata, March 08-10 & 14–16, 2014.

Training Program on “*Six Sigma Black Belt*”: SQC & OR Unit, Chennai, June 22–July 19, 2013.

Training Program on “*Six Sigma Green Belt*”: SQC & OR Unit, Chennai, July 15–19, 2013.

Training Program on “*Six Sigma Green Belt*”: SQC & OR Unit, Chennai, October 19–27, 2013.

Training Program on “*Six Sigma Master Black Belt*”: SQC & OR Unit, Chennai, December 01, 2013–March 16, 2014.

Workshop on “*Positioning Manufacturers for Economic Upturn*”: SQC & OR Unit, Coimbatore, June 07, 2013.

Workshop on “*Achieving Breakthrough Quality Edition III*”: SQC & OR Unit, Coimbatore, in association with The Hindu, June 29, 2013.

National Workshop on “*Multi objective Evolutionary Optimization for Engineering Applications & Product /Process innovation through TRIZ on Mechanical Engineering*”: SQC & OR Unit, Coimbatore, held at JCT College of Engineering and Technology, Pichanur, August 30-31, 2013.

Training Programme on “*ISO 9001-2015 Sustaining for Competitiveness*”: SQC & OR Unit, Coimbatore, held at Bannari Amman Spinning Mills Ltd. Dindigul, September 03, 2013.

Conferences and Seminars

Training Programme on “7 Quality Tools in GAIL Executives”: SQC & OR Unit, Coimbatore, held at FCRI, Palkhat, September 10, 2013.

Training Programme on “Kanovian Model on Patient care”: SQC & OR Unit, Coimbatore, held at KG, Hospital Coimbatore, October 15, 2013.

Training Programme on “Internal Quality Audit”: SQC & OR Unit, Coimbatore, held at MYK Spinning Industry Ltd., Gunded, Hyderabad, October 21, 2013.

Training Programme on “Statistical Techniques for Quantitative Project Management”: SQC & OR Unit, Mumbai, April 29-20, 2013.

Training Programme on “Six Sigma Black Belt”: SQC & OR Unit, Mumbai, April-June, 2013.

Training Programme on “Six Sigma Green Belt (Part-2)”: SQC & OR Unit, Mumbai, held at L&T Mysore, May 07-09, 2013.

Training Programme on “Statistical Techniques for Data Mining & Business Analytics”: SQC & OR Unit, Mumbai, June 05-07, 2013.

Training Programme on “Six Sigma Green Belt (Part-1)”: SQC & OR Unit, Mumbai, held at L&T Vadodara, July 01-03, 2013.

Training Programme on “Six Sigma Green Belt”: SQC & OR Unit, Mumbai, July 22-26, 2013.

Training Programme on “Six Sigma Master Black Belt”: SQC & OR Unit, Mumbai, August-September 2013.

Training Programme on “Six Sigma Green Belt (for XIMB TQM Students)”: SQC & OR Unit, Mumbai, held at Xavier Institute of Management, Bhubaneswar, August 24-25 & September 07-08, 2013.

Training Programme on “SixSigma Advanced Statistical Tools for Equate Petrochemicals”: SQC & OR Unit, Mumbai, held at Kuwait, September 14-19, 2013.

Training Programme on “Statistical Process Control (for Uttam Galva Metalics Limited)”: SQC & OR Unit, Mumbai, held at Wardha, Maharashtra, September 30-October 01, 2013.

Training programme on “Six Sigma Green Belt (Part-2)”: SQC & OR Unit, Mumbai held at L&T Vadodara, October 03-05, 2013.

Training Programme on “Six Sigma Green Belt”: SQC & OR Unit, Mumbai, October 19-21 & 26-27, 2013.

Training Programme on “Six Sigma Black Belt”: SQC & OR Unit, Mumbai, held at Aditya Birla Management Corporation Pvt. Ltd., Mumbai, October 22-25, 2013.

Training Programme on “Statistical Techniques using MINITAB (for JSPL)”: SQC & OR Unit, Mumbai, held at JSPL, Raigarh, October 29 – November 01, 2013.

Training Programme on “Statistical Techniques for Data Mining & Business Analytics”: SQC & OR Unit, Mumbai, November 18-20, 2013.

Training Programme on “Six Sigma Black belt”: SQC & OR Unit, Mumbai, November, 2013-January 2014.

Conferences and Seminars

Training Programme on “*Six Sigma Black Belt*”: SQC & OR Unit, Mumbai, held at Aditya Birla Management Corporation Pvt. Ltd., Mumbai, December 02-06, 2013.

Training Programme on “*Statistical Process Control (for JSPL)*”: SQC & OR Unit, Mumbai, held at JSPL, Barbil, December 09-11, 2013.

Training programme on “*Six Sigma DFSS Green Belt (Part-1) for L&T, Powai*”: SQC & OR Unit, Mumbai, held at Bangalore, January 06-08, 2014.

Training Programme on “*Statistical Techniques using MINITAB (for JSPL)*”: SQC & OR Unit, Mumbai, held at JSPL, Raigarh, January 16-18, 2014.

Training Programme on “*Six Sigma DFSS Green Belt (Part-2) (for L&T, Powai)*”: SQC & OR Unit, Mumbai, held at Bangalore, February 05-07, 2014.

Training Programme on “*Six Sigma Green Belt*”: SQC & OR Unit, Mumbai, February 15-17 & 22-23, 2014.

Training Programme on “*Statistical Techniques for Data Mining & Business Analytics*”: SQC & OR Unit, Mumbai, March 15-16 & 22-23, 2014.

Workshop on “*Business Analytic*”: SQC & OR Unit, Pune, held at MIT-SOM College, August 24, 2013.

Internship Programme on “*Library & Information Science*”: Library, Kolkata in collaboration with Department of Library Information Science, University of Calcutta, April 01-17 April 2013.

2nd Training Programme on “*Adobe Photoshop: a Basic Course*”: Library, Kolkata, February 10-14, 2014.

National Workshop on “*Design and Development of Institutional Repository using Dspace*”: Library, Kolkata, March 03-07, 2014.

4th Workshop on “*Digital Pictorial Photography*”: Library, Kolkata, March 03-07, 2014.

Exhibition and Contest on “*Photography*”: Library, Kolkata, March 03-07, 2014.

Workshop on “*Designing and Management of Web Based Library Services*”: Library, Documentation & Information Science Division, Kolkata in collaboration with the Department of Library & Information Science, Mizoram University, Aizawl, held at Department of LIS, Mizoram University, Aizawl, March 11-15, 2014

Workshop on “*Design and Development of Institutional Repository using Dspace (Development Programme for Employees of Library)*”: Library, Kolkata, March 26-27, 2014,

Workshop on “*Modern Trends in Soft Computing and Security Issues*”: CSCR, Kolkata in collaboration with National Institute of Science and Technology (NIST), Berhampur, Odisha, September 23-28, 2013.

5th International Conference on “*Pattern Recognition and Machine Intelligence*”: CSCR, Kolkata in collaboration with MIU, Kolkata, December 10-14, 2013.

Demonstration on “*Income Tax E-filing - How to Submit I.T. Return on-line (for Employees of ISI Kolkata)*”: CSSC, Kolkata, July 02-09, 2013.

Conferences and Seminars

Demonstration on “*Income Tax E-filing - How to Submit I.T. Return on-line* (for Employees of ISI Delhi)”: CSSC, Kolkata, July 15-16, 2013.

Demonstration on “*Income Tax E-filing - How to Submit I.T. Return on-line* (for Employees of ISI Bangalore)”: CSSC, Kolkata, July 23-24, 2013.

Training Program on “*Advanced MS-Word & Excel 2007* (for Employees of ISI Kolkata)”: CSSC, Kolkata, September 18-October 01, 2013.

Training Program on “*Website Development & Hosting* (for Employees of ISI Kolkata)”: CSSC, Kolkata, October 22-October 31, 2013.

Training Program on “*SPSS* (for Employees of ISI Kolkata)”: CSSC, Kolkata, November 07-22, 2013.

Training Program on “*Linux OS, OpenOffice & LaTeX* (for Employees of ISI Kolkata)”: CSSC, Kolkata, December 16–23, 2013.

Training Program on “*Advanced MS-Word & Excel 2007* (for Employees of ISI Delhi)”: CSSC, Kolkata, held at Delhi, January 20-24, 2014.

Training Program on “*Website Development & Hosting* (for Employees of ISI Kolkata)”: CSSC, Kolkata, February 20–21, 2014.

Training Program on “*Introductory C Programming* (for Employees & Wards of ISI Kolkata)”: CSSC, Kolkata, March 04 - 31, 2014.

Lectures and Seminars

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Athreya, Krishna B., Iowa State University, USA (20.02.2014): Statistical estimation of an integral with respect to an infinite measure.

Bal, Kaushik, National Institute for Science Education and Research Institute of Physics Campus, Bhubaneswar (09.09.2013): Existence result to a Quasilinear Singular Elliptic.

Banerjee, Agnid, Purdue University, USA (07.06.2013): Gradient bounds and Monotonicity of energy for some non-linear singular diffusion equations.

Banerjee, Arindam, University of Virginia, USA (06.08.2013): Bounds on Castelnuovo-Mumford regularity of edge ideals of simple graphs.

Basu, Samik, Ramakrishna Mission Vivekananda University, Howrah (29.04.2013): Homotopy Groups and Periodic Geodesics of closed 4-manifolds.

Basu, Sumanta, Department of Statistics, University of Michigan, USA (21.05.2013): Network Granger Causality with Inherent Grouping Structure.

Bhattacharya, Rabi, The University of Arizona, USA (02.12.2013): Some problems of Ruin and Survival in Economics: Applications of Limit Theorems in Probability.

Conferences and Seminars

Bhattacharya, Siddhartha, School of Mathematics, Tata Institute of Fundamental Research, Mumbai (18.03.2014): Groups with polynomial growth.

Bhattacharya, Siddhartha, School of Mathematics, Tata Institute of Fundamental Research, Mumbai (19.03.2014): Groups with polynomial growth.

Bhatwadekar, S.M., Bhaskaracharya Pratishthana, Pune (11.11.2013): A note on Quasi Laurent Polynomial Algebras in n variables.

Bhatwadekar, S.M., Bhaskaracharya Pratishthana, Pune (12.11.2013): Projective modules over the kernel of a locally nilpotent derivation.

Biswas, Anup, Technion, Isreal (01.08.2013): Control of a queuing system under the moderate deviation scaling.

Chaudhuri, Sanjay, Department of Statistics and Applied probability, National University of Singapore (22.07.2013): An Conditional Empirical Likelihood Approach to Combine Sampling Design and Population Level Information.

Das, Adhikari, Sukumar, Harish-Chandra Research Institute, Allahabad (19.08.2013): Visibility of integer lattice points.

Das, Soumya, Indian Institute of Science, Bangalore (07.11.2013): Characterization of Siegel cusp forms by the growth of their Fourier coefficients.

Datta, Basudeb, Department of Mathematics, Indian Institute of Science, Bangalore (06.05.2013): tight triangulations of manifolds.

Datta, Basudeb, Indian Institute of Science, Bangalore (13.12.2013): Minimal crystallizations of 3-manifolds.

Dhar, Subhra Sankar, Presidency University, Kolkata (03.06.2013): The Trimmed Mean in the Isotonic Regression.

Ghosh, Subhrashekhar, Princeton University, USA (22.01.2014): Large Deviations for zeros of random polynomials with iid exponential coefficients.

Gupta, Ved Prakash, Jawaharlal Nehru University, Delhi (27.12.2013): Representations of subfactor planar algebras.

Hazra, Rajat Subhra, Institute for Mathematics, University of Zurich, Switzerland (13.01.2014): Thick points for the Gaussian Free Field in 4 dimensions.

Hazra, Rajat Subhra, Institute for Mathematics, University of Zurich, Switzerland (15.01.2014): Continuity and chemical distances in scale-free percolation.

Hwang, Chii-Ruey, Institute of Mathematics, Academia Sinica, Taipei, Taiwan (11.02.2014): Comparison of Monte Carlo markov Processes.

Kar, Aditi, University of Oxford, UK (08.04.2013): Topological Superrigidity.

Keshari, Manoj K., Indian Institute of Technology, Bombay (14.05.2013): Cancellation of projective modules.

Conferences and Seminars

Mandal, Satya, University of Kansas, USA (29.07.2013): How Topology shaped, and is still shaping, the Obstruction Theory in Algebra.

Mandal, Satya, University of Kansas, USA (30.07.2013): Localization and witt Groups of Cohen Macaulay Rings.

Munshi, Ritabrata, School of Mathematics, Tata Institute of Fundamental Research, Mumbai (28.11.2013): What is subconvexity?

Munshi, Ritabrata, School of Mathematics, Tata Institute of Fundamental Research, Mumbai (03.12.2013): Subconvexity in $GL(3)$.

Munshi, Ritabrata, School of Mathematics, Tata Institute of Fundamental Research, Mumbai (03.12.2013): Subconvexity in $GL(3)$.

Munshi, Ritabrata, School of Mathematics, Tata Institute of Fundamental Research, Mumbai (06.12.2013): Subconvexity in $GL(3)$ – Part II.

Munshi, Ritabrata, School of Mathematics, Tata Institute of Fundamental Research, Mumbai (20.05.2013): Subconvexity problem for degree three L-functions.

Narisetty, Naveen, N., Department of Statistics, University of Michigan, Ann Arbor, USA (19.08.2013): Max-min notion of depth for functional data.

Ogawa, Shigeyoshi, Department of Mathematics, Ritsumeikan University, Japan (10.02.2014): On a Stochastic Fourier Transformation.

Parikh, Rohit, City University of New York, USA (02.01.2014): Epistemic Reasoning and its Applications: an Introduction.

Raghunathan, M.S., National Centre for Mathematics, Mumbai (17.09.2013): Geometry's Centre to Arithmetic-Faltings' theorem.

Raghunathan, M.S., National Centre for Mathematics, Mumbai (16.09.2013): On Betti Numbers of Locally Symmetric Spaces.

Ray, Goubab, University of British Columbia, Vancouver, Canada (05.08.2013): Unicellular Maps in High Genus.

Sen, Bodhisattva, Columbia University, USA (24.03.2014): Nonparametric Convex Regression.

Sengupta, J., School of Mathematics, Tata Institute of Fundamental Research, Mumbai (03.02.2014, 05.02.2014 & 07.02.2014): Introduction to The Spectral Theory of Automorphic Forms.

Si, Si, Graduate School of Information Science and Technology, Aichi Prefectural University, Japan (25.11.2013): Notes on Hida Distributions.

Si, Si, Graduate School of Information Science and Technology, Aichi Prefectural University, Japan (27.11.2013): Some aspect of noises depending on time and space parameters, respectively.

Srinivas, S., Tata Institute of Fundamental Research, Mumbai (03.04.2013): Algebraic versus topological entropy for surface over finite fields.

Tejas, Kalelkar, Washington University, St Louis, USA (21.11.2013): Taut foliations of punctured-surface bundles.

Conferences and Seminars

Thomas, Viji, Indian Institute of Science Education and Research, Thiruvananthapuram (12.09.2013): A journey from Gauss' lemma to pruffer domains to Gaussian rings.

Yamashita, Makoto, Ochanomizu University, Japan (11.03.2014): Poisson boundaries, Yetter-Drinfeld algebras, and classification of non-Kac compact quantum groups of $SU(n)$ type.

Stat-Math Unit, Delhi

Adhikari, S.D., Harish-Chandra Research Institute, Allahabad (20.11.2013): Two early Ramsey-type theorems: Some generalizations and applications.

Ayyer, Arvind, Indian Institute of Sciences, Bangalore (19.02.2014): Probabilistic juggling.

Banwait, Barinder, University of Warwick, UK (23.10.2013): The local to global question in number theory.

Barman, Rupam, Indian Institute of Technology, Delhi (06.11.13): Hypergeometric functions over finite fields and trace of Frobenius of elliptic curves.

Bilu, Yuri, University of Bordeaux, France (18.02.2014): Drawing curves on checkered paper.

Borkar, Vivek, Indian Institute of Technology, Bombay (24.04.2013): Risk-sensitive control and the Donsker-Varadhan functional.

Chandran, Sunil, Indian Institute of Sciences, Bangalore (06.09.2013): Boxicity and Poset dimension.

Chatterji, Indira, Universite d' Orleans, France (13.11.2014): Median spaces and $CAT(0)$ cube complexes.

Dey, Partha Sarathi, New York University, USA (17.07.2013): A new approach to Stein's method for normal approximation.

Grijalba, Jhon Jairo Bravo, Centro de Ciencias Matematicas, Universidad Nacional Autónoma de México (UNAM), Mexico (27.11.2013): On Generalized Fibonacci numbers.

Kalbfleisch, Jack, University of Michigan, USA (15.01.2014): Repeated randomization in cluster randomized trials.

Kalelkar, Tejas, Indian Institute of Science Education and Research, Pune (07.03.2014): Taut foliations of punctured-surface bundles.

Khaledi, Baha-Eldin, Razi University, Iran (03.04.2013): Stochastic comparisons of generalized order statistics.

Labourie, FranCois, Universite Paris-sud, France (11.09.2013): Cross ratios and surface groups.

Lucijan, Plevnik, University of Ljubljana, Slovenia (02.12.2013): Preservers on idempotent operators.

Mubayi, Dhruv, University of Illinois at Chicago, UK (24.07.2013): Hypergraph Ramsey problems.

Papadopoulos, Athanase, Institut de Recherche Mathématique Avancée, Université de Strasbourg (03.12.2013): On the Funk and the Hilbert metrics.

Conferences and Seminars

Roy, Sutanu, Georgia Augusta-University of Göttingen, Germany (25.10.13): Twisted tensor product of C^* -algebras.

Saeb, Ali, University of Mysore, Mysore (12.03.2014): On entropies convergence of max domain of attraction and max stable laws.

Saxena, P.K., Scientific Analysis Group, Defence Research and Development Organization (04.09.2013): Information security: Issues and Challenges.

Shorey, T.N., Indian Institute of Technology, Mumbai (10.07.2013): Products of factorials and of consecutive integers.

Singh, Anupam Kumar, Indian Institute of Science Education and Research, Pune (29.01.2014): Strongly real classes in finite unitary groups.

Sinha, K.B., Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore (03.05.2013): Stopping CCR-flows and endomorphism semigroups on Fock space.

Sinha, K.B., Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore (22.01.2014): An approximation theorem and two-variable trace formula.

Tiwari, Rashmi, University of Delhi, Delhi (19.03.2014): L-moments and TL-moments estimation and recurrence relations for moments of generalized order statistics from Lindley distribution.

Stat-Math Unit, Bangalore

Athreya, K.B., Iowa State University, USA (08.08.2013): Invitation to Mathematics.

Balasubramanian, R., Institute of Mathematical Sciences, Chennai (08.07.2013): Additive Number Theory.

Bharath, Karthik, Ohio State University, USA (30.12.2013): On a clustering criterion for smooth distributions.

Bhattacharyay, Biswa Nath, Former Director of Asian Development Bank, Manila (16.05.2013): Determinants of Bond Market Development in Asia.

Bilu, Yuri, Universite de Bordeaux, France (20.01.2014): Effective proof of the theorem of André on the complex multiplication points on curves.

Camia, Federico, New York University, Abu Dhabi (07.10.2013): 2D Ising Model: Scaling limits and magnetization critical exponent.

Chaudhuri, Chitrabhanu, Northwestern University, USA (01.08.2013): Operads and Moduli of Hyperelliptic Curves.

Dey, Parthasarathi, University of Warwick, UK (19.12.2013): Multiple phase transitions in long-range first-passage percolation on square lattices.

Dubey, Umesh, Indian Institute of Science, Bangalore (27.02.2014): Some topics on triangulated categories.

Conferences and Seminars

Fakhruddin, Najmuddin, Tata Institute of Fundamental Research, Mumbai (28.01.2014, 30.01.2014, 04.02.2014, 11.02.2014, 13.02.2014, 18.02.2014, 20.02.2014, 11.03.2014 & 13.03.2014): Some topics on triangulated categories.

Farris, David, National Centre for Biological Sciences, Bangalore (30.01.2014): Embedded contact homology.

Gupta, Ankit, Department of Biosystems Science and Engineering, ETH Zurich, Switzerland (28.10.2013): The Fleming-Viot limit of an interacting spatial population with fast density regulation.

Gupta, Arvind, Inter University Centre for Astronomy and Astrophysics, Pune University, Pune (28.03.2014): Science through activities.

Hwang, Chii-Ruey, Institute of Mathematics, Taiwan (13.02.2014): Comparison of Monte Carlo Markov Processes.

Joseph, Mathew, University of Sheffield, UK (19.12.2013): Path properties of the Stochastic heat equation.

Khare, Apoorva, Stanford University, USA (27.11.2013): Faces and maximizer subsets of highest weight modules.

Khmaladze, Estate, Victoria University of Wellington, New Zealand (02.02.2014): On martingales in multidimensional time: scanning martingales.

Kratz, Marie, ESSEC Business School, France (24.03.2014): On the Estimation of Risk Measures using Extreme Value Theory Tools.

Anil Kumar, C.P., Institute of Mathematical Sciences, Chennai (26.09.2013): Orbit of pairs in finite modules over discrete valuation rings.

Lohr, Wolfgang, University of Duisburg-Essen, Germany (08.04.2013): Convergence of Subtree Pruning Processes.

Madiman, Mokshay, University of Delaware, USA (08.04.2013): Reverse entropy power inequalities.

Mukherjee, Rahul, Indian Institute of Management, Calcutta (25.09.2013): Construction of highly efficient factorial designs for cDNA microarray experiments: A general method.

Munor, Ian J., Cheriton School of Computer Science University of Waterloo, Canada (31.01.2014): Codes: Representing Information.

Munshi, Ritabrata, Tata Institute of Fundamental Research, Mumbai (19.09.2013): Rational points on intersection of two quadrics.

Murty, Ram, Queen's University, Canada (01.07.2013, 02.07.2013, 04.07.2013 & 02.12.2013): Codes, Lattices and Theta Functions & Special values of L-series.

Murthy, Vasudeva A.S., Tata Institute of Fundamental Research-Centre for Applicable Mathematics, Bangalore (15.01.2014, 21.01.2014, 22.01.2014 & 28.01.2014): Introduction to Equations of Fluid Mechanics.

Ogawa, Shigeyoshi, Ritsumeikan University, Japan (13.02.2014): On a direct inversion formula for SFT.

Conferences and Seminars

Ram, Mohan H.Y., Indian National Science Academy, New Delhi (17.02.2014): Seed- The Miracle of Nature.

Ranade, Nissin, State University of New York Stony Brook, USA (06.01.2014): Intersections of closed curves on a surface.

Rao, Bhaskara, K.P.S., Indiana University Northwest, USA (24.06.2013): Zumkeller numbers and Practical problems.

Reddy, Tulsi Ram, A., Indian Institute of Science, Bangalore (07.10.2013): Determinantal point processes in the plane from products of random matrices.

Sane, Sarang, University of Kansas, USA (05.07.2013): Euler classes, projective modules and the Gersten-Witt complex.

Sane, Sharad, Indian Institute of Technology, Mumbai (23.01.2014): Maximal k-clique problem.

Sankaran, Parameshwaran, Institute of Mathematical Sciences, Chennai (04.04.2013): Rational homotopy of certain spaces.

Shankar, Kartik, Indian Institute of Science, Bangalore (17.10.2013): Tags, transmitters and trees: tracking sea turtles in time and space.

Singhi, Navin M., Tata Institute of Fundamental Research, Mumbai (03.07.2013): Is one eye enough to see an object?

Sundaresan, Rajesh, Indian Institute of Science, Bangalore (24.03.2014): Asymptotics of mean-field interactions in a wireless local area network.

Vadlamani, Sreekar, Tata Institute of Fundamental Research-Centre for Applicable Mathematics, Bangalore (28.10.2013): Scaling limits for critical quantum Curie-Weiss random graphs.

Wills, Stephen, University College Cork, Ireland (11.02.2014): An algebraic construction of quantum flows with unbounded generators.

Yogeshwaran, D., Technion – Israel Institute of Technology, Israel (06.03.2014): Central limit theorems for some random simplicial complexes.

Stat-Math Unit, Chennai

Balakumar, G.P., Institute of Mathematical Sciences, Chennai (12.11.2013): Model domains in C^3 with abelian automorphism group.

Baricz, Arpad, Babes-Bolyai University, Romania (06.11.2013): The monotone form of l' Hospitals rule and geometrically concave distributions.

Baricz, Arpad, Babes-Bolyai University, Romania (07.11.2013): Infinitely divisible distributions, Stieltjes transforms and Turan type inequalities.

Baricz, Arpad, Babes-Bolyai University, Romania (18.03.2014): The new-is-better-than-used class of life distributions.

Das, Sourish, Chennai Mathematical Institute, Chennai (28.01.2014): Some Perspective on Efficient Market Hypothesis and Multiple Testing Problem.

Conferences and Seminars

De, Subhadeep, National Physical Laboratory, Council of Scientific & Industrial Research, New Delhi (17.12.2013): Atomic Clocks: The Frequency Standards in India.

Diaconis, Persi, Stanford University, USA (20.12.2013): Statistical Analysis of Large Networks.

Ganguly, Ayon, Indian Institute of Technology, Kanpur (18.04.2013): Some Contributions to Step-stress Life Testing.

Gorenflo, Rudolf, Free University of Berlin, Germany (10.04.2013): Subordination in fractional diffusion processes: the analytic approach.

Jana, Purbita, University of Calcutta (23.04.2013): On categorical relationship between structures and spaces.

Kannan, Nandini, University of Texas, San Antonio, USA (22.01.2014): Step-stress models with an immune fraction.

Kumar, Sonam, Chennai Mathematical Institute, Chennai (16.04.2013): Clustering Genes by Plotting them on a 61-dimensional Vector Space, and Finding the Cluster of a Foreign Gene.

Lahiri, Ananya, Chennai Mathematical Institute, Chennai (01.10.2013): Integrated volatility estimation for fractional Brownian motion driven stock price model.

Pandit, Shilpa Ashok, Inner Worlds, Institute for Financial Management and Research, Chennai (02.04.2013): Using Statistics in Social Science Research: A few reflections.

Paul, Debashis, University of California, Davis, USA (20.08.2013): Limiting spectral distribution of sample covariance and auto covariance matrices for a class of large dimensional time series.

Sahoo, Swadesh Kumar., Indian Institute of Technology, Indore (05.07.2013): Generalization of uniform domains and quasiconformal mappings.

Sreejith A.V., Tata Institute of Fundamental Research, Mumbai (24.12.2013): The Power of Multiplication.

Tupurani, Srikanth, Institute of Mathematical Sciences, Chennai (17.09.2013): Birkhoffs ergodic theorem.

Upadhye, Neelesh, S., Indian Institute of Technology, Madras (16.08.2013): Compound Poisson Approximation to Convolutions of Compound Negative Binomial Variables.

Wang, Yanjing, Peking University, China (24.09.2013): Axiomatizations of Dynamic Epistemic Logic.

Applied Statistics Division

Applied Statistics Unit, Kolkata

Bhattacharyya, Arnab, Indian Institute of Science, Bangalore (06.08.2013): Every locally characterized affine-invariant property is testable.

Chakrabarty, Tapan Kumar, North-Eastern Hill University, Shillong (11.02.2014): Estimating distribution of breastfeeding duration from retrospective reports.

- Dey, Dipak Kumar, University of Connecticut, Storrs, CT, USA (15.01.2014): Bayesian inference using Bregman divergence measures.
- Dutta, Ritabrata, Helsinki University of Information Technology, Helsinki, Finland (07.02.2014): Classifier ABC.
- Ghosh, Malay, University of Florida, Gainesville, USA (09.07.2013): Benchmarking small area estimators.
- Ghosal, Subhashis, North Carolina State University, USA (27.08.2013): Bayesian methods for high dimensional models: convergence issues and computational challenges.
- Kulkarni, Hemangi, Shivaji University, Kolhapur (07.08.2013): Integrated likelihood methods for one-way circular ANOVA.
- Kalbfleisch, Jack, University of Michigan, USA (08.01.2014): Repeated randomization in cluster randomized trials.
- Majumdar, Debarun, Texas State University-San Marcos, USA (16.07.2013): The impact of immigration-related challenges and deportation worries on the well-being of Latinos in the US.
- Mazumder, Rahul, Columbia University, New York, USA (23.07.2013): Statistical boosting, implicit and explicit regularization – a mathematical programming viewpoint.
- Mukherjee, Pratyay, Aarhus University, Denmark (24.01.2014): Recent results on non-malleable codes.
- Mazumder, Rahul, Columbia University, USA (28.01.2014): Factor analysis via a modern optimizations lens.
- Paul, Debashish, University of California, Davis, USA (18.02.2014): A regularization of Hotelling's T^2 statistic for high-dimensional data.
- Paul, Ranjit Kumar, Indian Agricultural Statistics Research Institute, New Delhi (19.02.2014): ARIMAX-GARCH-WAVELET technique for forecasting volatile crop yield.
- Pal Choudhury, Parichoy, Johns Hopkins University, Baltimore, USA (07.01.2014): Mendelian randomization: a review from a causal inference perspective.
- Rosenblum, Michael, Johns Hopkins University, Baltimore, USA (21.01.2014): Optimal tests of treatment effects for the overall population and two subpopulations in randomized trials, using sparse linear programming.
- Ranjan, Pritam, Acadia University, Wolfville, Nova Scotia, Canada (25.03.2014): Factorial experiments with randomization restrictions and space-filling designs.
- Srivastava, Radhendushka, Indian Institute of Technology, Bombay (12.09.2013): A bootstrap two-sample test in high dimension using random projection.
- Sanyal, Nilotpal, University of Missouri-Columbia, USA (10.12.2013): A Bayesian hierarchical multiscale methodology for functional MRI data analysis.
- Von Rosen, Dietrich, Swedish University of Agricultural Sciences, Sweden (20.12.2013): Explicit estimators in unbalanced mixed linear models with applications to SAE.

Conferences and Seminars

Vignesh, T.S., GE Global Research, Bangalore (30.04.2013): Software reliability for multi-type defects: applications to modern bug database.

Bayesian Interdisciplinary Research Unit

Chen, Chun-Houh, Academia Sinica, Taiwan (13.02.14 & 17.02.2014): Matrix visualization: approaching statistics and statistical approach and some extensions of matrix visualization - the GAP approach.

Galit Shmueli, Indian School of Business, Gachibowli, Hyderabad, India (19.06.2013): Harnessing CART for causal modeling.

Ghosh, Malay, University of Florida, Gainesville, USA (25.07.2013): Bayesian benchmarking with application to small area estimation.

Ghosh, Sucheta, University of Trento, Trento, Italy (18.12.2013): Investigating temporal dynamics of prosodic and lexical accommodation.

Lahiri, Parthasarathi, University of Maryland, College Park, USA (07.08.2013): Small area interval estimation.

Maitra, Ranjan, Department of Statistics, Iowa State University (11.04.2013): Assessing significance in finite mixture models.

Robert, Paige, Department of Mathematics and Statistics, Missouri University of Science and Technology, Rolla, USA (05.06.2013): New directions in saddlepoint-based bootstrap inference for quadratic estimating equations.

Sengupta, Indranil, Department of Mathematics, North Dakota State University (14.08.2013): Generalized BN-S model in finance.

Sarkar, Sanat, Temple University, USA (02.01.2014): Controlling false discovery rate in two-stage multiple testing.

Computer and Communication Sciences Division

Advanced Computing and Microelectronics Unit

Amit K. Dinda, All India Institute of Medical Sciences, New Delhi (19.03.2014): Nano-carrier Mediated Macrophage Targeting: the Therapeutic Challenge for Intracellular Infections.

Bharadwaj Amrutur, Indian Institute of Science Bangalore, (18.03.2014): Neuro-electronic Hybrid Systems: Challenges and Opportunities.

Bhattacharya, Sayan, Postdoctoral Fellow, MPI Saarbrucken, Germany (25.11.2013): Auctions, Anarchy and Approximations.

Bhattacharya, Subhasis, Synopsys India Pvt. Ltd., Bangalore (13.03.2014): Implementation of Distributed Algorithms.

Bhattacharya, Tarun, Department of Electronics & Electrical Communication Engineering, Indian Institute of Technology, Kharagpur (18.03.2014): Nano-enabled MEMS-based Sensors and Actuators.

Conferences and Seminars

Biswas, Santosh, Dept. of Computer Science & Engineering, Indian Institute of Technology, Guwahati, (31.03.2014): On-line Testing (OLT) of VLSI Circuits and Systems.

Chakraborty, Amit, Dartmouth College, USA (17.01.2014): Information Complexity and the Set Intersection Problem.

Chakraborty, Supratik, Dept. of Computer Science & Engineering, Indian Institute of Technology, Mumbai (31.10.2013): Hashing based almost-uniform generation and model counting.

Das, Gautam K., Indian Institute of Technology Guwahati (26.12.2013): Unit Disk Cover Problem in 2D.

De, Pradipta, State University of New York (SUNY), Korea (29.01.2014): Perspectives on Mobile Cloud Computing and its Applications.

Dhar, Subhankar, San Jose State University, California (08.07.2013): Education Without Boundaries: Will Massive Open Online Courses Change How We teach?

Fujita, Masahiro, University of Tokyo, Japan (24.03.2014): Testing and Debugging VLSI Systems.

Ghosh, Swaroop, University of South Florida, USA (16.01.2014): High-Density and Robust Domain wall memory for Future Embedded Caches.

Giri, Narasimha, The School of Computing and Information Sciences, Florida International University USA (26.12.2013): Geometric Spanners and Avatars.

Gupta, Arobinda, Department of Computer Science and Engineering, Indian Institute of Technology, Kharagpur (14.03.2014): Self-stabilizing Distributed Algorithms.

Huang, Juinn-Dar, National Chiao Tung University, Taiwan (18.03.2014): Sample Preparation on Digital Microfluidic Biochips.

Jayaraman, Bharat, State University of New York (SUNY), Buffalo, USA (25.03.2014): Dynamic Analysis and Visualization of Program Execution.

Khan, Arindam, Georgia Institute of Technology, Atlanta, USA (23.12.2013): Improved Approximation Algorithm for Two-Dimensional Bin Packing.

Konar, Aniruddha, International Business Machines Corporation, Bangalore, (19.03.2014): Graphene Transistors and its Applications.

Liu, Iou-Jen, National Taiwan University, Taiwan (19.03.2014): Stitch-Aware Routing for Multiple E-Beam Lithography.

Mitra, Debasis, National Institute of Technology, Durgapur (19.03.2014): Testing and Error Detection in Micro / Nano fluidic Biochips.

Mukherjee, Animesh, Dept. Of Computer Science and Engineering, Indian Institute of Technology, Kharagpur (20.02.2014): That's sick dude: Automatic identification of word sense change across different timescales.

Ou, Hung-Chih, National Taiwan University, Taiwan (18.03.2014): Double Patterning Lithography-Aware Analog Placement.

Conferences and Seminars

Pande, Partha P., School of Electrical Engineering and Computer Science Washington State University, Pullman, USA (19.07.2013): Millimeter (mm)-Wave Wireless NoC as interconnection Backbone for Multicore chips: Promises and Challenges.

Patel, Janak H., Electrical and Computer Engineering, University of Illinois, Urbana-Champaign, USA (27.03.2014): CMOS Process Variations: A 'Critical Operation Point' Hypothesis.

Radhakrishnan, Jaikumar, School of Technology and Computer Science, Tata Institute of Fundamental Research, Mumbai (31.05.2013): Two-colouring uniform hypergraphs.

Rahaman, Anisur, Division of Mathematical Sciences, Nanyang Technological University, Singapore (31.03.2014): Distributed Computation in Dynamic Network via Random Walks.

Rajamani, Sriram K., Microsoft Research Lab, India (05.04.2013): Correct Design of asynchronous software.

Roy Chowdhury, Shubhajit, Center for VLSI and Embedded Systems Technology, Indian Institute of Technology, Hyderabad (03.01.2014): Embedded Systems for non-invasive Monitoring of patients.

Roy, Pranab, Bengal Engineering & Science University, Shibpur (19.03.2014): On Routing and Placement Issues in Digital Microfluidic Biochips.

Sarkar, Vivek, Rice University, Houston, Texas, USA (15.05.2013): Synergistic Challenges in Data-intensive Science and Exascale Computing.

Singh, Veerendra, Department of Electrical Engineering, Indian Institute of Technology, Mumbai (19.03.2014): Testing and Fault-tolerance Issues in Nano-scale digital circuits.

Sivalingam, Krishna M., Department of Computer Science and Engineering, Indian Institute of Technology, Madras (14.03.2014): Software Defined Networks.

Electronics and Communication Sciences Unit

Adamson, Greg, University of Melbourne, Australia (07.03.2014): One Day Seminar on Norbert Wiener, Cybernetics, Humanity & Technology.

Basu, Subhadip, Department of Computer Science and Engineering, Jadavpur University, Kolkata (09.03.2013): Multi-scale opening of conjoined objects in shared intensity space.

Bhattacharya, Arundhati, Cybernetics Systems, PGAD-RCI, DRDO, New Delhi (07.03.2014): Cybernetics and the Science of Military Command and Control.

Bhowmik, Deepayan, Heriot-Watt University, Edinburgh, UK (22.08.2013): Scalable watermark extraction for real-time authentication of JPEG 2000 images.

Biswas, Mainak, Qualcomm Multimedia R&D, Bangalore (13.01.2014): Recent advances in Computer Vision and Image Processing in mobile: computing environment.

Dasgupta, Prithviraj, University of Nebraska Omaha, USA (30.12.2013): Fast and Dynamic Reconfiguration Techniques for Modular Self-Reconfigurable Robots.

Gopal, T.V., Department of Computer Science, Anna University, Chennai (07.03.2014): What impacts the Progress of Cybernetics?

Conferences and Seminars

Kummamuru, Supriya, Business Systems & Cybernetics Centre, Tata Consultancy Services Limited, Hyderabad (07.03.2014): Evolution of a Cybernetic Model: Outcome of TCS Consulting Practice.

Misra, Sumit, RS Software, Kolkata (06.06.2013): Big Data Analytics: An overview of technology and application.

Narayana, M.G.P.L., BS&CC, Tata Consultancy Services, Hyderabad (07.03.2014): Cybernetics Approach for Business Solution Design.

Machine Intelligence Unit

Agarwal, Shivani, Indian Institute of Science, Bangalore (23.04.2014): Statistically Consistent Algorithms for Complex Prediction Problems.

Bhattacharyya, Arnab, Department of Computer Science and Engineering, Indian Institute of Technology, Kanpur (05.02.2014): Mining Statistically Significant Substructures using the Chi-square Measure.

Narayana, P.J., International Institute of Information Technology, Hyderabad (31.03.2014): Space 3D Structure: Estimation and Application.

Verma, Manik, Microsoft Research India (31.03.2014): Multi-label Learning with Millions of Labels for Query Recommendation.

Documentation Research and Training Centre

Altangerel, Chagnaa, School of Information Technology, National University of Mongolia, Mongolia (22.11.2013): Natural Language Processing and Applications.

Chatterjee, Amitabha, Dept. of Library & Information Science, Jadavpur University, Kolkata (08.11.2013): Index and Indexing-Part-I.

Chatterjee, Amitabha, Dept. of Library & Information Science, Jadavpur University, Kolkata (11.11.2013): Index and Indexing-Part-II.

Chatterjee, Amitabha, Dept. of Library & Information Science, Jadavpur University, Kolkata (13.11.2013): Indexing Language Part-I.

Chatterjee, Amitabha, Dept. of Library & Information Science, Jadavpur University, Kolkata (15.11.2013): Indexing Language Part-II.

Chatterjee, Amitabha, Dept. of Library & Information Science, Jadavpur University, Kolkata (22.11.2013): Designing of Depth Classification Schedule.

Chatterjee, Amitabha, Dept. of Library & Information Science, Jadavpur University, Kolkata (25.11.2013): Documentation and its facets.

Oh, Dong-Geun, Dept. of Library & Information Science and Dean, School of Library and Information Science, Kei-Myung University, Daegn, South Korea (21.08.2013): LIS Education and Research in Korea: Current Status and Prospect.

Rath, Pravakar, Dept. of Library and Information Science, Mizram University, Aizwal (01.08.2013): Changing Dimensions in Library and Information Profession.

Conferences and Seminars

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (08.11.2013):
UDC: History & Governance.

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (11.11.2013):
UDC: Main classes vis-a-vis DDC.

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (13.11.2013):
Common Auxiliaries -1.

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (15.11.2013):
Common Auxiliaries -2.

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (22.11.2013):
Special Auxiliaries.

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (25.11.2013):
Citation Order: Principle and Inversion.

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (27.11.2013):
Classification of Languages and Literature.

Satija M.P, Dept. of Library & Information Science, Guru Nanak Dev University, Amritsar (29.11.2013):
Classifying recent publications.

Sonwane, Shashank S, Dept. of Library & Information Science, Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad (21.10.2013-01.11.2013): Series of lecture on Scientometrics and Informetrics.

Systems Science and Informatics Unit

Bringer, Yves, Telecom Saint-Etienne, Université Jean Monnet, France (03.03.2014): 3D Industrial
Image Applications.

Bruzzone, Lorenzo, Department of Information Engineering and Computer Science, University of
Trento, Italy (27.01.2014): Current Scenario and Challenges in the Analysis of Multitemporal Remote
Sensing Images.

Cheng, Qiuming, Department of Earth and Space Science and Engineering, York University, Canada
(10.02.2014): Singularity theory and informatics techniques for prediction of mineral resources and
recognition of geochemical pollution patterns.

Physics and Earth Sciences Division

Geological Studies Unit

Kar, Nandini, Rochester University, USA (22.12.2013): Surface uplift history of Andean Plateau:
implications for geodynamic processes.

Physics and Applied Mathematics Unit

Conferences and Seminars

Banerjee, Rabin, S.N. Bose Centre for Basic Sciences, Kolkata (06.09.2013): Exact result in two dimensional hydrodynamics with gauge and gravitational anomalies.

Das, Siba Prasad, Institute of Physics, Bhubaneswar (06.02.2014): A short overview on Higgs physics at the Large Hadron Collider.

Graf, Walter-H, École polytechnique fédérale de Lausanne, Switzerland (25.11.2013): Mixing of matter in waterway receiving waste water.

Kanbur, Shashi, Department of Physics, State University of New York, Oswego, USA (04.06.2013): The non-linearity of the Cepheid period-luminosity relation.

Sarkar, Sankar, Sikkim Manipal Institute of Technology, Sikkim (17.09.2013): Turbulence in loose boundary streams.

Si, Si, Graduate School of Information Science and Technology, Aichi Prefectural University, Japan (27.11.2013): Some aspect of noises depending on time and space parameters, respectively.

Venkateshan, S.K., TNQ Books and Journals Private Limited, Chennai (09.05.2013): Art of writing academic article and modern trends in publishing;

Venkateshan, S.K., TNQ Books and Journals Private Limited, Chennai (10.05.2013): Turbulence in fluid flows and the breaking of implicit symmetries.

Biological Sciences Division

Biological Anthropology Unit

Das, Ketaki, West Bengal Voluntary Health Association, Kolkata (28.03.2014): Lecture series on Qualitative research method in public/ community health studies.

Jesani, Amar, Indian Journal of Medical Ethics, Switzerland (09.01.2014): Research Ethics: History, utility and functions of ethics review in improving standards of research.

Human Genetics Unit

Bhattacharya, Raja, West Bengal University of Technology, Kolkata (12.09.13): Peptide motifs: present and future.

Ray Chaudhury, S.P., University of California, Davis, USA (28.01.2014): Inflammatory cascades of psoriatic disease.

Social Sciences Division

Economic Research Unit

Bandyopadhyay, Debasis, University of Auckland, New Zealand (10.01.2014): Economic Wellbeing of A Society In A Culture of Violence Against Women.

Banik, Nilanjan, Glocal University, UK (20.08.2013): Is India Shining?

Conferences and Seminars

Basu, Deepankar, Department of Economics, University of Massachusetts, Amherst, USA (01.08.2013): An Empirical Investigation of the Calorie Consumption Puzzle in India.

Bera, K. Anil, University of Illinois, Urbana Champaign, USA (25.07.2013): Spatial Regression: The Curious Case of Negative Dependence.

Bhattacharjee, Subhra, United Nations Development Programme, New York (23.07.2013): Capturing Preferences under Incomplete Scenarios Using Elicited Choice Probabilities.

Chakraborty, Tanika, Indian Institute of Technology, Kanpur, Uttar Pradesh (18.07.2013): Court-ship Kinship and Business: A Study on the Interaction between the Formal and Informal Institutions and Its Effect on Entrepreneurship.

Chattopadhyay, Srobonti, Department of Economics, Jawaharlal Nehru University, New Delhi (18.04.2013): Selling a Technological Innovation Through Auction in an Oligopolistic Industry.

Dasgupta, Swapan, Dalhousie University, Canada (20.12.2013): On a Model of Forestry.

De, Utpal Kumar, Department of Economics, North-Eastern Hill University, Shilong (29.01.2014): Changing Climate and the Agricultural Scenario of Assam since 1950.

Ghatak, Maitreesh, London School of Economics, UK (08.08.2013): Market Structure and Borrower Welfare in Microfinance.

Gupta, Rangan, University of Pretoria, South Africa (19.12.2013): Socio-Political Instability and Growth Dynamics.

Lahiri, Kajal, University at Albany, State University of New York, USA (03.01.2014): Birthweight and Academic Achievement in Childhood.

Munshi, Soumyanetra, Department of Economics, Indira Gandhi Institute of Development Research, Mumbai (03.12.2013): Analysis of Conflict within a Contested Land: the Case of Kashmir.

Paul, Saumik, University of Nottingham, UK (15.01.2014): The Livelihood Effects of Industrialization on Displaced Households: Evidence from Falta Special Economic Zone, West Bengal.

Sultana, Rezina, Indian Institute of Management, Udaipur (05.06.2013): Reversal of Envy.

Population Studies Unit

Chatterjee, Nandita, IQ City Medical College & IQ City Narayana Hrudayalaya Hospital, Durgapur, West Bengal (25.02.2014): Early Intervention to Prevent Disability.

Chattopadhyay, Asis Kumar, Department of Statistics, Calcutta University (29.08.2013): Stochastic Solution of a Manpower Planning Problem.

Mukherjee, S.P., Department of Statistics, Calcutta University and Mentor of Indian Association for Productivity Quality and Reliability, Kolkata (07.11.2013): Estimating the Burden of Disease.

Sampling and Official Statistics Unit

Bhaumik, Mrinal, National Accounts Division, Central Statistical Organisation, Govt. of India (19.03.2014): Development of business register for building a coherent system of National Accounts in India.

Chaudhuri, Bivas, Central Statistical Organisation, Govt. of India (19.11.2013): Overview of Statistical Surveys in India - Issues and Realities.

Conferences and Seminars

Ghatak, Maitreesh, London School of Economics, UK (19.08.2013): Profit with purpose? Theory and experimental evidence of social enterprise.

Lahiri, Sajal, Vandevveer Department of Economics, Southern Illinois University, Carbondale, USA (12.11.2013): Financing growth - foreign aid vs. international credit.

Manna, G.C., Economics Statistics Division, Central Statistics Office, Ministry of Statistics & Programme Implementation, Govt. of India (24.03.2014): Poverty lines for India: A re-examination of calibration and its implications for poverty estimates.

Mukhopadhyay, Bidisha, Calcutta Business School, Kolkata (12.03.2014): Financial development, social development and economic growth: casual nexus in selected Asian countries.

Raut, Lakshmi K., National Bureau of Economic Research, Cambridge, USA (06.12.2013): Intergenerational long term effects of pre-school – Structural estimates from a discrete dynamic programming model.

Roy Chowdhury, Sahana, Indian Council for Research on International Economic Relations, New Delhi (28.01.2014): Inequality and size of informal sector during recession.

Sarkar, Amitava, Indian Association for the Cultivation of Science, Kolkata (03.04.2013): Developing a possible operational risk measure of Banking Activities: an application of Bayesian Probabilistic Network.

Sinha, Bimal Kumar, UMBC and Board of Regents Professor of the University System of Maryland, USA (07.01.2014): Data analysis under confidentiality protection.

Sociological Research Unit

Das, Rajat Kanti, Vidyasagar University, Midnapore, West Bengal (28.03.2014): Kinship, Society and Politics: when do they converge.

Ganguly, Ramanuj, Department of Sociology, West Bengal State University, Barasat, West Bengal (11.02.2014): Gendered understanding for gender in Indian Society: A critical look ahead.

Ghosh, Biswajit, Department of Sociology, University of Burdwan, West Bengal (14.02.2014): Legal Strategies to curb violence against women and girl child at home: a critical review of some laws in India.

Ghosh, Himanshu, West Bengal College Service Commission (20.02.2014): Right to equality: Indian women.

Maruthakutti, Rangasamy, Department of Sociology, Manonmaniam Sundaranar University, Tamil Nadu (27.01.2014): Methodology for family social network research.

Rana, Kumar, Pratichi Institute, Pratichi Trust, West Bengal (10.03.2014): The Muslim question and practice of democracy.

Ray, Antara, Department of Sociology, Presidency University, Kolkata (13.03.2014): Gender and caste: (re) locating Dalit women.

Conferences and Seminars

Economics and Planning Unit

Balakrishnan, Pulapre, Centre for Development Studies, Trivandrum, Kerala (21.03.2014): The Mechanism of Economic Growth in India.

Barua, Rashmi, Singapore Management University, Singapore (12.04.2013): No Pass No Drive: Education and Allocation of Time.

Chand, Srustidhar, Advanced School of Economics, Ca' Foscari University, Italy (06.09.2013): Strategic Information Transmission with Budget Constraint.

Dasgupta, Aparajita, Population Council, New York City, USA (29.11.2013): Can the Major Public Works Policy Buffer Negative Shocks in Early Childhood? Evidence from Andhra Pradesh, India.

De, Sankar, Shiv Nadar University, Uttar Pradesh (11.10.2013): Borrowing Culture and Debt Relief: Evidence from a Policy Experiment.

Deb, Rahul, University of Toronto, Canada (23.08.2013): Symmetric Auctions.

Dhasmana, Anubha, Indian Institute of Management, Bangalore (13.09.2013): Real Effective Exchange Rate and Manufacturing Sector Performance: Evidence from Indian firms.

Dimitrov, Dinko, Saarland University, Germany (21.02.2014): Paths to stability in two-sided matching under uncertainty.

Dubey, Pradeep, Stony Brook University, USA (25.10.2013): Money as Minimal Complexity.

Ghosh, Parikshit, Delhi School of Economics, Delhi (28.03.2014): Character Endorsements and Electoral Competition.

Guha, Brishti, Singapore Management University, Singapore (16.12.2013): Who Will Monitor the Monitors? Informal Law Enforcement and Collusion at Champagne.

Hammer, Jeffrey, Princeton University, USA (17.01.2014): Sanitation and externalities in Delhi slums – an empirical investigation.

Kapoor, Mudit, Indian School of Business, Hyderabad (18.10.2013): Why So Few Women in Politics? Evidence from India.

Khemani, Stuti, World Bank, USA (20.08.2013): Equilibrium Consequences of Clientelism for Government Performance: An Empirical Investigation.

Lahkar, Ratul, Institute for Financial Management and Research, Chennai (06.06.2013): Evolutionary Game Theory and Applications.

Majumdar, Dipjyoti, Concordia University, Canada (05.04.2013): An Optimistic Search Equilibrium.

Prakash, Nishith, Connecticut, USA (02.08.2013): Cycling to School: Increasing Secondary School Enrollment for Girls in India.

Ranjan, Abhishek, Universit'e Paris 1 Panth'eon Sorbonne, France (27.09.2013): Arbitrage structure and finite date model with financial restriction.

Raut, Lakshmi K., Social Security Administration, USA (13.12.2013): Intergenerational Long Term Effects of Preschool - Structural Estimates from a Discrete Dynamic Programming Model.

Sen, Ananya, University of Toulouse, France (27.08.2013): Statistical Externalities and the Labour Market in the Digital Age.

Sudarshan, Anant, Harvard University, USA (24.01.2014): The Economic Impacts of Temperature on Industrial Productivity: Evidence from Indian Manufacturing.

Vohra, Rajiv, Brown University, USA (15.07.2013): Farsighted Stable Sets.

Economic Analysis Unit

Busenna, P., University of Hyderabad, Hyderabad (18.11.2013): Structural Transformation in Rural Employment: Findings from Macro and Micro Data.

Chakravarti, Anindita, Madras School of Economics (23.08.2013): Factors Determining Health Insurance Penetration in India: An Empirical Analysis.

Mathew, Susan, University of Hyderabad, Hyderabad (27.08.2013): Female Labour Market Outcomes and Adverse Incorporation: A Case of Feminisation of Labour.

Mori, Yuko, Hitotsubashi University, Japan (04.03.2014): What is the effect of Political reservation on Political Competition.

Motiram, Sripad, Indira Gandhi Institute of Development Research, Mumbai (10.03.2014): Unemployment Burden and its Distribution: Theory and Evidence from India.

Motiram, Sripad, Indira Gandhi Institute of Development Research, Mumbai (17.03.2014): Inequality and Polarisation.

Pal, Barun Deb, Institute for Social and Economic Change, Bangalore (31.01.2014): An Assessment Carbon Reduction Policy Option for India-A Computable General Equilibrium Modelling Approach.

Shindo, Junko, University of Yamanashi, Japan (26.03.2014): Nitrogen Flow in Agriculture: India and Asia.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Coimbatore

Bakthavatsalam, G., Padmasree, KG Group and Post Graduate Medical Centre (29.10.2013): Need for statistical knowledge for physicians – as preferred by Prof. P.C. Mahalanobis.

Center for Soft Computing Research: A National Facility

Banerjee, S., Bhabha Atomic Research Centre, Mumbai (28.02.2014): How to Design a Nuclear Reactor.

Banerjee, S., Indian Institute of Science Education and Research, Kolkata (16.09.2013): The importance of understanding nonlinearity in engineering science.

Conferences and Seminars

Chakraborty A., St. Thomas College of Engineering and Technology, Kolkata (19.11.2013): Emotion recognition using type-2 fuzzy sets and computing with word model.

Chakraborty A., National Institute of Technology, Shillong, Meghalaya (22.11.2013): Sense and contextual-overlap based classification of documents using WordNet.

Chakraborty, M.K., Jadavpur University, Kolkata (02.07.2013 & 09.07.2013): An introduction to first order logic leading to paraconsistency (Part-I & II).

Hashimoto., R.F., University of Sao Paulo, Brazil (03.10.2013): A data integration methodology to discover genes involved in complex diseases.

Konar A., Jadavpur University, Kolkata (19.11.2013): Emotion recognition using type-2 fuzzy sets and computing with word model.

Kumar, A., Indian Institutes of Technology, Mumbai (21.02.2014): A/D conversion of bandlimited signals in additive independent Gaussian noise.

Majumder, S., Indian National Centre for Ocean Information Services, Hyderabad (06.01.2014): Application of topological methods in inverse problems: getting equations from ECG and sound data.

Martins Jr., D., University of Sao Paulo, Brazil (02.09.2013): Inference of gene regulatory networks by feature selection.

Mukherjee, A., Indian Institutes of Technology, Kharagpur (11.07.2013): Shift of research focus in Computer Sciences over the last fifty years: What citation network analysis reflects?

Nanda, P.K., Institute of Technical Education and Research, Siksha 'O' Anusandhan University, Bhubaneswar (04.09.2013): Unsupervised color image segmentation using constrained compound MRF models.

Perciano T., University of Sao Paulo, Brazil (02.09.2013): Detection of thin and ramified structures using Markov Random Fields and perceptual information.

Rodriguez, Rosario Medina, University of Sao Paulo, Brazil (03.10.2013): Machine learning using straight line segments.

Slezak, D., University of Warsaw, Poland (10.07.2013): Rough Sets - Modern Applications & Scalability Challenges.

Sur, A., Massachusetts Institute of Technology, USA (18.12.2013): Reaching for the stars: The life and times of Meghnad Saha.

5. SANKHYĀ

The internationally renowned journal *Sankhyā*, an official publication of the Indian Statistical Institute, was founded by Professor P.C. Mahalanobis in 1932 and began publication under his editorship. It is devoted to original research articles in Probability, Mathematical Statistics and Applied Statistics. Reviews and discussion articles on current research activity in the above areas are also published. A rigorous peer review process is followed for acceptance of articles submitted for publication in *Sankhyā*. Many seminal articles in Probability, Theoretical Statistics and Applied Statistics have appeared in *Sankhyā*. The journal is published in two separate series – Series A and Series B. Series A with two issues per year, one in February and the other in August, covers Probability and Theoretical Statistics, while Series B with two issues per year, one in May and the other in November, covers Applied and Interdisciplinary Statistics. The present Editorial Board (2012-2014) of *Sankhyā* is as follows:

Beginning 2010, Springer has entered into a co-publication agreement with the Institute and has exclusive rights for the international distribution of the journal. The editorial system is now completely electronic, that is, the entire process starting from submission of articles to editorial processing ending in final editorial decision for articles is now done on line.

The following issues have been published during April 2013 to April 2014:

May 2013 : Volume 75, Part I, Series B [Both Electronic and Print Editions]
August 2013 : Volume 75, Part II, Series A [Both Electronic and Print Editions]
November 2013 : Volume 75, Part II, Series B [Both Electronic and Print Editions]
February 2014 : Volume 76, Part I, Series A [Both Electronic and Print Editions]

The following issue is ready for publication:

May 2014 : Volume 76, Part I, Series B

The following issues are currently under process for publication:

August 2014 : Volume 76, Part II, Series A
November 2014 : Volume 76, Part II, Series B

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Prasanta Kumar Sen, Indian Statistical Institute, Kolkata, India
Ranjit Mandal, Indian Statistical Institute, Kolkata, India

6. SCIENTIFIC PAPERS AND PUBLICATIONS

Books Published

Applied Statistics Division

Applied Statistics Unit, Kolkata

Atkinson, A.C. and Biswas, A.: *Randomized Response-Adaptive Designs in Clinical Trials*, Chapman Hall/ CRC (In the Monograph on Statistics and Applied Probability Series), ISBN-10: 1584886935, ISBN-13: 978-15848869, 2014.

Chaudhuri, A. and Christofides, T.C.: *Indirect Questioning in Sample Surveys*, Springer-Verlag, Berlin, 2013.

Lahiri, S., Schick, A., Sengupta, A. and Sriram, T.N. (eds.): *Contemporary Developments in Statistical Theory*, Springer, New York, 2013.

Computer and Communication Sciences Division

Computer Vision and Pattern Recognition Unit

Chaudhuri, Bidyut B. and Parui Swapan Kr. (eds.): *Advances in Digital Document Processing and Retrieval*, World Scientific Publishing, Singapore, pages 323, ISBN 978-981-4368-70-4, 2014.

Electronics and Communication Sciences Unit

Mitra, Susanta and Bagchi, Aditya: *Data Model for Social Networks-Design and Query Processing*, Lap Lambert Academic publishing, Germany, ISBN: 978-3-659-46140-8, 2013.

Panigrahi, Ketan, Bijaya, Suganthan, Nagaratnam, Ponnuthurai, Das, Swagatam, Dash and Sekhar, Subhransu (eds.): *Proceedings of 4th International Conference on Swarm, Evolutionary, and Memetic Computing - SEMCCO 2013, Part-I*, Lecture Notes in Computer Science 8297, Springer 2013, ISBN: 978-3-319-03752-3, Chennai, 2013.

Ray, Kumar Sankar and Ray, Bimal Kumar: *Polygonal Approximation and Scale Space Analysis of Closed Digital Curve*, CRC Press–Apple Academic Press, Taylor & Francis Group, pages 388, ISBN: 9781926895338, 2013.

Ray, Kumar Sankar: *Soft Computing and its Applications: A Unified Engineering Concept*, CRC Press–Apple Academic Press, Vol.-1, Taylor & Francis Group, pages 597, ISBN: 9781926895383, 2014.

Ray, Kumar Sankar: *Soft Computing and its Applications: Fuzzy Reasoning and Fuzzy Control*, CRC Press–Apple Academic Press, Vol.-2, Taylor & Francis Group, pages 405, ISBN: 9781771880466, 2014.

Ray, Indrakshi and Bagchi, Aditya (eds.): *Information Systems Security*, Proceedings of the 9th International Conference on Information Systems Security, Lecture Notes in Computer Science, Vol.-8303, Springer, 2013.

Machine Intelligence Unit

Lingras, P., Wolski, M., Cornelis, C., Mitra, S. and Wasilewski, P. (eds.): *Rough Sets and Knowledge Technology (RSKT 2013)*, Lecture Notes in Artificial Intelligence-8171, Springer Verlag, Berlin, 2013.

Maji, P., Ghosh, A., Murty, M.N., Ghosh, K. and Pal, S.K. (eds.): *Pattern Recognition and Machine Intelligence: Fifth International Conference, PReMI 2013*, Proceedings, Springer-Verlag, Berlin, Heidelberg, Lecture Notes in Computer Science, pages 753, Vol.-8251, ISBN: 978-3-642-45061-7 (Print), 978-3-642-45062-4 (Online), 2013.

Documentation Research and Training Centre

Dutta, B. and Prasad, A.R.D: *Semantic e-learning system: theory, implementation and applications*, Lambert Academic Publishing (LAP), Germany, pages 216, ISBN: 978-3-659-18318-8, 2013.

Systems Science and Informatics Unit

Pal, S.K. (MIU), Meher, S.K. (eds.): *Granular Soft Computing for Pattern Recognition and Mining*, Applied Soft Computing, Vol.-13, No.-9, pages (3942-4010), 2013.

Social Sciences Division

Economic Research Unit

Chakravarty, Satya R.: *An Outline of Financial Economics*, Anthem Press, New York, pages 299, ISBN: 978-0-85728-507-2, 2013.

Linguistic Research Unit

Dasgupta, Probal, Camacho, Jorge and Ertl, István: *Beletra Almanako 17*, Mondial, New York, 2013.

Dasgupta, Probal, Camacho, Jorge and Ertl, István: *Beletra Almanako 18*, Mondial, New York, 2013.

Dasgupta, Probal, Camacho, Jorge and Ertl, István: *Beletra Almanako 19*, Mondial, New York, 2014.

Economics and Planning Unit, Delhi

Ghate, Chetan, Pickford, Stephen, Francis Rathinam and Callaghan, (eds.): *Global Cooperation Among G20 Countries: Responding to the Crisis and Restoring Growth*, Springer Verlag, India, 2014.

Publications

Economic Analysis Unit, Bangalore

Ramachandran, V.K. and Swaminathan, Madhura (eds.): *Dalit Households in Village Economies*, Tulika Books, New Delhi, pages 339, ISBN: 978-93-82381-30-3, 2014.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Kolkata

Sarkar, A. (SQC & OR Unit, Mumbai), Anis, M.Z. and Sikder, S. (SQC & OR Unit, Mumbai) (eds.): *Proceedings of the International Conference on Quality, Reliability and Operations Research*, Excel India Publishers, New Delhi, pages 206, ISBN: 978-93-82880-27-1, 2013.

SQC & OR Unit, Bangalore

John, Bobby, Acharya, U.H. and Chakraborty, A.K. (eds.): *Quality and Reliability Engineering – Recent Trends and Future Directions*, Allied Publishers Pvt. Ltd, India, pages 444, ISBN: 978-81-8424-831-9, 2013.

SQC & OR Unit, Pune

Biswas, D., Dey, A., Chakraborty, M., Dey, S.K., Sengupta, A., Bhattacharjee, S., Kundu and Rath, S.: *Habitual physical activity score as a predictor of the 6-min walk test distance in healthy adults*, Respiratory Investigation, Vol.-51, No.-4, 250-256, 2013

Papers Published in Journals

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Bose, Arup and Gupta, Barnali: Mixed markets in a bilateral monopoly, *Journal of Economics*, **110(2)**, 141-164, Online Version: DOI: 10.1007/s00712-012-0310-8, 2013.

Banerjee, Sayan and Bose, Arup: Noncrossing partitions, Catalan words and the semicircle law, *Journal of Theoretical Probability*, **26(2)**, 386-409, Online Version: DOI: 10.1007/s10959-011-0365-4, 2013.

Bhattacharjee, Monika and Bose, Arup: Consistency of large dimensional sample covariance matrix under weak dependence, *Statistical Methodology* (Special issue in memory of Kesar Singh), **20**, 11-26, Online Version: DOI: 10.1016/j.stamet.2013.08.005, 2014.

Bhattacharjee, Monika and Bose, Arup: Estimation of autocovariance matrices for infinite dimensional vector linear processes, *Journal of Time Series Analysis*, Online Version: DOI: 10.1111/jtsa.12063, 2014.

Bhatwadekar, S.M., Dutta, Amartya K. and Onoda, N.: On algebras which are locally A^1 in codimension-one, *Transactions of the American Mathematical Society*, **365** (9), 4497-4537, 2013.

Bose, Arup and Sen, Sanchayan: Finite diagonal random matrices, *Journal of Theoretical Probability*, **26**(3), 819-835, Online Version: DOI: 10.1007/s10959-011-0378-z, 2013.

Bose, Arup, Chakravarty, Satya R. and D'Ambrosio, Conchita: Richness orderings, *Journal of Economic Inequality*, **12**(5-22), Online Version: DOI: 10.1007/s10888-013-9249-4, 2014.

Bose, Arup, Gangopadhyay, Sreela and Saha, Koushik: Convergence of a Class of Toeplitz Type Matrices, *Random Matrices: Theory Applications*, **02**(3), 1350006, (21 pages), Online Version: DOI: 10.1142/S2010326313500068, 2013.

Chakraborty, Anirvan and Chaudhuri, Probal: On Data Depth in Infinite Dimensional Spaces, *Annals of the Institute of Statistical Mathematics*, **66**, 303-324, 2014.

Dasgupta, R.: Characterization theorems based on conditional quantiles with applications, *Journal of Environmental Statistics*, **4**(6), 01-25, 2013.

Dasgupta, R.: Discussion of 'Agricultural epidemiology and environmental toxicity: some statistical perspective', *Journal of Indian Society of Agricultural Statistics*, **67**(2), 175-177, 2013.

Dutta, Subhajit, Chaudhuri, Probal and Ghosh, Anil: Linear Discriminant Analysis of Character Sequences Using Occurrences of Words, *Statistica Sinica*, **24**, 493-514, 2014.

Gupta, Neena: On the cancellation problem for the affine space \mathbb{A}^3 in characteristic p , *Inventiones Mathematicae*, **195**, 279-288, 2014.

Rao, D.R. and Gupta, Neena: On the non-injectivity of the Vaserstein symbol in dimension three, *Journal of Algebra*, **399**, 378-388, 2014.

Stat-Math Unit, Delhi

Bapat, R.B. and Sivasubramanian, S.: Product distance matrix of a graph and squared distance matrix of a tree, *Applicable Analysis and Discrete Mathematics*, **7**, 285-301, 2013.

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Social Sciences Division

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Das, S.: Impact of MGNREGA on Livelihood of Rural Poor in India: A Study Based on National Sample Survey Data, *50th Annual Golden Jubilee Conference of the Indian Econometric Society (TIES)*, organized by Indira Gandhi Institute of Development Research (IGIDR), Mumbai, 2013.

Pal, M., Ghosh, N. B. (SRU) and Bharati, P.(BAU): Poverty Eradication Programmes in India: Actions Taken and Impacts Made in Global Social transformation and Social Action: The Role of Social Workers, Volume III, *Social Work – Social Development*, Sven Hesse (ed.), Stockholm University, Sweden, ASHGATE, 2014.

Bharati, Susmita (SRU), Pal, Manoranjan and Bharati, Premananda (BAU): Growth and Nutritional Status of Pre-school Children: A Comparative Study of Jharkhand, Bihar and West Bengal in *Advances in Growth Curve Models*, Ratan Dasgupta(ed.), Indian Statistical Institute, Springer, 2013.

Linguistic Research Unit

Dash, Niladri Sekhar and Hussain, Mazhar: Designing a Generic Scheme for Etymological Annotation (EA): A New Type of Language Corpora Annotation, *Proceedings of the ALR-11 in 6th International Joint Conference on Natural Language Processing*, Nagoya Congress Centre, Nagoya, Japan, 64-71, 2013.

Dash, Niladri Sekhar and Aman, Atul: An Attempt towards Documentation and Preservation of Khortha, *Proceedings of the Second Seminar on Endangered and Lesser-Known Languages (ELKL-II)*, Dept. of Linguistics, Lucknow, India, 3-13, 2013.

Dash, Niladri Sekhar: Developing a Digital Pronunciation Dictionary in Bengali for Computer-Assisted Language Teaching, E-Learning, and Language Technology, *Proceedings of the 35th Annual and 1st*

Publications

International Conference of the Linguistic Society of India (ICOLSI-1), Central Institute of Indian Languages, Mysore, India, 78-81, 2013.

Dash, Niladri Shekhar: Consonant Graphic Variants in Bengali: Their Patterns of Usage and Their Nature of Pronunciation within Words, *Proceedings of the 11th International Conference of South Asian Languages and Literatures (ICOSAL 11)*, Banaras Hindu University (BHU), Varanasi, India, 26-36, 2014.

Dash, Niladri Shekhar and Aman, Atul: A Phonological Overview of Khortha – A Language Spoken in Jharkhand, *Proceedings of the 11th International Conference of South Asian Languages and Literatures (ICOSAL 11)*, Banaras Hindu University (BHU), Varanasi, India, 17-27, 2014.

Dash, Niladri Sekhar and Mishra, Vandana: Using Electronic Text Data in Constructing a Digital Hindi Newspaper Corpus: Perspectives and Challenges, *Proceedings of the 11th International Conference of South Asian Languages and Literatures (ICOSAL 11)*, Banaras Hindu University (BHU), Varanasi, India, 89-99, 2014.

Dash, Niladri Sekhar: Investigating into the Patterns of Usage and Nature of Pronunciation of Some Consonant Grapheme Clusters in Bengali, *Proceedings of the 30th South Asian Languages Analysis Roundtable (SALA 30)*, Centre for Applied Linguistics and Translation Studies, University of Hyderabad, Hyderabad, India, 88-98, 2014.

Dash, Niladri Sekhar and Mishra, Vandan: A Quantitative Analysis of Lexical Distribution in a Sample Digital Hindi Corpus of Newspaper Texts, *Proceedings of the 30th South Asian Languages Analysis Roundtable (SALA 30)*, Centre for Applied Linguistics and Translation Studies, University of Hyderabad, Hyderabad, India, 152-162, 2014.

Dash, Niladri Sekhar: Language Attitude of Khortha Speakers in Giridih: A Survey Report, *Proceedings of the National Conference on Inter-disciplinary Researches in Social Sciences in Eastern India with special reference to Jharkhand (NCIRSSEI-2014)*, Sociological Research Units, Indian Statistical Institute, Kolkata and Giridih, Jharkhand, 1-12, 2014.

Sampling and Official Statistics Unit

Pathak, Prasanta and Verma, Vivek: Projection of Indian Population by Using Leslie Matrix with Changing Age Specific Mortality Rate, Age Specific Fertility Rate and Age Specific Marital Fertility Rate, *Advances in Growth Curve Models*, Ratan Dasgupta (ed.), 227-240, Springer, 2013.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Bangalore

John, Bobby and Kadavevaramath, R.S.: Optimization of the yield of the code review process, *Proceedings of the International Conferences on Quality, Reliability and Operations Research (ICONQROR-2013)*, Excel India Publishers, ISBN: 978-93-82880-27-12013, 161-167, 2013.

John, Bobby: A dual response surface optimization approach for minimizing the variation of paint thickness in powder coating process, *International Conference on Advanced Materials, Manufacturing, Management & Thermal Sciences (AMMMT-2013)*, Tumkur, ISBN-13 978-81-926304-0-3, 2013.

SQC & OR Unit, Mumbai

Sarkar, Ashok (SQC & OR Unit, Mumbai), Mukhopadhyay, Arup R. (SQC & OR Unit, Kolkata) and Ghosh, Sadhan K.: Process Modeling and Measures in Lean Six Sigma, *Proceedings of International Conference of Quality Reliability and Operation Research*, Ashok Sarkar, Sagar Sikder and Md. Zafar Anis (eds.), ISBN: 978-93-82880-27-1, 39-45, 2013.

Sikder, Sagar, Mukherjee, I., Panja, S.C. and Bera, S.: A Mahalanobis Taguchi System – based Approach for Correlated Multiple Response Process Monitoring, *Proceedings of the International conference on Industrial Engineering and Operations Management*, IEOM Society, Indonesia, 2118-2125, 2014.

Library, Documentation and Information Sciences Division**Library, Kolkata**

Bhattacharya, Krishna: Revisiting P.C. Mahalanobis Memorial Museum & Archives, *Journal of Department of Museology, University of Calcutta*, 10, 158-161, 2014.

Center for Soft Computing Research: A National Facility

Datta, A., Ghosh, S. and Ghosh, A.: Band elimination of hyperspectral imagery using correlation of partitioned band images, *Proc. 2nd International Conference on Advances in Computing, Communications and Informatics (ICACCI-2013)*, India, 2013.

Mahanta, P., Bhattacharyya, D.K. and Ghosh, A.: A Subspace Module Extraction Technique for Gene Expression Data, *Proc. 5th International Conference on Pattern Recognition and Machine Intelligence (PReMI'13)*, Kolkata, India, 635-640, 2013.

R.C. Bose Centre for Cryptology and Security

Sen Gupta, Sourav, Maitra, Subhamoy, Meier, Willi, Paul, Goutam and Sarkar, Santanu: Dependence in IV-related bytes of RC4 key enhances vulnerabilities in WPA, *Proceedings of the 21st International Workshop on Fast Software Encryption (FSE)*, Lecture Notes in Computer Science (LNCS), Springer, London, 2014.

Mukherjee, Imon and Paul, Goutam: Efficient Multi-bit Image Steganography in Spatial Domain, *Proceedings of the 9th International Conference on Information Systems Security (ICISS)*, Lecture Notes in Computer Science (LNCS), Springer, Kolkata, 8303, 270-284, 2013.

Khalid, Ayesha, Hassan, Muhammad, Chattopadhyay, Anupam and Paul, Goutam: RAPID-FeinSPN: A Rapid Prototyping Framework for Feistel and SPN-Based Block Ciphers, *Proceedings of the 9th International Conference on Information Systems Security (ICISS)*, 8303, 169-190, Lecture Notes in Computer Science (LNCS), Springer, Kolkata, India, 2013.

Saha, Shubhajit and Paul, Goutam: On Effective Sharing of User Generated Content, *Proceedings of the 11th Asia Pacific Conference on Computer Human Interaction (APCHI)*, Bangalore, India, 114-118, 2013.

Publications

Paul, Goutam and Paul, Soumi: Proposal for a Novel Computerized Menu-Presentation Interface for Restaurants, *Proceedings of the 11th Asia Pacific Conference on Computer Human Interaction (APCHI)*, Bangalore, India, 119-122, 2013.

Prado, Antonio, Ruj, Sushmita and Nayak, Amiya: *Enhanced Privacy and Reliability for Secure Geocasting in VANET*, IEEE ICC, Budapest, Hungary, 1599-1603, 2013.

Huang, Zhen, Wang, Cheng, Ruj, Sushmita, Nayak, Amiya and Stojmenovic, Ivan: Modeling Cascading Failures in Smart Power Grid using Interdependent Complex Networks and Percolation Theory, *8th IEEE Conference on Industrial Electronics and Applications (ICIEA)*, Melbourne, Australia, 1023-1028, 2013.

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Ruj, Sushmita and Sakurai, Kouichi: Secure and Privacy Preserving Hierarchical Wireless Sensor Networks using Hybrid Key Management Technique, IEEE Globecom, Atlanta, USA, 2013.

Bag, Samiran, Ruj, Sushmita and Roy, Bimal: Jamming Resistant Schemes for Wireless Communication: A Combinatorial Approach, *9th International Conference on Information Systems Security (ICISS 13)*, LNCS, Springer, Kolkata, India, **8303**, 43-62, 2013.

Papers Published in Books

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Dasgupta, R.: Moment bounds for Strong-Mixing processes with applications, *Statistical Paradigms*, World Scientific, **14**, 2014.

Dasgupta, R.: Characterization theorems based on conditional quantiles with applications, *Journal of Environmental Statistics*, **4(6)**, 01-25, 2013.

Dasgupta, R.: Discussion of Agricultural epidemiology and environmental toxicity: some statistical perspective, *Jour.of Indian Soc.of Agricultural Statistics*, **67(2)**, 175-177, 2013.

Dasgupta, R.: Yam Growth Experiment and Above-ground Biomass as Possible Predictor, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(1)**, 01-33, 2013.

Dasgupta, R.: Non uniform Rates of Convergence to Normality for Two sample U-statistics in Non IID Case with Applications, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(4)**, 60-88, 2013.

Dasgupta, R.: Optimal-Time Harvest of Elephant Foot Yam and Related Theoretical Issues, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(6)**, 101-130, 2013.

H. Maity, R. Dasgupta and B.S. Mazumder: Evolution of Scour and velocity fluctuation due to turbulence around cylinders, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(7)**, 131-148, 2013.

Dasgupta, R.: South Pole Ozone Profile and Lower Tolerance Limit, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(8)**, 149-170, 2013.

Dasgupta, R.: Tuber Crop Growth and Pareto Model, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(10)**, 185-198, 2013.

Dasgupta, R.: Growth Curve Model in Relation to Extremal Processes based on Stationary Random Variables, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(12)**, 215-226, 2013.

Ratan Dasgupta and Avinash Dharmadikari: Growth curve for cumulative defects, *Advances in Growth Curve Models: Topics from the Indian Statistical Institute*, Springer Proceedings in Mathematics & Statistics, **46(14)**, 241-257, 2013.

Applied Statistics Division

Applied Statistics Unit, Chennai

Guang, Gong and Gupta, K.C.: Cryptography: Stream and block ciphers, *Handbook of Finite Fields*, CRC-Press, Chapman and Hall, Gary L. Mullen and Daniel Panario (eds.), Discrete Mathematics and Its Applications series, ISBN: 9781439873786, 2013.

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Computer and Communications Sciences Division

Computer Vision and Pattern Recognition Unit

Mukherjee, A., Garain, U. and Biswas, A.: Diagram Drawing Using Braille Text: A Low Cost Learning Aid for Blind People, *Global Trends in Intelligent Computing Research and Development*, B.K. Tripathy and D.P. Acharjya (eds.), IGI Global, USA, **(14)**, 384-406, 2103

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Publications

for Text Extraction from Scene Images, Pattern Recognition and Machine Intelligence, P. Maji et al. (ed.), LNCS, Springer, **8251**, 489-494, 2013.

Ghosh, Kripabandhu and Parui, Swapan K.: Retrieval from OCR text: RISOT Track, Multilingual Information Access in South Asian Languages, P. Majumder et al.(ed.), LNCS, Springer, **7536**, 214-226, 2013.

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Machine Intelligence Unit

Maji, P. and Paul, S.: Rough Set Based Feature Selection: Criteria of Max-Dependency, *Max-Relevance, and Max-Significance*, Rough Sets and Intelligent Systems: Professor Zdzislaw Pawlak in Memoriam, A. Skowron and Z. Suraj (eds.), Springer, 393-418, 2013.

Physics and Earth Sciences Division

Geological Studies Unit

Hartley, A.J., Weissmann, G., Bhattacharaya, P., Nichols, G. J., Scuderi, L. A., Davidson, S. K., Leleu, S., Chakraborty, T., Ghosh, P. and Mather, A.E.: Soil development in the modern Distributive Fluvial Systems: preliminary observations with implications for interpretation of paleosols in the rock record, *New Frontiers in Paleopedology and Terrestrial Paleoclimatology*, S.G. Dreise and L.C. Nordt (eds.), SEPM (Special Publication), **104**, 149-158, 2013.

Weissmann, G.S., Hartley, A.J., Scuderi, L.A., Nichols, G.J., Owen, A., Davidson, S.K., Atchley, S.C., Bhattacharyya, P., Chakraborty, T., Ghosh, P., Nordt, L.C., Michel, L.A., and Tabor, N.J.: Prograding Distributive Fluvial Systems – Geomorphic Models and Ancient Examples, *New Frontiers in Paleopedology and Terrestrial Paleoclimatology*, S. G. Dreise and L. C. Nordt (eds), SEPM (Special Publication), **104**, 131-147, 2013.

Physics and Applied Mathematics Unit

Roy, Sisir: Consciousness, functional geometry and internal representation: Interdisciplinary perspectives on consciousness and the self, Sangeetha Menon et al (ed.), Springer, 285-306, 2014.

Biological Sciences Division

Agricultural and Ecological Research Unit

Dasgupta, N., Nandy, P. and Das, S.: Salt Stress: A biochemical and physiological adaptation of some Indian halophytes of Sundarbans, *Molecular Stress Physiology of Plants*, G.R.Rout and A.B.Das (eds.), Springer, **ISBN: 978-81-322-0806-8**, 2013.

Biological Anthropology Unit

Pal, M (ERU), Ghosh, B.N. (SRU) and Bharati, P.: Poverty eradication programmes in India: Actions taken and impacts made Global social transformation and social action, *The Role of Social Workers*, S.Hessle (ed.), Social Work – Social Development, Stockholm University, Sweden, ASHGATE, III, 2014.

Adak, D.K., Shun, D.S. and Bharati, P.: Changing perspective of poverty in northeast India, Poverty and Social Exclusion in India, A. Chattopadhyay (ed.), Rawat Publications, Jaipur, 68-77, 2013.

Karmakar, B. and Kobylansky, E.: Sexual dimorphism in Muzeina Bedouins from South Sinai, *Multi variate analysis on dermatoglyphic traits with asymmetry and diversity*, H.Kaarma (ed.), Tartu University Press, Tartu University, Estonia, 68-83, 2013.

Reddy, B.M.: People of India: Implications of recent DNA studies, *History of Ancient India, Prehistoric Roots*, D.K. Chakrabarti and Makkhan Lal (eds.), Vivekananda International Foundation and Aryan Books International, New Delhi, 1, 28-58, 2014.

Mukhopadhyay, B.: Anthropology in public health: Some observations on further possibilities of human well-being in India, *Anthropology and The Future of Humankind*, INCAA Occasional Papers 27, A.K. Danda, S. Gregory and D.G. Danda (eds.), Indian National Confederation and Academy of Anthropologists, Jhargram and Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal, 290-298, 2014.

Social Sciences Division

Economic Research Unit

Bossert, Walter, Chakravarty, Satya R., Ceriani, Lidia and D'Ambrosio, Conchita: Intertemporal Material Deprivation, *Poverty and Social Exclusion: New Methods of Analysis*, G. Betti and A. Lemmi (eds.), Routledge, London, 128-142, 2013.

Chakraborty, Bidisha and Gupta, Manash, Ranjan: Human Capital Accumulation, Environmental Quality, Taxation and Endogenous Growth, *Analytical Issues in Trade Development and Finance*, A.N. Ghosh and A. Karmakar (eds.), Springer, 193–215, 2014.

Ghosh, C. and Ghosh, A.: Monetary Policy and Crisis, *Analytical Issues in Trade Development and Finance*, A.N. Ghosh and A. Karmakar (eds.), Springer, 371-380, 2014.

Linguistic Research Unit

Dasgupta, Probal: Postparolo: loghi en malegraj hejmoj, *En la Profundo*, Jorge Camacho (ed.), Mondial, New York, 289-304, 2013.

Dasgupta, Probal: Dialogical investigations on Daya Krishna and Ramchandra Gandhi, *Philosophy as Saṃvāda and Svarāj: Dialogical Meditations on Daya Krishna and Ramchandra Gandhi*, Shail Mayaram (ed.), Sage, New Delhi, 199-213, 2014.

Dasgupta, Probal: Scarlet and green: phi-inert Indo-Aryan nominals in a co-representation analysis, *Grammatica et Verba / Grammar and Verve/ Studies in South Asian, historical, and Indo-European linguistics in honour of Hans Henrich Hock*, Shu-Fen Chen, Benjamin Slade (eds.), Beech Stave, Ann Arbor/ New York, 46-52, 2013.

Publications

Dash, Niladri Sekhar: Development of ELT Resources from English Language Corpora: Some New Methods, *Emerging Issues in English Language Teaching (ELT)*, Arvind M. Nawale and Prashant Mothe (eds.), GNOSIS, New Delhi, ISBN: 978-93-81030-46-2, 176-198, 2013.

Psychology Research Unit

Dutta Roy, D.: Reading motivation of tribal students in Tripura and Manipur: An Empirical study, *Tribal education in India: Challenges and Strategie*, Niladri Pradhan (ed.), FIRMA KLM Pvt. Ltd., Kolkata, 159 -180. 2014.

Sampling and Official Statistics Unit

Mukherjee, Diganta and Sinha, Uday Bhanu: Understanding NREGA: A Simple Theory and Some Facts, *Human Capital and Development: The Indian Experience*, N.S. Siddharthan and K. Narayanan (eds.), Springer, 2013.

Sociological Research Unit

Bharati, Susmita, Pal, Manoranjan (ERU) and Bharati, Premananda (BAU): Growth and nutritional status of pre-school children: A comparative study of Jharkhand, Bihar and West Bengal, R Dasgupta (ed.), *Advances in Growth Curve Models*, Springer, 257-270, 2013.

Choudhuri, Anil. K. and Jana, Rabindranath: Social Network Analysis Approach for Studying Caste, Class and Social Support in Rural Jharkhand and West Bengal: An Empirical Attempt, *Social Networking - Mining, Visualization, and Security*, Mrutyunjaya Panda, Satchidananda Dehuri and Gi-Nam Wang (eds.), Intelligent Systems Reference Library, Springer, 65, 147-200, 2014.

Ghosh, B.N., Pal, M (ERU) and Bharati, P.(BAU): Poverty eradication programmes in India: Actions taken and impacts made Global social transformation and social action, *The Role of Social Workers*, S.Hessle (ed.), Social Work – Social Development, Stockholm University, Sweden, ASHGATE, III, 2014.

Ghosh, Bhola Nath: Process of Development of Women in Rural Jharkhand, *Livelihood and Health: Issues and Process in Rural Development*, P. Dash Sharma and D. Chatterjee (eds.), Serial Publications, New Delhi, 92-105, 2014.

Economics and Planning Unit, Delhi

Ghate, Chetan, Mike, Callaghan, Stephen, Pickford and Francis, Rathinam: Introduction, *Global Cooperation Among G20 Countries: Responding to the Crisis and Restoring Growth*. Springer Verlag, India, 1, 1–21, 2014.

Economic Analysis Unit, Bangalore

Ramachandran, V.K.: Introduction in Dalit Households in Village Economies, V.K. Ramachandran and Madhura Swaminathan (eds.), Tulika Books, New Delhi, 2014.

Ramachandran, V.K., Dhar, N.S. and Kaur, Navpreet: Hired Manual Workers: A note, *Dalit Households in Village Economies*, V.K. Ramachandran and Madhura Swaminathan (eds.), Tulika Books, New Delhi, 2014.

Rajashekara, H.M., Vardhan, Pratap and Daya Sagar, B.S.: Generation of Zonal Map from Point Data via Weighted Skeletonization by Influence Zone, *IEEE Geoscience and Remote Sensing Letters*, **9(3)**, 403-407, 2012.

Swaminathan, Madhura and Singh, Shamsheer: Exclusion in Access to Basic Civic Amenities, *Dalit Households in Village Economies*, V.K. Ramachandran and Madhura Swaminathan (eds.), Tulika Books, New Delhi, 2014.

Swaminathan, Madhura and Rawal, Vikas: Income Inequality in Village India and the Role of Caste, *Dalit Households in Village Economies*, V.K. Ramachandran and Madhura Swaminathan (eds.), Tulika Books, New Delhi, 2014.

Vardhan, Ashok S., Rajesh, N., Daya Sagar, B.S. and Rajashekara H.M.: Automatic Detection of Orientation of Mapped Units via Directional Granulometric Analysis, *IEEE Geoscience and Remote Sensing Letters*, **10(6)**, 1449-1453, 2013.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Kolkata

Bandyopadhyaya, Amitava and Jane Willshire, Mary.: Engineering Foundations, *Guide to the Software Engineering Body of Knowledge Ver. 3.0 SWEBOK*, Pierre Bourque, Ricrd E (Dick) Fairly (eds.), IEEE Computer Society, 15-1--15-16, 2014.

SQC & OR Unit, Bangalore

John, Bobby and Acharya, U.H.: Quality and Reliability Engineering: An Introduction, *Quality and Reliability Engineering – Recent Trends and Future Directions*, Allied Publishers, India, **ISBN: 978-81-8424-831-9**, 1-2, 2013.

7. VISITING SCIENTISTS, HONOURS AND AWARDS

A number of distinguished scientists from India and abroad participated in the research, training and other scientific activities of the Institute during the year. Some of them came to the Institute on invitation and spent fairly long periods in the Institute to assist in the regular research and teaching programmes, while others came for short periods and gave lectures and seminars. Most of them were available for consultation by the faculty members of the Institute. Names of the visiting scientists are given below.

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Subhash, B., School of Mathematical Sciences, National Institute of Science Education and Research, Bhubaneswar, May 01-June 30, 2013.

Mandal, Satya, Department of Mathematics, University of Kansas, USA, July 25-August 02, 2013.

Paul, Pampa, Institute of Mathematical Sciences, Chennai, June 01, 2013-March 31, 2014.

Basak, Tathagata, Department of Mathematics, Iowa State University, USA, July 08-August 17, 2013.

Onoda, Nobuharu, Department of Mathematics, University of Fukui, Japan, December 25, 2013-January 06, 2014.

Asanuma, Teruo, Faculty of Science, University of Toyama, Japan, December 15, 2013-January 06, 2014.

Bal, Kaushik, National Institute of Science Education & Research, Bhubaneswar, September 06-09, 2013.

Thomas, Viji Z., Indian Institute of Science Education and Research, Trivandrum, September 07-14, 2013.

Raghunathan, M.S., Indian Institute of Technology, Mumbai, September 15-18, 2013.

Kumar, Pradip, Harish Chandra Research Institute, Allahabad, January 01-June 30, 2014.

Si Si, Faculty of Information Science & Technology, Aichi Prefectural University, Japan, November 24-30, 2013.

Bhatwadekar, S.M., Bhaskaracharya Pratishthana, Pune, November 10-20, 2013.

Chavan, Sameer, Department of Mathematics, Indian Institute of Technology, Kanpur, July 11-20, 2013.

Asanuma, Tereu, University of Toyama, December 15, 2013-January 01, 2014.

Chakraborty, Partha Sarathi, Institute of Mathematical Sciences, Chennai, December 16, 2013-January 04, 2014.

Parikh, Rohit, City University of New York, January 01-04, 2014.

Sengupta, Jyotirmoy, School of Mathematics, Tata Institute of Fundamental Research, Mumbai, February 01-11, 2014.

Basu, Saugata, Department of Mathematics, Purdue University, February 07, 2014.

Athreya, Krishna B., Iowa State University, USA, February 18-23, 2014.

Stat-Math Unit, Delhi

Adhikari, S.D., Harish-Chandra Research Institute, Allahabad, November 13-21, 2013.

Ayyer, Arvind, Indian Institute of Sciences, Bangalore, February 16-21, 2014.

Abu Baker, Abdullah Bin, Indian Institute of Technology, Kanpur, March 01–August 31, 2014.

Banwait, Barinder, University of Warwick, United Kingdom, October 20-23, 2013

Bilu, Yuri, University of Bordeaux, France, February 15-22, 2014.

Chakraborty, Partha Sarathi, Institute of Mathematical Sciences, Chennai, March 13-19, 2014.

Das, Suchismita, Indian Institute of Science Education and Research, Kolkata, since January 1, 2013–December 12, 2013.

Dey, Partha Sarathi, New York University, New York, July 14-19, 2013.

Dey, Aloke, National Academy of Sciences, India, January 01–December 31, 2014.

Dutta, Kunal, Institute of Mathematical Science, Chennai. April 01–August 13, 2013.

Ganesan, Ghurumuruhan, École polytechnique fédérale de Lausanne, Lausanne Switzerland, December 23-29, 2013.

Garge, Shripad, Indian Institute of Technology, Mumbai, February 16-22, 2014.

Grijalba, Jhon Jairo Bravo, Centro de Ciencias Matemáticas, UNAM, Mexico, November 01-December 04, 2013.

Guzman, Sergio, Centro de Ciencias Matemáticas, UNAM, Mexico, November 01-December 04, 2013.

Karandikar, R.L., Chennai Mathematical Institute, Siruseri, May 9-11, 2013.

Kochar, S.C., Portland State University, USA, December 10-29, 2013.

Krishnan, Santhana, Indian Institute of Technology, Mumbai, April 6, 2013-May 9, 2013.

Kumar, Ravinder, Himachal Pradesh University, Shimla, December 26, 2013-February 5, 2014.

Lahiri, Ananya, Chennai Mathematical Institute, Seruseri, June 25-July 20, 2013.

Lal, Arabinda K, Indian Institute of Technology, Kanpur, June 05-20, 2013.

Kannan, Rajesh M., Indian Institute of Technology, Chennai, September 16, 2013-February 21, 2014.

Visiting Scientists, Honours and Awards

Mohari, Anilesh, Institute of Mathematical Sciences, Chennai, December 02-10, 2013.

Mukhopadhyay, Siuli, Indian Institute of Technology, Mumbai, February 17-21, 2014.

Murty, Ram, Queens University, Canada, July 05-07, 2013.

Nimbalkar, Uttara Naik, University of Pune, Pune, May 28-30, 2013.

Pati, Sukanta, Indian Institute of Technology, Guwahati, June 05-20, 2013.

Plevnik, Lucijan, University of Ljubljana, Slovenia, September 25, 2013-January 31, 2014.

Pundir, Sudesh, Pondicherry University, Puducherry, October 28-November 01, 2013.

Ali, Saeb, University of Mysore, Mysore, December 10, 2013-till September 30.

Sankaran. P.G., Cochin University of Science and Technology, Cochin, India, March 18-21, 2014.

Shorey, T.N., Indian Institute of Technology, Mumbai, June 30-July 18, 2013.

Sharma, Rajesh, Himachal Pradesh University, Shimla, December 26, 2013-February 05, 2014.

Singh, Ajit Iqbal, Indian National Science Academy, New Delhi, June 01, 2013-May 31, 2014.

Singh, Ng Sudhir, Manipur University, Imphal, October 20-November 16, 2013.

Singh, Anupam Kumar, Indian Institute of Science Education and Research, Pune, January 01-February 28, 2013.

Subramanian, Siva, Indian Institute of Technology, Mumbai, June 17-26, 2013.

Sundar, S, Chennai Mathematical Institute, Siruseri, June 07-July 15, 2013.

Stat-Math Unit, Bangalore

Baker, Abdullah Bin Abu, Indian Institute of Technology, Kanpur, since June 20, 2013 for 2 months.

Basu, Madhushree, Institute of Mathematical Sciences, Chennai, since September 16, 2013 for one year.

Bilu, Yuri, Universite de Bordeaux, France, January 9-13, 2014.

Chandgotia, Nishant, University of British Columbia, July 14-19, 2013.

Chattopadhyay, Arup, National Board for Higher Mathematics, July 1, 2013 for one year.

Chaudhuri, Chitrabhanu, Northwestern University, USA, July 29-August 02, 2013.

Das, Bata Krishna, University of Lancaster, UK, since November 17, 2012 - till June 2014.

Dey, Lakshmi Kanta, National Institute of Technology, Durgapur, June 07-19, 2013.

Visiting Scientists, Honours and Awards

Fakhruddin, Najmuddin, Tata Institute of Fundamental Technology, Mumbai, January 20–March 20, 2014.

Jayanarayanan, C.R., January 15, 2014 for 6 months.

Kumar, Anil, C.P., Institute of Mathematical Sciences, Chennai, February 10–21, 2014.

Lohr, Wolfgang, Universitat Duisburg-Essen, Germany, April 01-15, 2013.

Majumdar, Dipramit, Brandeis University, July 01, 2013-till April 10, 2014.

Munshi, Ritabrata, Tata Institute of Fundamental Research, Mumbai, September 02–20, 2013.

Pal, Sarbeswar, Chennai Mathematical Institute, Chennai, July 30, 2013 for one year.

Prajapati, Sunil Kumar, National Board for Higher Mathematics, July 01, 2013 for one year.

Raju, Sankara, National Board for Higher Mathematics, July 03, 2013 for one year.

Ramesh, G., Indian Institute Technology, Hyderabad, July 10, 2013 for 3 weeks.

Rangaswamy, Manikandan, Cochin University of Science and Technology, Cochin, February 24–March 31, 2014.

Sahasrabudhe, Neeraja, University of Padova, Italy, July 15, 2013–March 14, 2014.

Sane, Sharad, Indian Institute Technology, Mumbai, December 18, 2013–January 23, 2014.

Sebastian, Ronnie, Humboldt Universitat zu Berlin, since December 14, 2012-May 31, 2013.

Subbiah, Loganatha Narayanasamy Government College, Ponneri, Chennai, Tamil Nadu, July 9-12, 2013.

Tripathi, Amit, National Board for Higher Mathematics, since December 1, 2012 for one year.

Warriyar, Vineetha K.V., Memorial University of Newfoundland, Canada, May 01–August 14, 2013.

Stat-Math Unit, Chennai

Patankar, Vijay M., since July 2011.

Baoulina, Ioulia, since October 10, 2011.

Sebastian, Nicy, since December 10, 2012.

Balakumar, G.P., since December 11, 2013 to till date.

Mohanna, Yusuf, American University of Sharjah, UAE, January 22-28, 2014.

Queffelec, Herve, University of Lille, France, November, 24-December 21, 2013.

Baricz, Arpad, Babes-Bolyai University, Romania, November, 04–08, & March, 15–22, 2014.

Li, Liulan, Hengyang Normal University, China, December, 27-March 23, 2014.

Visiting Scientists, Honours and Awards

Applied Statistics Division

Applied Statistics Unit, Kolkata

Basak, Prasanta, Pennsylvania State University, USA, July 06-28, 2013.

Basak, Indrani, Pennsylvania State University, USA, July 06-28, 2013.

Chakraborty, Tapan, North-Eastern Hill University, Shillong, Maghalaya, January 22–February 12, 2014.

Narayanan, Rajendran, Cornell University, New York, USA, November 06, 2013–January 05, 2014.

Patra, Arpita, University of Bristol, UK, January 01-December 31, 2014.

Bayesian and Interdisciplinary Research Unit

Chen, Chun Houh, Institute of Statistical Science, Academia Sinica, Taiwan, February 14–15, 2014.

Dutta, Ganesh, Jadavpur University, May 13–31, 2013.

Ghosh, Malay, University of Florida, USA, July 01–31, 2013.

Mandal, Abhijit, RIKEN Brain Science Institute, Hirosawa, Wako, Japan, May 01, 2013–March 31, 2014.

Paige, Robert L, Missouri University of Science and Technology, USA, June 03– 7, 2013.

Shmueli, Galit, Indian School of Business, Hyderabad, June 19–20, 2013.

Applied Statistics Unit, Chennai

Diaconis, Persi, Stanford University, USA, December 19-20, 2013.

Fatima, Anisha, P., April 01- August 16, 2013.

Ganguly, Ayon, Indian Institute of Technology, Kanpur, April 30-September 20, 2013.

Paul, Debashis, University of California at Davis, USA, August 18-21, 2013.

Applied and Official Statistics Unit, North-East Centre, Tezpur

Bhattacharjee, Sushant K., Rajshahi University, Bangladesh, since November 21, 2012-July 31, 2013.

Computer and Communication Sciences Division

Advanced Computing and Microelectronics Unit

Basu, Arindam, School of Electrical and Electronic Engineering, Nanyang Technology University,

Singapore, July 01–December 31, 2013.

Bint, Gregory, Computer Science of Carleton University, Canada, January 01–March 31, 2014)

Chakraborty, Goutam, Department of Software & Information Science, Iwate Prefectural University, Takizawa, Japan, August 22–September 09, 2013.

Chakrabarty, Krishnendu, Department of Electrical and Computer Engineering, Duke University, Durham, USA, July 19–August 14, 2013.

De, Pradipta, Department of Computer Science, SUNY, Korea, January 01–31, 2014.

Jayaraman, Bharat, Department of Computer Science, SUNY, Buffalo, USA, March 23–March 27, 2014.

Paul, Subhabrata, Department of Mathematics, Indian Institute of Technology, Delhi, March 01, 2013–April, 2014.

Computer Vision and Pattern Recognition Unit

Shivakumar, P., University of Malay, Malaysia, July 11-28, 2013.

Ballester, Miguel Ángel Ferrer, Universidad de Las Palmas de Gran Canaria, Spain, March 09-16, 2014.

Tian, S., National University of Singapore, Singapore, November 29–December 06, 2013.

Electronics and Communication Sciences Unit

Chung, I-Fang, Institute of Biomedical Informatics, National Yang-Ming University, Taipei, Taiwan, Republic of China, March 05-26, 2014

Dutta, H.N., National Physical Laboratory, New Delhi, March 12-16, and September 20-28, 2013.

Mukherjee, Snehasis, National Institute of Standards and Technology, Maryland, USA, March 18-31, 2014.

Machine Intelligence Unit

Aparajeeta, Jeetashree, Siksha O Anusandhan University, Odisha, March 03-31, 2014.

Chakraborty, Basabi, Iwate Prefectural University, Japan, August 22- September 09, 2013.

Chakraborty, Chiranjib, Department of Bio-informatics, School of Computer and Information Sciences, Galgotias University, Greater Noida, Uttar Pradesh, March 12-21, 2014.

Narayanan, P.J., Indian Institute of Technology, Hyderabad, March 30–till April 01, 2014.

Documentation, Research and Training Centre, Bangalore

Altangerel, Chagnaa, School of Information Technology, National University of Mongolia, Mongolia, November 17-22, 2013.

Visiting Scientists, Honours and Awards

Amin, Saiful, Library Systems Specialists, Semantic Consulting Services Pvt, Ltd, Bangalore, August 01 2013-March 31 2014.

Asundi A.Y, Bangalore University, Bangalore, August 01-December 31 2013.

Chatterjee Amitabha, Department of Library and Information Science, Jadavpur University, Kolkata, November 07-December 6, 2013.

Oh, Dong-Geun, School of Library and Information Science, Kei-Myung University, Daegn, South Korea, August 21, 2013.

Rath, Pravakar, Dept. of Lib. & Inf. Sc., Mizoram University, Aizwal, July 30 2013-August1, 2013.

Sangam S.L, Karnataka University, Dharwad, Karnataka, September -December 31, 2013.

Satija M.P., Department of Library and Information Science, Guru Nanak Dev University, Amritsar, November 05-December 04, 2013.

Sonwane,Shashank S, Department of Library and Information Science, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, October 21-November 01, 2013.

Systems Science and Informatics Unit, Bangalore

Pinnamaneni, Bhanu Prasad, Matrix Vision, Germany, November 08-10, 2013.

Bruzzzone, Lorenzo, University of Trento, Italy, January 26-28, 2014.

Bovolo, Francesca, University of Trento, Italy, January 26-28, 2014.

Cheng, Qiuming, York University, Canada, February 09-10, 2014.

Bringer, Yves, University Jean Monnet, France, March 01-05, 2014.

Computer Science Unit, Chennai

De, Subhadeep, National Physical Laboratory, New Delhi, December 01-31, 2013.

Kumar, Sanjeev, Indian Institute of Science Education and Research, Mohali, December 01-31, 2013.

Sekar, Gautham, Visiting Scientist, since May 02, 2012 to till date.

Wang, Yanjing, Peking University, China, September 17-November 28, 2013.

Physics and Earth Sciences Division

Geological Studies Unit

Makovicky, Peter J., Field Museum of Natural History, Chicago, USA, June 17–19, 2013.

Visiting Scientists, Honours and Awards

Ravelson, Miky, Lova University of Antananarivo, Tananarive, Madagascar, July 11–15, 2013.

Wilson, Jeffrey, Archer University of Michigan, USA, March 10-14, 2014.

Physics and Applied Mathematics Unit

Venkateshan, S.K., TNQ Books and Journals, Chennai, May 07–17, 2013.

Choudhary, S., University of Durban, South Africa, May 27–July 26, 2013.

Midya, Bikashkali, Universite libre de Bruxelles, Brussels, Belgium, June 01–July 31, 2013.

Chatterjee, Sujit, Post Doc. Fellow at Harish Chandra Research Institute, Allahabad, July 22–August 04, 2013.

Chakrabarti, Alope, Department of Mathematics, Indian Institute of Sciences, Bangalore, May 31–03, 2013 and November 12–16, 2013.

Jha, Sanjeev, University of New South Walls, Sydney, Australia, December 22–25, 2013.

Abraham, Ralph, University of California, Santa Cruz, USA, February 10-14, 2014.

Braun, Hans, University of Marburg, Germany, March 13-17, 2014.

Kaligatla, R., Department of Mathematics, Indian Institute of Technology, Chennai, February 01–28, 2014.

Biological Sciences Division

Agricultural & Ecological Research Unit

Fuwa, Nobu Hiko, Waseda University, Japan, December 04–24, 2013.

Biological and Anthropology Unit

Jesani, Amar, Indian Journal of Medical Ethics, Mumbai, January 09, 2014.

Das, Ketaki, West Bebgal Voluntary Health Association, Kolkata, March 28, 2014.

Social Sciences Division

Economic Research Unit

Bag, Parimal Kanti, Department of Economics, National University of Singapore, Singapore, December 04, 2013–January 03, 2014.

Chakraborty, Bikas K., Centre for Applied Mathematics & Computational Science, Saha Institute of Nuclear Physics, Kolkata, since August, 2013-till date.

Visiting Scientists, Honours and Awards

Chatterjee, Kalyan, Department of Economics, Pennsylvania State University, University Park, Pennsylvania, USA, June 03-24, 2013.

Chattopadhyay, Srobonti, Indian Institute of Management, Calcutta, July 01- August 30, 2013.

Dasgupta, Swapan, Department of Economics, Dalhousie University, Canada, September 16–December 16, 2013.

De, Utpal Kumar, Department of Economics, North Eastern Hill University, Shillong, Meghalaya, December 20, 2013-February 10, 2014.

Isola, Osowole Oyedeji, Department of Statistics, University of Ibadan, Nigeria, May 01–October 30, 2013.

Maiti, Pradip, Economic Research Unit (superannuated), Kolkata, July 01–December 31, 2013.

Mutuswami, Suresh, Department of Economics, University of Leicester, University Road, Leicester, UK, January 02-07, 2014.

Ghosh, Arghya, School of Economics, Australian School of Business, University of New South Wales, Sydney, Australia, January 27–February 17, 2014.

Sinha, Bhanu, Uday, Department of Economics, Delhi School of Economics, University of Delhi, New Delhi, March 10-18, 2014.

Sen, Debapriya, Department of Economics, Ryerson University, Toronto, Canada, since November 01, 2012–August 31, 2013.

Sengupta, Sarbajit, Department of Economics, Visva Bharati University, Santiniketan, since January 01-June 30, 2013.

Roychoudhury, Saurav, School of Management, Capital University, Columbus, USA, September 01, 2013–till May 31, 2014.

Linguistic Research Unit

Bayer, Josef, University of Konstanz, Germany, February 19-28, 2014.

Das, Debopam, Simon Fraser University, Canada, August 28-30, 2013.

Ghosh, Rajat, Majan University College, Oman, August 12, 2013.

Majumder, Tapas, Cognizant Technology Solutions India, September 20, 2013.

Saha, Jay, Jawaharlal Nehru University, New Delhi, September 09-10, 2013.

Sahay, Poonam, Ranchi University, Jharkhand, September 30–October 01, 2013.

Psychology Research Unit

Coulacoglou, Carina, Greece, January 15, 2014.

Chatterjee, Susmita, Globsyn Business School, Kolkata, September 07, October 25, and November 01, 2013.

Sampling and Official Statistics Unit

Sarkar, Amitava, West Bengal University of Technology, Kolkata, since July 16, 2012-September 30, 2013.

Husain, Zakir, Population Research Centre, University of Delhi, New Delhi, since October 26, 2012-April 24, 2013.

Kumar, Sunil, University of Jammu, Jammu & Kashmir, since September 01, 2012-May 28, 2013.

Kar, Aloke, Statistical Institute for Asia & Pacific (SIAP), Chiba, Japan, since March 01, 2014-till date..

Economics and Planning Unit, Delhi

Balakrishnan, Pulapre, Centre for Development Studies, Thiruvananthapuram, Kerala, January 01-till May 31, 2014.

Barua, Rashmi, Singapore Management University, Singapore, March 01–till April 30, 2014.

Bhattacharya, Sourav, University of Pittsburg, USA, August 01–03, 2013.

Chakrabarti, Rajesh, July 22-November 30, 2013.

Chand, Srustidhar, University of Venice, Italy, September 01-30, 2013, October 01-31, 2013, and November 01, 2013–March 31, 2014.

Dasgupta, Aparajita, Population Council, New Delhi, November 29, 2013.

De, Sankar, Shiv Nadar University, Noida, Uttar Pradesh, October 11, 2013

Deb, Rahul, University of Toronto, Canada, August 08–September 4, 2013.

Dhasmana, Anubha, Indian Institute of Management, Bangalore, September 13, 2013

Dhillon, Amrita, University of Warwick, London, UK, Aug 08-31, 2013.

Dimitrov, Dinko, Saarland University, Germany, February 21, 2014

Dubey, Pradeep, Stony Brook University, USA, October 25, 2013

Ghatak, Maitreesh, London School of Economics, London, UK, December 18-20, 2013.

Ghosh, Parikshit, Delhi School of Economics, New Delhi, March 28, 2014

Guha, Brishti, Singapore Management University, Singapore, December 16, 2013

Hammer, Jeffrey, Princeton University, USA, January 17, 2014

Kapoor, Mudit, Indian School of Business, Hyderabad, October 18, 2013

Visiting Scientists, Honours and Awards

Khemani, Stuti, World Bank, USA, 20th August, 2013

Kletzer, Kenneth, University of California, Santa Cruz, USA, February 09–21, 2014.

Lahkar, Ratul, Institute for Financial Management and Research, Chennai, June 06, 2013

Libois, Francois, University of Namur, Belgium, November 13-20, 2013.

Mace, Antonin, Ecoe Polytechnique, Paris, France, November 25–December 22, 2013.

Majumdar, Dipjyoti, Concordia University, Canada, April 05, 2013

Moffatt, Peter G., University of East Anglia, Norwich, England, UK, April 15-18, 2014.

Nath, Swaprava, Indian Institute of Science, Bangalore, September 01, 2013-till August 01, 2014.

Paul, Anand, Oxford University, UK, November 01 – December 23, 2013.

Prakash, Nishith, University of Connecticut, USA, August 02, 2013

Prakash, Nishith, Fairfield Way, University of Connecticut, USA, July 29- August 11, 2013.

Ranjan, Abhishek, Universite Paris, France, September 27, 2013

Raut, Lakshmi K., Social Security Administration, USA, December 13, 2013

Sane, Renuka, Indira Gandhi Institute of Development Research, Mumbai, July 01, 2013–till June 30, 2014.

Saran, Rene, Yale University, Singapore, March 31-till April 05, 2014.

Sen, Ananya, University of Toulouse, France, August 27, 2013

Singh, Gurbachan, Independent Economist, January 01-till April 30, 2014.

Somanathan, Rohini, Delhi School of Economics, New Delhi, since August 30, 2012-till date.

Sudarshan, Anant, Harvard University, USA, January 24, 2014

Vohra, Rajeev, Brown University, USA, July 03–August 09, 2013

Wadhwa, Wilima, Annual Status of Education Report Centre, New Delhi, July 22–November 30, 2013.

Yamazaki, Koji, Kobe University, Japan, September 12, 2013–February 10, 2014.

Economic Analysis Unit, Bangalore

Guo, Yanqing, Shanghai University of Finance and Economics, China, January 12–February 27, 2014.

Mathew, Shalina, University of Hyderabad, October 01, 2013–March 31, 2014.

Mori, Yuko, Hitotsubashi University, Japan, March 01–06, 2014.

Motiram, Sripad, Indira Gandhi Institute of Development Research, Mumbai, March 09-18, 2014.

Okabe, Jun-ichi, Yokohama National University, Japan, November 01–09, 2013.

Shindo, Junko, Shanghai University of Finance and Economics, China, March 21–29, 2014.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Delhi

Raghavan, T.E.S., University of Illinois at Chicago, USA, February 20–24, 2014

Sinha, Sagnik, Jadavpur University, Kolkata, March 27–31, 2014

Center for Soft Computing Research: A National Facility

Batens, Diderik, Centre for Logic and Philosophy of Science, University of Ghent, Belgium, February 13-17, 2014.

Beziau,,Jean-Yves, Federal University of Rio de Janeiro, Brazilian Research Council and Brazilian Academy of Philosophy, Brazil, February 13-17, 2014.

Brown, Bryson, University of Lethbridge, Canada, February 13-17, 2014.

Chaudhury, Santanu, Indian Institute of Technology, Delhi, December 09-14, 2013.

Cho, Sung-Bae, Yonsei University, Korea, December 11-13, 2013.

Dasgupta, Dipankar, Univesity of Memphis, USA, December 12, 2013.

De, Ronde, Christian, University of Buenos Aires, CONICET, Argentina and Center Leo Apostel, Belgium, February 13-17, 2014.

Dutta, Soma, Institute of Mathematical Sciences, Chennai, February 13-17, 2014.

El - Baz, Ali Hassan, University of Damietta, Egypt, since March 01, 2014 - till date.

Ganguly, Niloy, Indian Institute of Technology, Kharagpur, December 10-14, 2013.

Girolami, M.A. University College London, London, December 09-15, 2013.

Hashimoto, Ronaldo Fumio, University of Sao Paulo, Brazil, October 02-05, 2013.

Henuen, Chris, University of Oxford, UK, February 13-17, 2014.

Kuznetsov, Sergei, Higher School of Economics, Moscow, December 09-15, 2013.

Martins Jr., David Correa, University of Sao Paulo, Brazil, August 31-September 02, 2013.

Perciano, Talita, University of Sao Paulo, Brazil, August 31-September 02, 2013.

Visiting Scientists, Honours and Awards

Pietruszczak, Andrzej, Nicolaus Copernicus University, Torun, Poland, February 13-17, 2014.

Priest, Graham, City University of New York, USA, University of Melbourne, Australia and University of St Andrews, Scotland, February 13-17, 2014.

Rodriguez, Rosario Medina, University of Sao Paulo, Brazil, October 02-05, 2013.

Saha, Punam Kumar, University of Iowa, USA, December 10-15, 2013.

Sinha, Sitabhra, Institute of Mathematical Sciences, Chennai, India, December 10-14, 2013.

Skowron, Andrzej, University of Warsaw, Poland, December 09-14, 2013.

Slezak, Dominik, University of Warsaw, Poland, July 10, 2013 & December 12-14, 2013.

Udupa, Jayram, University of Pennsylvania, USA, December 08-15, 2013.

HONOURS AND AWARDS

Ghosh, J.K.

Awarded: Padma Shri (Science and Engineering), Government of India, 2014.

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Gupta, Neena

Selected: Associate, Indian Academy of Science, 2013-2018;

Awarded: Saraswathi Cowsik Medal (Outstanding Paper), Tata Institute of Fundamental Research, 2013 and
INSA Medal (Young Scientist), 2014.

Stat-Math Unit, Delhi

Jain, Tanvi

Awarded: SERB Women Excellence Award, Science and Engineering Research Board (SERB),
Department of Science & Technology.

Applied Statistics Division

Applied Statistics Unit, Kolkata

Kattumannil, S.K.

Awarded: Indo-US Research Fellowship, Science and Engineering Research Board,
DST, Govt. of India and Indo-US Science & Technology Forum.

Computer and Communication Sciences Division

Electronics and Communication Sciences Unit

Pal, Nikhil Ranjan

Elected: Vice President (Publications), IEEE Computational Intelligence Society, USA,
since January 2013.

Machine Intelligence Unit

Mitra, Sushmita

Selected: IEEE CIS Distinguished Lecturer, 2014-2016.

Bandyopadhyay, Sanghamitra

Member: Education Commission of West Bengal, 2013-2014;

Fellow (by invitation), Institution of Electronics and Telecommunications Engineers, 2013 and
Senior Associate, International Centre for Theoretical Physics, Trieste, Italy, 2013.

Awarded: Best Paper Award, 2nd International Conference on Recent Advances in Computational
Systems (RAICS), IEEE 2013.

Ghosh, Kuntal

Awarded: Certificate of Recognition (Project Guide of a student project selected as a gold medal
winner in the Initiative for Research and Innovation in Science), Confederation of Indian
Industry (CII) and Department of Science & Technology, Govt. of India, 2014.

Documentation, Research and Training Centre, Bangalore

Dutta, Biswanath

Awarded: Best Paper Award, International Academy, Research and Industry Association, 2013;
Best Paper Award, International Society for Knowledge Organization, UK, 2013 and
World Library Leaders Promising Professional Award 2013, Satija Research Foundation in
Library and Information Science, 2013.

Computer Science Unit, Chennai

Ghosh, Sujata.

Awarded: Best Paper Award (With Nils Bulling & Rineke Verbrugge), 16th International Conference on
Principles and Practices of Multi-Agent Systems (PRIMA 2013).

Physics and Earth Sciences Division

Geological Studies Unit

Saha, Dilip

Elected: Fellow, West Bengal Academy of Science and Technology.

Das, Shiladri Shekhar

Visiting Scientists, Honours and Awards

Awarded: Sharada Chandra Gold Medal (Best Indian paper by the Paleontological Society of India), Lucknow, 2013.

Physics & Applied Mathematics Unit

Ghosh, Subir

Awarded : Associateship, Third World Academy of Sciences (TWAS)-UNESCO, 2012-2015.

Social Sciences Division

Economic Research Unit

Chakravarty, Satya R.

Awarded: Consultant, Asian Development Bank, Manila, Philippines, 2013.

Maiti, Pulakesh

Awarded: Leading Scientists of the World, the International Biographical Centre, 2013.

Mitra, Manipushpak

Awarded: Mahalanobis Memorial Medal, the Indian Econometric Society, 2012.

Sarkar, Abhirup

Nominated: Chairman, Fourth Finance Commission, West Bengal, 2014.

Economics and Planning Unit, Delhi

Ghate, Chetan

Appointed: Member, Expert Committee (Revise and Strengthen the Monetary Policy Framework), Reserve Bank of India and
Member, Technical Advisory Committee (Monetary Policy), Reserve Bank of India.

Economic Analysis Unit, Bangalore

Mathew, Shalina,

Awarded: Labour Economics Award (Young South Asian Scholars), South Asia Research Network (SARNET), 2013.

Rajashekara, H.M.

Selected: Member of Technical Advisory Committee, Central University of Karnataka, Gulbarga.

Ramachandran, V. K.

Awarded: Indian Council of Social Science Research National Fellowship, 2013-2015.

Center for Soft Computing Research: A National Facility

Pal, S.K.

Selected: Chair Professor, Indian National Academy of Engineering.

Awarded: Diamond Jubilee Medal, Institution of Electronics and Telecom Engineers, India and Golden Jubilee Medal, IEEE, USA.

R.C. Bose Center for Cryptology and Security

Paul, Goutam

Awarded: Young Scientist Platinum Jubilee Award, National Academy of Sciences, India, 2013.

8. EDITORIAL AND OTHER SCIENTIFIC ASSIGNMENTS

EDITORIAL ASSIGNMENTS

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Bose, Arup (Associate Editor): *Statistical Methodology, Indian Journal of Pure and Applied Mathematics, Statistics and Probability Letters.*

Chaudhuri, Probal (Editor): *International Statistical Review and STAT*; (Associate Editor): *Statistical Methodology and Advances in Statistical Analysis.*

Stat-Math Unit, Delhi

Bhatia, Rajendra (Senior Editor): *Linear Algebra and Its Applications*; (Editor): *Operators and Matrices; Journal of Ramanujan Mathematical Society*; (Managing Editor): *Texts and Readings in Mathematics; Culture and History of Mathematics*; (Correspondent): *Mathematical Intelligencer.*

Bhatt, Abhay Gopal (Co-editor): *Sankhya.*

Dewan, Isha (Associate Editor): *Computational Statistics and Data Analysis; Journal of Indian Statistical Association*; (Editor): *Special issue of JISA in honor of Prof Deshpande's 70th birthday*; Associate Editor - *CSDA and JISA.*

Stat-Math Unit, Bangalore

Bhat, B.V. Rajarama (Chief Editor): *Proceedings of the Indian Academy of Sciences, Mathematics.*

Ramasubramanian, S.: (Associate Editor): *Sankhya, Series A, Volume 75, 2013, Indian Statistical Institute.*

Rao, T.S.S.R.K.: (Lead Guest Editor): *Geometry of Function spaces, Journal of Function spaces and applications, 2013.*

Sastry, N.S.N: (Editor, Groups of Exceptional type): *Coxeter Groups and Related Geometries, Volume 82, 2014, Springer Proceedings in Mathematics and Statistics.*

Sury, B.: (Editor): *Ramanujan Mathematical Society Mathematics Newsletter, RMS; Resonance, Journal of science education published by the Indian Academy of Sciences.*

Stat-Math Unit, Chennai

Ponnusamy, S. (Editor-In-Chief): *Mathematics Newsletter, Ramanujan Mathematical Society*; (Managing Editor): *Journal of Analysis*; (Associate Editor): *Bulletin of Malaysian Mathematical Sciences Society.*

Applied Statistics Division

Applied Statistics Unit

Biswas, Atanu (Editor): *Sankhya Series B*, since 2012; (Associate Editor): *Statistics and Probability Letters*, Elsevier, since July 2011; *Sequential Analysis*, Taylor and Francis, since June 2003; *Communications in Statistics, Theory and Methods*, Taylor and Francis, since January 2007; *Communications in Statistics, Simulation and Computation*, Taylor and Francis, since January 2007; *Sri Lankan Journal of Applied Statistics*, since January 2013.

Dewanji, Anup (Associate Editor): *Journal of Statistical Planning and Inference*, Elsevier.

SenGupta, Ashis (Editor-in-Chief): *Environmental and Ecological Statistics*, Springer, USA, 2013; (Editor): *Scientiae Mathematicae Japonicae*, Japanese Association of Mathematical Sciences (JAMS), Japan, 2013; (Associate Editor): *Journal of Statistics and Applications* 2013; *Journal of Indian Statistical Association*, India, 2013.

Computer and Communication Sciences Division

Advanced Computing and Microelectronics Unit

Bhattacharya, B.B. (Editor): *Journal of Electronic Testing: Theory and Applications*, Springer.

Sur-Kolay, S. (Associate Editor): *ACM Transactions on Embedded Computing Systems*.

Computer Vision and Pattern Recognition Unit

Chaudhuri B.B.(Associate Editor): *International Journal of Pattern Recognition and Artificial Intelligence*; *International Journal of Computer Vision*; *International Journal of Document Analysis*; *IETE Technical Review*; *Electronic Letters on Computer Vision and Image Analysis*; *CSI Journal of Computing*; (Guest Editor): *Frontiers in Handwriting Processing*.

Bhattacharya, U., (Guest Editor): *Frontiers in Handwriting Processing*.

Garain Utpal (Technical Committee Chair): *Int. Association for Pattern Recognition (IAPR)*, Technical Committee on Computational Forensics (TC-6); (Associate Editor): *International Journal on Document Analysis and Recognition (IJ DAR)*, Springer.

Pal, Umapada (Associate Editor): *ACM Transactions on Asian Language Information Processing*, ACM; *Electronic Journal on Computer Vision and Image Analysis*, CVC Press; *Pattern Recognition Letters*, Elsevier.

Electronics and Communication Sciences Unit

Chanda, Bhabatosh (Area Editor): *IETE Journal of Education for the areas of Image Processing, Pattern Recognition, Computer Vision and Artificial Intelligence*, since 2013; (Member for the Editorial Advisory Board): *Mathematical Morphology (MM) Journal*, since 2013.

Das, Swagatam (Founding Co Editor-in-Chief): *Swarm and Evolutionary Computing*, Elsevier Journal; (Associate Editor): *IEEE Transactions on Systems, Man, and Cybernetics: Systems*; *IEEE*

Editorial and other Assignments

Computational Intelligence Magazine; *IEEE Access*: *Neurocomputing*, Elsevier; *Information Sciences*, Elsevier; (Editor): *Engineering Application of Artificial Intelligence*, Elsevier; (Editorial Board Member): *Progress in Artificial Intelligence*, Springer; *International Journal of Artificial Intelligence and Soft Computing*; *International Journal of Autonomous and Adaptive Communications Systems*.

Mukherjee, D.P.: *ISRN Machine Vision Open Access Journal*, since 2010.

Pal, N.R. (Associate Editor): *IEEE Transactions on Fuzzy Systems*, since January 2011; *IEEE Transactions on Systems, Man and Cybernetics–Part B (now CYB)*, since 2001; *International Journal of Approximate Reasoning*, since June 1993.

Machine Intelligence Unit

Bandyopadhyay, S. (Associate Editor): *IEEE Transactions on Systems, Man and Cybernetics, Systems*; *Sadhana*, Springer.

Ghosh, A. (Associate Editor): *IET-Computer Vision*.

Mitra, S. (Associate Editor): *IEEE/ACM Trans. On Computational Biology and Bioinformatics (IEEE TCBB)*, 2010-14; *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery (WIRE DMKD)*, 2008-2014; *Information Sciences*, 2013-2014; *Neurocomputing*, 2005-2014; *Journal of Computational Intelligence in Bioinformatics (JCIB)*, 2005-2014.

Documentation Research and Training Centre, Bangalore

Biswanath Dutta (Editor): *Proceedings of the International Conference on Knowledge Modelling and Knowledge Management*, 2013.

Devika P. Madalli (Editor): *Proceedings of the International Conference on Knowledge Modelling and Knowledge Management*, 2013.

Systems Science and Informatics Unit, Bangalore

Meher, S.K. (Guest Editor): *Applied Soft Computing*, 2013; (Guest Editor): *Pattern Recognition Letters*, 2014.

Sagar, B.S.D. (Editor): *Discrete Dynamics in Nature and Society (DDNS)*, Since 2003; (Member Editorial Advisory Board): *Computers & Geosciences*, ISSN: 0098-3004, Since 2014, Elsevier Publishers.

Physics and Earth Sciences Division

Geological Studies Unit

Saha, Dilip (Editor): *Indian Journal of Geology*.

Chakraborty, Tapan (Guest Editors): *Tropical Rivers of the Indian subcontinent and South East Asia: Landscape evolution, morphodynamics and hazards*, 2013

Physics and Applied Mathematics Unit

Maiti, Santanu Kumar, (Associate Editor): *International Journal in Theoretical Science*, America Scientific Publishers, USA.

Mandal, B. N. (Chief Editor): *OPSEARCH*, Journal of the Operational Research Society of India, Springer.

Roy, Sisir (Editor): *Frontiers in Physics*, Switzerland.

Biological Sciences Division

Biological and Anthropology Unit

Mukhopadhyay, B. (Associate Editor): *Journal of Indian Anthropological Society*, 2012; Official publication of Indian Anthropological Society.

Roy, S.K. (Associate Editor): *The Anthropologist*, International Journal of Contemporary and Applied Studies of Man, Kamla Raj Enterprises.

Social Sciences Division

Economics Research Unit

Chakravarty, Satya R. (Associate Editor): *Social Choice and Welfare*, 2013, Springer Verlag; (Co-Editor): *Economics E-Journal*, 2013, Kiel Institute of the World Economy, Germany; (Member, Advisory Board): *Book Series Economic Studies in Inequality*, Springer-Verlag.

Linguistic Research Unit

Dasgupta, Probal: (Editor): *Language Problems and Language Planning*, Amsterdam: Benjamins.

Psychology Research Unit

Dutta Roy, D. (Editor-in-chief): *Psybernews*, since 2010.

Sampling and Official Statistics Unit

Mukherjee, Diganta (Guest Editor): *Studies in Microeconomics*, Sage.

Pathak, Prasanta (Assistant Editor): *Indian Journal of Regional Science*, since 2004.

Sociological Research Unit

Jana, Rabindranath (Statistical Editor): *Indian Journal of Dermatology*, since 2012.

Editorial and other Assignments

Economics and Planning Unit, Delhi

Das Satya.P (Editor): *Indian Growth and Development Review*.

Mishra Debasis (Associate Editor): *Mathematical Social Sciences*, since 2014.

Ray Chowdhury Prabal (Associate Editor): *Indian Growth and Development Review*.

Somanathan, Eswaran (Associate Editor): *Environment and Development Economics*.

Economics Analysis Unit, Bangalore

Ramachandran, V.K. (Editor): *Review of Agrarian Studies*.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Coimbatore

Rajagopal, A. (Editor): *Achieving Breakthrough Quality*.

Library, Documentation and Information Science Division

Library, Kolkata

Pal, Jiban K. (Member, Board of Editors): *Databib World Repository*, since October 2012; (Associate Editor): *International Journal of Digital Library Services (IJODLS)*, ISSN: 2250-1142, Academic Journals, since 2011; *IASLIC Newsletter*, ISSN: 0018-845X, IASLIC, since 2011 up to 2013.

Centre for Soft Computing Research: A National Facility

Ghosh. A. (Associate Editor): *IET-Computer Vision*.

Pal S. K. (Associate Editor): *Information Sciences*, Elsevier; *Fuzzy Sets and Systems*, Elsevier; *Fundamenta Informaticae*, IOS Press; *Applied Intelligence*, Kluwer; *Int. J. Computational Intelligence and Applications*, World Scientific; *IET Image Processing*, IEE Press; *LNCS Trans. on Rough Sets*, Springer; *Journal of Intelligent Information Systems*, Springer; (Editor-in-Chief): *International Journal of Signal Processing, Image Processing and Pattern Recognition*, SERSC; (Executive Advisory Editor): *IEEE Trans. on Fuzzy Systems*, *International Journal of Approximate Reasoning*, and *International Journal of Image and Graphics*; (Guest Editor): *IEEE Systems; Man and Cyberns-A; Pattern Recognition Letters; Fundamenta Informaticae; Theoretical Computer Science: Theory of Natural Computing; Applied Soft Computing; IET Image Processing; Natural Computing*, Springer; (Book Series Editor): *Frontiers in Artificial Intelligence and Applications (FAIA)*, IOS Press; *Statistical Science and Interdisciplinary Research*, World Scientific.

R.C. Bose Centre for Cryptology and Security

Ruj, Sushmita (Associate Editor): *Ad Hoc and Sensor Wireless Networks Journal*.

SCIENTIFIC ASSIGNMENTS/ACADEMIC VISITS ABROAD

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Bose, Arup:

(1) Concordia University, Canada, March 31-April 12; (2) CRM Colloque in Probability, Montreal, April 04, 2013; (3) CRM Colloque in Statistics, Montreal, April 12, 2013; (4) Dept. of Statistics, Michigan State University, US, May 27-29, 2013; (5) Dept. of Biostatistics, University of Louisville, US, May 30-31, 2013; (6) Dept. of Economics, University of Cincinnati, US, June 01-14, 2013; (7) Advanced School and Workshop on Random Matrices and Growth Models. ICTP, Trieste, Italy, September 02-13, 2013; (8) Workshop on Multivariate Analysis and Random Matrices: New Tendencies, CIMAT, Guanajuato, Mexico, September 19-21, 2013; (9) University of Cincinnati, Dept of Economics, US, November 22-December 06; (10) Indiana University--Purdue University, Indianapolis (IUPUI), US, December 07-08; (11) University of Minnesota, US, December 09-19.

Chaudhuri, Probal:

(1) ISI World Statistics Congress, Hong-Kong, August, 2013; (2) Institute of Mathematical Science, National University of Singapore, March, 2014.

Maulik, Krishanu:

2nd IMS-Asia Pacific Rim Meeting, Tokyo, Japan, July 02-04, 2013.

Srivastava, S.M.:

(1) University of Athens, Athens, Greece, September 03-06, 2013; (2) University of Munster, Germany, September 06-October 06, 2013.

Stat-Math Unit, Delhi

Bandyopadhyay, Antar:

(1) University of California in Berkeley, USA, September 01, 2013-May 31, 2014; (2) 17th INFORMS Applied Probability Society Conference, San Jose, Costa Rica, July 15-19, 2013.

Bapat, R. B. :

(1) 17th Conference of the International Linear Algebra Society at Providence, Rhode Island, USA, June 03-07, 2013; (2) Southeast University, Nanjing, China, July 20-22, 2013; (3) Chiao Tung University, Hsinchu, Taiwan, November 18-22, 2013, Plenary Speaker; (4) IBM T. J. Watson Research Center, Yorktown Heights, New York, USA, December 02-06, 2013.

Bhatia, Rajendra:

(1) University of Manchester, UK, April 08-17 2013; (2) Institute of Computer Science, Czech Academy of Sciences, Prague, June 02-12; (3) INRIA, Paris, June 13-28; (4) International Centre for Theoretical Physics, Trieste, July 01-12; (5) Sungkukwan University, Suwon, Korea, November 01-30; (6) Kyushu University, Fukuoka, Japan, November 13-14.

Editorial and other Assignments

Chatterjee, Arindam:

Department of Statistics and Mathematics, Univ. of Paris X, France, November 28, 2013-January 24, 2014.

Dewan, Isha:

(1) Department of Statistics, University of Hongkong, Hong Kong, August 26-September 06, 2013; (2) Statistical Analysis of Competing Risks with Missing Causes of Failure, World Statistics Congress, Hongkong, August 25-31, 2013.

Jain, Tanvi:

Advanced School and Workshop in Matrix Geometries held at ICTP Trieste, Italy, July 01-12, 2013, gave a talk in the workshop in addition to taking tutorial sessions.

Laishram, Shanta:

(1) University of Bristol, UK, May 20-25, 2013; (2) Rational Points-Geometric, Analytic and Explicit Approaches, University of Warwick, UK, May 27-31, 2013; (3) UNESCO-CIMPA School on Algebraic Curves at University of Philippines, Manila, July 22-August 03, 2013; (4) 17th Workshop on Elliptic Curve Cryptography(ECC), KULeuven, Leuven, Belgium, September 16-18, 2013; (5) University of York, UK, September 18-21, 2013; (6) University of Bordeaux, France, September 22-12 October, 2013; (7) UNAM, Morelia, Mexico, December 01-31, 2013.

Roy, Rahul:

(1) University of Waterloo, Canada, May 14-June 05, 2013; (2) CIMAT, Mexico, June 06-July 05, 2013; (3) Laboratoire MAPS, Université Paris Descartes, Paris, France, August 19-30, 2013, meeting and discussion; (4) Centro de Investigación en Matemáticas, A.C. (CIMAT), Mexico, March 03-31, 2014.

Sarkar, Anish:

(1) UFR de Mathématiques, Université des Sciences et Technologies, Lille, June 09-23, 2013; (2) UV University, Amsterdam, August 26-September 15, 2013.

Sarkar, Deepayan:

69th Deming Conference on Applied Statistics, Atlantic City, NJ, USA, NY, USA, December 02-13, 2013.

Stat-Math Unit, Bangalore

Athreya, Siva:

(1) University of Duisburg-Essen, Germany, July 01-12, 2013; (2) Hokkaido University, Sapporo, Japan, August 05-10, 2013; (3) National University of Singapore, Singapore, November 18-22, 2013; (4) NZ Probability Workshop, University of Auckland, New Zealand, January 06-10, 2014.

Bhat, Rajarama B.V.:

(1) 34th International conference on Quantum Probability and Related Fields, Steklov Mathematical Institute of Russian Academy of Sciences, Moscow, Russia, September 16-20, 2013; (2) School of Mathematical Sciences of the University of College Cork, Ireland, November 17-28, 2013.

Gorai, Sushil:

Winter School in Complex Analysis and Complex Geometry, KAWA-NORDAN, CIRM, Marseille, France, March 24-29, 2014.

Kumar, Manish:

Conference on Arithmetic Geometry, Banach Center of the University of Warsaw, Poland, July 15-21, 2013.

Raja, C.R.E.:

(1) Universitat Paderborn, Germany October 01-November 30, 2013 & March 04-16, 2014; (2) Caprace, UCL, Belgium, March 17-18, 2014.

Rajeev, B.:

(1) Freiburg, Germany, May 21–25, 2013; (2) Math Department, Strasbourg University (Michel Emery), Strasbourg, France, May 26–June 06, 2013 & February 17–19, 2014; (3) Oslo University (Bernt Oksendal), Oslo, Norway, June 06–08, 2013 and February 19-21, 2014; (4) Caadi Ayyad University (Youssef Ouknine), Marrakesh, Morocco, February 03-17, 2014.

Sarkar, Jaydeb:

(1) Fudan University, Shanghai, China, July 08-10, 2013; (2) Special session on Operator Theory and Function Spaces, Alba Iulia, Romania, June 24-July 01, 2013; (3) Bolyai Institute, University of Szeged, Hungary, June, 2013.

Sreekantan, Ramesh:

(1) University of Alberta, Canada, June 03-22, 2013; (2) Pan Asian Number Theory conference, Hanoi, Vietnam, July 22-26, 2013.

Sury, B.:

(1) Banff Centre, Canada, April 12-19, 2013; (2) University of Toronto, Canada, April 22-30, 2013.

Stat-Math Unit, Chennai

Ponnusamy, S.:

(1) University Groningen, Netherlands, Netherland, September, 14-19, 2013; (2) Hengyang Normal University, Hunan, China, May 31-June 15, 2013.

Applied Statistics Division

Applied Statistics Unit, Kolkata

Atanu Biswas:

(1) 10th International Workshop on Model-Oriented Data Analysis and Optimum Design (MoDa 10), Łagów Lubuski, Poland, June 10–14, 2013; (2) First International Conference on Information, Operations Management and Statistics (ICIOMS 2013), Kuala Lumpur, Malaysia, September 01-03, 2013; (3) University of Malaya, Kuala Lumpur, Malaysia, September 01-04, 2013; (4) National Chengchi University, Taipei, Taiwan, December 12-19, 2013.

Bose, Mausumi:

59th World Statistics Congress, Hong Kong, August 25-30, 2013.

Chakraborty, Arnab:

Pennsylvania State University, University Park, PA, USA, May 19--June 30, 2013.

Dewanji, Anup:

(1) 59th World Statistics Congress, Hong Kong, August 25-30, 2013; (2) Fred Hutchinson Cancer Research Center, Seattle, USA, June 05-July 17, 2013.

Pal Choudhury, Pabitra:

(1) Automatic Control Lab, ETH Zurich, Switzerland, May 14-28, 2013; (2) Dept. of Mathematics and Computer Science, Claflin University, USA, June 03-05, 2013; (3) Dept. of Bio-Chemistry, Virginia Tech, Blacksburg, VA, USA, June 17-20, 2013; (4) Dept. of Computer Science, Arizona State

Editorial and other Assignments

University, USA, June 27-28, 2013 (5) Biology Division, Argonne National Laboratory, Chicago, USA, July 07-08, 2013.

Sen Gupta, Ashis:

(1) Department of Statistics, University of California, Riverside, USA, January 01–March 31, 2014; (2) University of Malaya, Kuala Lumpur, Malaysia, June 10-20, 2013; (3) Keio University, Tokyo, Japan, June 20–July 04, 2013; (4) Institute of Statistical Mathematics, Tokyo, Japan, January 13-16, 2014; (5) International Workshop On Advances and Applications in Distribution Theory, Institute of Statistical Mathematics, Tokyo, Japan, January 14, 2014; (6) Georgia Regents University, Georgia, USA, March 20-21, 2014.

Bayesian Interdisciplinary Research Unit

Basu, Ayanendranath:

International Conference on Robust Statistics (ICORS 2013), St. Petersburg, Russia, July 08-12, 2013.

Bose, Smarajit:

First International Conference on Information, Operations Management and Statistics (ICIOMS 2013), Kuala Lumpur, Malaysia, September 01-03, 2013.

Pal, Amita:

(1) First International Conference on Information, Operations Management and Statistics (ICIOMS 2013), Kuala Lumpur, Malaysia, September 01-03, 2013; (2) University of Maryland, College Park, MD, USA, May 14-17, 2013.

SahaRay, Rita:

Department of Mathematics and Computer Science, Southwestern University, USA, October 18-20, 2013.

Applied Statistics Unit, Chennai

Kattumannil, S.K.:

Michigan State University, USA, January-December 2014.

Sen, R.:

(1) Second Workshop on Industry & Practices for Forecasting, EDF, Paris, June 05-07, 2013; (2) National University of Singapore, Singapore, March 24-28, 2014.

Applied and Official Statistics Unit, North-East Centre, Tezpur

Bhattacharjee, Sushant K.:

Rajshahi University, Bangladesh, April 01-July 31, 2013.

Computer and Communication Sciences Division

Advanced Computing and Microelectronics Unit

Banerjee, A.:

(1) Stanford University, US, July, 2013; (2) IEEE Cloud conference, California, USA, June 27 - July 02,

2013; (3) State University of New York (SUNY), Korea campus, US, March, 2014.

Bhattacharya, B.B.:

(1) ECE Dept., Duke University, USA, April 01, 2013 – May 31, 2013; (2) School of Software, Tsinghua University, Beijing, China, November 06 - December 31, 2013; (3) EEE Department, Nanyang Technological University (NTU), Singapore, December 12 -14, 2013.

Ghosh, S.C.:

11th International Conference on Advances in Mobile Computing & Multimedia, Austria, December 02-04, 2013.

Sinha, B.P.:

Intelligent Informatics Laboratory, Dept. Of Software Engineering and Information Science, Iwate Prefectural University, Japan, March 12-20, 2014.

Sur-Kolay, S.:

(1) IEEE Annual Symposium on VLSI, Natal, Brazil, 2013; (2) Federal University of Rio Grande do Sul (UFRGS), Porto Alegre, Brazil; (3) Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil; (4) IV International School on Quantum Information, Paraty Brazil.

Computer Vision and Pattern Recognition Unit

Bhattacharya U.:

(1) ICDAR 2013 Conference, Washington DC, USA, August 25-28, 2013; (2) CBDAR 2013 Workshop, Washington DC, USA, August 23, 2013; (3) MOCR 2013 Workshop, Washington DC, USA, August 24, 2013.

Chaudhuri B.B.:

(1) San Yat Sen University, Kaohsiung, Taiwan, October 03-07, 2013; (2) SPIE Electronic Imaging Conference, San Francisco, USA, February 02-06, 2014.

Garain Utpal:

(1)10th International Workshop on Graphics Recognition (GREC), USA, August 20-21, 2013; (2) 12th International Conference on Document Analysis and Recognition (ICDAR), USA, August 25-28, 2013.

Pal, Umapada:

(1)University of Malay, Malaysia, May 26-28, 2013; (2) National University of Singapore, Singapore, May 28-June 01, 2013; (3) 12th International Conference on Document Analysis and recognition, Washington, USA, August 23-29, 2013; (4) Graduate School of Engineering, Mie University, Japan, October 16-November 15, 2013; (5) Session Chair, 2nd Asian Conference on Association for Pattern Recognition (ACPR), Okinawa, Japan, November 06-08, 2013; (6) The University of Colombo School of Computing (UCSC), Sri Lanka, December 10-16, 2013; (7) University of Malay, Malaysia, February 24-28, 2014; (8) 2nd International Conference on Pattern Recognition (ACPR) Okinawa, Japan, November 06-08, 2013; (9) University of Malay, Malaysia, May 27, 2013.

Electronics and Communication Sciences Unit

Chanda, Bhabatosh:

(1) Eleventh International Symposium on Mathematical Morphology, Uppsala, Sweden, May 27-29, 2013; (2) Nineth International Symposium on Visual Computing, Crete, Greece, July 29-31, 2013.

Das, Swagatam:

(1) IEEE Symposium Series on Computational Intelligence (SSCI) 2013, Singapore, April 16-19, 2013; (2) Yasar University, Izmir, Turkey, September 04, 2013; (3) IEEE Symposium Series on

Editorial and other Assignments

Computational Intelligence (SSCI) 2013, Singapore, April 16–19, 2013; (4) Dept of Electrical and Computer Engineering, National University of Singapore, Singapore, from May 06 – 13, 2013.

Mukherjee, Dipti Prasad:

(1) 10th IEEE International Conference on Automatic Face and Gesture Recognition 2013, Shanghai, China, April 22-27, 2013; (2) Department of Automation, Shanghai Jiao Tong University, Shanghai, April 26, 2013; (3) Department of Electrical and Computer Engineering, University of Virginia, Charlottesville, USA, July-August, 2013; (4) University of Nebraska Omaha, USA, August 12, 2013; (5) MICCAI 2013, Nagoya, Japan, September 22-28, 2013; (6) Department of Radiology, Graduate School of Medicine, Osaka University, Osaka, Japan, September 22-28, 2013.

Pal, Nikhil Ranjan:

(1) Brain Research Center, National Chiao-Tung University, Taiwan, September 29-November 29, 2013; (2) Brain Research Center, National Chiao Tung University, Taiwan, October 01, 2013; (3) Computational Intelligence Society Workshop on Recent advances in Computational Intelligence and Its Applications, Lima, Peru, March 14, 2014, (4) IEEE Computational Intelligence Society Executive committee meeting, Lima, Peru, March 15, 2014; (5) IEEE Panel of Editors meeting, Chicago, USA, March 28-29, 2014.

Machine Intelligence Unit

Bandyopadhyay, S.:

(1) Genoa Bioinformatics Workshop, Genoa, Italy, June 14, 2013; (2) IEEE Multi Criteria Decision Making (MCDM), IEEE Symposium Series on Computational Intelligence (SSCI), Singapore, April 16, 2013; (3) Panelist-IEEE Women in Computational Intelligence, Panel Discussion during IEEE Symposium Series on Computational Intelligence (SSCI), Singapore, April 17, 2013; (4) Multimodal Social Data Mining Workshop of the EDBT/ICDT 2014 Joint Conference, Athens, Greece, March 24-28, 2014.

De, Rajat K.:

15th International Congress of Immunology – ICI 2013, Milan, Italy, August 22-27, 2013.

Ghosh, A.:

RWTH-Aachen University, Germany, May-June 2013.

Documentation, Research and Training Centre, Bangalore

Dutta, Biswanath:

Department of Information Engineering and Computer Science, University of Trento, Italy, April 14–May 17, 2013.

Madalli, Devika P:

(1) Ozyegin Universitesi, Istanbul, Turkey, May 22-24, 2013; (2) AgINFRA Project meeting at MTA Sztaki, Budapest, Hungary, May 27-31, 2013; (3) Dept. of Information Studies at UDL, University of College London, UK, September 13, 2013; (4) Research Data Alliance Second Plenary meeting, Washington, DC, USA, September 16-18 2013; (5) G8+06 Data Infrastructure working group meeting, European Commission, Brussels, March 24, 2014; (6) 3rd plenary meeting of Research Data Alliance, Insight Centre for Data Analytics, Dublin, Ireland, March 26-28, 2014.

Prasad A.R.D:

(1) Ozyegin Universitesi, Istanbul, Turkey, May 22-24, 2013; (2) AgINFRA Project meeting at MTA Sztaki, Budapest, Hungary, May 27-31, 2013; (3) 2nd Review Meeting of AgINFRA project meeting

held, Athens, December 10-15, 2013; (4) G8+06 Data Infrastructure working group meeting, European Commission, Brussels, March 24, 2014; (5) 3rd plenary meeting of Research Data Alliance, Insight Centre for Data Analytics, Dublin, Ireland, March 26-28, 2014.

Systems Science and Informatics Unit, Bangalore

Majumdar, Kaushik:

- (1) Society for Neuroscience Annual General Meeting, San Diego, California, November 08-13, 2013;
- (2) Electrical Geodesics Inc, Eugene, Oregon, USA, November 15, 2013.

Sagar, B.S.D.:

- (1) Uppsala University, Sweden, May 27–29 2013; (2) 33rd IEEE International Geoscience and Remote Sensing Symposium, Melbourne, Australia, July 21-26, 2013.

Computer Science Unit, Chennai

Chakraborty, Prabuddha:

Department of Theoretical Physics III, Centre for Electronic Correlations and Magnetism, Institute for Physics, University of Augsburg, Augsburg, Germany, June–July, 2013.

Ghosh, Sujata:

- (1) University of Seville, Spain, March, 2014; (2) University of Groningen, Netherlands, May-July, 2013;
- (3) University of Groningen, Netherlands, July, 2013.

Karthick, T.:

- (1) University of Tohoku, Tokyo, Japan, November 03-10, 2013; (2) National Chiao Tung University, Hsinchu, Taiwan, November 19-22, 2013.

Sekar, Gautham:

2nd Workshop on Current Trends in Cryptology, Ekaterinburg, Russia, June 24, 2013.

Physics and Earth Sciences Division

Geological Studies Unit

Ghosh, Parthasarathi:

- (1) 10th International Conference on Fluvial Sedimentology, Leeds, UK, July 14-19, 2013; (2) 8th International Conference on Geomorphology, Paris, France, August 27-31, 2013; (3) Post-Conference Scientific Excursion, P6B – Western North-Alps, France and Italy, September 02-06, 2013.

Patranabis-Deb, Sarbani:

- (1) Korea Institute of Geosciences and Mineral Resources (KIGAM), Daejeon, Korea, September 30–October 04, 2013; (2) Department of Geological Sciences, Indiana University, USA, Research Collaboration and laboratory studies, November 28-December 20, 2013.

Sengupta, Dhurjati Prasad:

10th North American Paleontology Convention Gainesville, Florida, USA, February 15-18, 2014.

Editorial and other Assignments

Physics and Applied Mathematics Unit

Das, Pradip Kumar:

(1) International Conference on National Institute for Mathematical Sciences, Daejeon. South Korea, August 18-24, 2013; (2) Steklov Mathematical Institute, Moscow, Russia, September 14-22, 2013; (3) Workshop on Decoherence and Quantum Tomography, Genova, Italy, June 25-30, 2013.

Ghosh, Subir:

Department of Physics, Universidad Nacional de La Plata, Argentina, October 26–December 21, 2013.

Roy, Sisir:

(1) 4th International Conference on Cognitive Neurodynamics, Sigtuna, Sweden, June 14-23, 2013; (2) International Conference on Methods and Models in Biosciences, Sofia, Bulgaria, June 24-28, 2013; (3) Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, June 29 - July 05, 2013; (4) New York University, NY, USA, August 14-23, 2013; (5) Department of Physics of Isfahan University of Technology (IUT), Iran, September 23 – November 06, 2013.

Roy, Barnana:

(1) International Conference on Applied Mathematics, Modeling and Computational Science (AMMCS-2013) Waterloo, Ontario, Canada; (2) The Department of Mathematics and Actuarial Science of the Indiana University, Northwest, USA, August 26 - September 6, 2013.

Roy, Pinaki:

(1) INFN Sezione di Perugia, Italy, December 01 – 29, 2013; (2) String Focus Group of the National Center for Theoretical Sciences (North Branch), Taipei, Taiwan, National University, Taiwan, March 09–16, 2014.

Biological Sciences Division

Biological Anthropology Unit

Bharati, P.:

(1) Department of Statistics, University of Rajshahi, Bangladesh, November 03-09, 2013; (2) University of Manchester, England, August 05-10, 2013.

Karmakar, B.:

5th Pan Arab Human Genetics Conference (PAHG2013), Dubai, November 17-19, 2013.

Mukhopadhyay, B.:

(1) Ohio University, College of Osteopathic Medicine, Ohio University, Athens, Ohio, November 05-07, 2013; (2) Aging and Society: Third Interdisciplinary Conference, Chicago, IL, USA, November 08-09, 2013; (3) The University of Texas at Brownsville, Department of Biomedical Sciences, Brownsville, Tx, USA, November 15, 2013.

Mukhopadhyay, S.:

(1) Ohio University, College of Osteopathic Medicine, Ohio University, Athens, Ohio, November 05-07, 2013; (2) Aging and Society: Third Interdisciplinary Conference, Chicago, IL, USA, November 08-09, 2013; (3) The University of Texas at Brownsville, Department of Biomedical Sciences, Brownsville, Tx, USA, November 15, 2013.

Human Genetics Unit

Ghosh, S.:

(1) University of Lubeck, Germany, April 22-24, 2013; (2) Leiden University Medical Center, Netherlands, April 25-26, 2013; (3) Harvard Medical School, Columbia University, USA, October 21-26, 2013.

Mukhopadhyay, I.:

University of Missouri, Columbia, USA, March 26 – April 24, 2014,

Roy, B.:

National Cancer Institute, Washington and Canada, Schulich School of Medicine and Dentistry, University of Western Ontario, Canada, April 11-15, 2013.

Social Sciences Division

Economic Research Unit

Chakravarty, Satya Ranjan:

(1) Southwest University, Chongqin, People's Republic of China, November 18- 22, 2013; (2) Sogang University in Seoul, Korea, August 21-26, 2013; (3) Asian Development Bank Headquarters in Manila, Philippines, March 09- 14, 2014.

Das, Samarjit:

(1) 1st International Conference on Information, Operations Management and Statistics (ICIOMS), Kuala Lumpur, Malaysia, September 01-06, 2013.

Kabiraj, Tarun:

(1) Frankfurt, Germany, July 02- 08 July, 2013.

Maiti, Pulakesh:

(1) Department of Statistics, Rajshahi University, Rajshahi, Bangladesh, April 03- 20, 2013; (2) 7th Annual International Conference on Statistics, Athens, Greece, June 17- 21 2013; (3) 1st International Conference on Information, Operations Management and Statistics (ICIOMS), Kuala Lumpur, Malaysia, August 29-September 06, 2013.

Mitra, Manipushpak:

(1) 13 SAET Conference on Current Trends in Economics, Paris, France, July 22- 29, 2013; (2) National University of Singapore, Singapore, August 01- 06, 2013; (3) School of Economics, University of New South Wales, Sydney, Australia, February 24-March 12, 2014.

Pal, Manoranjan:

(1) Department of Development Economics, South Asia Institute (SAI), University of Heidelberg, Germany, June 10-11, 2013; (2) Universite Catholique de Louvain, Belgium, June 14-19, 2013; (3) Department of Statistics, University of Rajshahi, Bangladesh, November 03-09, 2013.

Sarkar, Abhirup:

(1) University of Birmingham & University of Nottingham, UK, September 11-22, 2013.

Editorial and other Assignments

Linguistic Research Unit

Dasgupta, Probal:

98th World Esperanto Congress, Reykjavík, Iceland, July 20-27 August, 2013.

Dash, Niladri Sekhar:

(1) 6th International Joint Conference on Natural Language Processing (IJCNLP-2013), Nagoya Congress Centre, Nagoya, Japan, October 14-18, 2013; (2) Asian Language Resource (ALR-11), Nagoya, Japan, October 14-19, 2013.

Psychology Research Unit

Dutta Roy, D:

(1) Shanghai University, July 10, 2013; (2) Workshop on agro-psychological counselling: concepts and process, Shanghai International Conference in Social Sciences (SICSS), China, July 11-13, 2013.

Ghosh, Anjali:

Euro-American Conferences for Academic Disciplines, Bad Hofgastein, Austria, June 17-21, 2013.

Gupta, Rumki:

San Antonio International Multi disciplinary Academic Conference, San Antonio, Texas, USA, October 18-20, 2013.

Sampling and Official Statistics Unit

Mitra, Sandip:

(1) Boston University, United States, October 31- November 03, 2013, (2) Harvard Kennedy School, US, November 02-03, 2013; (3) International Growth Centre, London School of Economics, UK, September 23-25, 2013; (4) Cleveland State University, US, November 04-06 2013.

Sociological Research Unit

Bharati, Susmita:

University of Manchester, England, August 05-10, 2013.

Suparna, Shome:

University of Manchester, England, August 05-10, 2013.

Economics and Planning Unit, Delhi

Afridi, Farzana:

(1) Young Lives Conference, Oxford University, UK, July 08-11, 2013; (2) NEUDC Conference, Harvard University, November 02-03, 2013.

Ghate, Chetan:

(1) ANU-Canberra, Australia, Lowy Institute, Sydney, May 22-31, 2013; (2) PET 13 Lisbon, Portugal, USA, June 30- July 08, 2013; (3) Arndt-Cordon Division of Economics (ACDE), Australia National University, Canberra, Australia, May, 2013.

Mukhopadhyay, Abhiroop:

(1)CMI, Bergen, Norway, August 27- September 10, 2013; (2) Ludwig-Maximilians University, Lehrturn, Munich and South Asia Institute, Heidelberg, Germany, June 20-26, 2013; (3) University of New South Wales Campus, Sydney, Australia, October 29 – November 02, 2013; (4) Japan External Trade Organization, Chiba, Japan, February 24 - 28, 2014.

Mishra, Debasis:

(1)Lund University, Sweden, February 17-21, 2014; (2) Asian Econometric Society Meeting, Singapore, August, 2013. (3) Biennian Conference of the Society for Economic Design, Lund, Sweden, July, 2013.

Ramaswami, Bharat:

(1) Renmin University of China, Beijing, China, April 09–13, 2013; (2) 17th ICABR Conference, Ravello, Italy, June 18-22, 2013; (3) Asia Competitiveness Review Seminar, LKY School of Public Policy, National University of Singapore, Singapore, August, 2013.

Ray Chowdhury, Prabal:

(1)National University of Singapore, Singapore, May 17- June 07, 2013; (2) School of Economics, Singapore Management University, Singapore, August 12- 23, 2013.

Sen, Arunava:

(1)Franqui Conference, Brussels, June, 2013; (2) Universite Catholique de Louvain, Belgium and Saarland University, Germany, June 24-July 02, 2013; (3) Lund University, Sweden, July 23-29, 2013; (4)Singapore Management University, Singapore, November 18 - 24, 2013.

Somanathan, E:

(1)Duke Sanford, School of Public Policy, Durham and Princeton University, New Jersey, May 20-June 14, 2013 (2) Workshop at SANDEE, Bangkok, Thailand, June 18 - 22, 2013; (iii) EEAEM conference at Gothenburg, Sweden, August 26 - 30, 2013.

Economics Analysis Unit, Bangalore

Ramachandran, V.K.:

(1) Department of Economics, Yokohama National University, Japan, July 31-October 30, 2013; (2) Meijo University, Nagoya, September 17, 2013; (3) Tokyo University, Tokyo, September 28, 2013; (4) Institute for Developing Economies, Chiba, October 24, 2013; (5) Yunnan University of Finance and Economics, China, April 27, 2013; (6) Shanghai University of Finance and Economics, China, April 30, 2013.

Swaminathan, Madhura:

(1) School of Economics, Fudan University, Shanghai, February 28- June 15, 2013; (2) Yunnan University of Finance and Economics, Channai, April 27, 2013; (3) Shanghai University of Finance and Economics, China, April 30, 2013; (3) Senshu University, Japan, October 06-07, 2013.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Kolkata

Pradhan, Biswabrata:

International Conference on Information, Operations Management and Statistics, Kuala Lumpur, Malaysia, September 01-03, 2013.

Editorial and other Assignments

SQC & OR Unit, Delhi

Neogy, S.K.:

The Hong Kong Polytechnic University, Hong Kong, December 16-18, 2013.

SQC & OR Unit, Chennai

Ravindran, G.:

(1) Jiao Tong University, China, May 20–June 10, 2013; (2) Department of Mathematics and Statistics, University of Maryland, Baltimore.

SQC & OR Unit, Hyderabad

Murthy, G.S.R.:

(1) Georgia Institute of Technology, Atlanta, USA, August 01-31 and September 16-27, 2013; (2) University of Michigan, Ann Arbor, USA, September 01-15, 2013.

Center for Soft Computing research: A National Facility

Chakraborty, M.K.:

(1) 4th World Congress and School on Universal Logic (UNILOG), Rio De Janeiro, Brazil, March 29-April 07, 2013; (2) University of Rio Grande do Norte, Natal RN, Brazil, April 08-14, 2013; (3) University of Warsaw, Poland, July 28- August 01, 2013; (4) Conference on Symmetry Festival 2013, Delft, The Netherlands, August 02-07, 2013; (5) Sun Yat-Set University, Guangzhou, China, September 16-20, 2013.

Ghosh, A.:

RWTH Aachen University, Germany, May 10 - June 17, 2013.

Pal S.K.:

(1) University of Pennsylvania, Philadelphia, USA, May 11-13, 2013; (2) University of Maryland, College Park, MD, USA, May 15-20, 2013; (3) 23rd Italian Workshop on Neural Networks, Vietri sul Mare, Salerno, Italy, May 23-25, 2013; (4) Dept. of Applied Mathematics, University of Naples, Parthenope, Italy, May 26-28, 2013; (5) 5th World Congress on Nature and Biologically Inspired Computing (NaBIC'13), Fargo, USA, August 12-14, 2013; (6) International Conf. on Image Analysis and Processing (ICIAP), Naples, Italy, September 11-13, 2013; (7) 24th General Meeting of TWAS, Buenos Aires, Argentina, September 30-October 5, 2013; (8) 13th International Conference on Hybrid Intelligent Systems (HIS'13), Tunis, Tunisia, December 04-06, 2013; (9) 13th International Conference on Intelligent Systems Design and Applications (ISDA'13), Universiti Putra Malaysia, Serdang, Malaysia, December 08-10, 2013; (10) 3rd World Congress on Information and Communication Technologies (WICT 13), Hanoi, Vietnam, December 15-18, 2013; (11) 6th International Conference on Soft Computing and Pattern Recognition 2013 (SoCPaR'13), Hanoi, Vietnam, December 15 - 18, 2013.

R.C. Bose Centre for Cryptology and Security

Ruj, Sushmita:

(1) JSPS-DST Asian Academic Seminar on Discrete Mathematics and its Applications, Tokyo, Japan,

November, 2013; (2) IEEE ICC, Budapest, Hungary, June, 2013; (3) IEEE Globecom, December, 2013; (4) RWTH, Aachen, June, 2013.

SCIENTIFIC ASSIGNMENTS/ ACADEMIC VISITS IN INDIA

Theoretical Statistics and Mathematics Division

Stat-Math Unit, Kolkata

Bose, Arup:

(1) Invited Speaker and Chairman of a session, Statistics 2013, Conference at C R Rao Advanced Institute of Math., Stat. and Comp.Sc, Hyderabad, December 28-31, 2013; (2) Special Invited Talk, STATQUEST 2014, Calcutta University, Kolkata, March 27, 2014.

Dutta, Amartya Kumar:

(1) Visited and Delivered Talks, Pondicherry University, Sri Aurobindo International Centre of Education and Chennai Mathematical Institute, Chennai, February 05-14, 2014; (2) Delivered the R.C. Gupta Endowment Lecture, 43rd Annual Conference of the AIMT (Association for Improvement of Mathematics Teaching), Noida, February 16, 2014; (3) Delivered a talk, UNESCO programme on International Understanding for Human Unity, Ramakrishna Mission Institute of Culture, Kolkata, February 20, 2014; (4) Delivered a talk, International Seminar on History and Philosophy of mathematics, Bose Institute, February 22, 2014; (5) Participated and delivered a talk, Discussion Meeting on Projective Modules and Affine Fibrations, IIT Bombay, March 10-14, 2014; (6) Delivered several lectures, Indology course of the Ramakrishna Mission Institute of Culture (RMIC), West Bengal, 2013-14.

Gupta, Neena:

(1) Participated delivered a talk, Workshop and Conference on Classical and Nonstable K -theory, Tata Institute of Fundamental Research, Mumbai, July 15-24, 2013; (2) Delivered an invited talk, Ramakrishna Mission Vivekananda University, Kolkata, September 04, 2013; (3) Delivered an invited talk, Chennai Mathematical Institute, Chennai, September 25, 2013; (4) Delivered an invited talk, Tata Institute of Fundamental Research, Mumbai, October 31, 2013; (5) Visited, School of Mathematics, TIFR, December 05-13, 2013; (6) Participated and delivered an invited talk, International Conference On Automorphisms of affine Varieties, Centre for Theoretical Sciences Kerala, School of Mathematics, Kozhikode February 21, 2014; (7) Participated and delivered a talk, Discussion Meeting on Projective Modules and Affine Fibrations, IIT Bombay, Mumbai, March 14, 2014.

Ganguly, Satadal:

(1) Delivered scientific talk, Conference Analytic Theory of Automorphic Forms, Institute of Mathematical Science, Chennai, December 09-13, 2013; (2) Visited for collaborative research, School of Mathematics, Tata Institute of Fundamental Research, Mumbai, October 01-21, 2013.

Stat-Math Unit, Delhi

Bapat, R.B.:

(1) Invited Lecture, INSA Annual Meeting, Tirupati, October 03-04, 2013; (2) Visited, Indian Institute of Technology, Mumbai, March 03-07, 2014.

Bhatia, Rajendra:

(1) Chair, National Committee on Mathematics, INSA-ICSU; (2) Member, INSPIRE Committee in Mathematics; (3) President, Association of Mathematics Teachers of India; (4) Invited Talks,

Editorial and other Assignments

International Workshop on Operator Theory, IISc, Bangalore, December, 2013; (5) Kishore Vaigyanik Protsahan Yojana Science Camp, IISc, Bangalore, December, 2013; (6) Indian Science Congress, Jammu, February, 2014; (7) Workshop on Operator and Spectral Theory, Kerala School of Mathematics, February, 2014.

Chakrabarty, Arijit:

Visited, Department of Mathematics of the Indian Institute of Science, Karnataka, February 08-10, 2014.

Dewan, Isha:

(1) IISER, Pune, November 26-29, 2013; (2) University of Cochin, Kerala, December 30, 2013–January 02, 2014;

Laishram, Shanta:

(1) Visited, TIFR-CAM, Bangalore, January 02-08, 2014; (2) IISc, Bangalore, February 10-15 2014; (3) Visited for research collaboration, Harish-Chandra Research Institute, Allahabad, February 24-26, 2014; (4) TIFR, Mumbai, March 27-30 2014.

Roy, Rahul:

(1) Plenary speaker, Conference on Discrete Mathematics, South Asian University, Delhi, October 25-26, 2013; (2) Indo-French conference on Network models, IISc, Bangalore, January 13-16, 2014; (3) Member, Selection Committee for Summer School Students, IASc, Bangalore.

Thakur, Maneesh:

(1) IISER, Pune, May 13-26, 2013; (2) IISER, Pune, December 02-06, 2013; (3) Institute of Mathematical Sciences, Chennai December 21-26, 2013.

Stat-Math Unit, Bangalore

Athreya, Siva:

Visited, Department of Mathematics, IIT, Bombay, February 20-26, 2014.

Bhat, Rajarama B.V.:

(1) Gave lectures, IIT Kanpur, Kanpur, May 06-10, 2013; (2) Gave lectures, INSPIRE Camp, Bhubaneswar, June 28-29, 2013; (3) Attended and gave a talk, 79th annual meeting of the Indian Academy of Sciences, Punjab University, Chandigarh, IISER, Mohali, November 08-12, 2013; (4) Invited speaker, Workshop and conference in Honour of Klayan B. Singh–70th Birthday, Kerala School of Mathematics, Kozhikode, Kerala, February 12-14, 2014; (5) Attended, Functional Analysis and Probability Workshop, Coorg, February 26-28, 2014.

Gorai, Sushil:

(1) Gave invited talks in Complex Analysis Symposium, Ramanujan Mathematical Society, Bangalore, June 27-30, 2013; (2) Visited, IISER, Pune, July 23-30, 2013; (3) Visited, IISER, Kolkata, August 02-09, 2013.

Kumar, Manish:

Visited and given a talk, IISER Pune, August 25-28, 2013, NIT Surathkal and Mysore University, Karnataka.

Raja, C.R.E:

Collaborate Research work and gave a talk, JNU, Delhi, September 30, 2013.

Rajeev, B.:

(1) Gave a talk, Bangalore Probability Seminar, IISc, Bangalore, April 22, 2013; (2) Talks, Newman college, Thodupuzha, Kerala, Trivandrum, December, 2013; (3) Part of an expert panel, Kerala Science Congress, Waynad Kerala, January 28-30, 2014; (4) An interactive session, Coimbatore Institute of Technology, Coimbatore, Tamil Nadu, March, 2014; (5) Attended, ICMET conference, Mohandas Engineering college, Trivandrum, December 18–20, 2013; (6) National Conference on Statistics, Department of Statistics, Kerala University, Trivandrum, March 14, 2014.

Ramasubramanian, S.:

Visited and give lecture, Department of Statistics, Cochin University of Science and Technology, Kochi, Kerala, January 20 - 25, 2014.

Sarkar, Jaydeb:

(1) Invited speaker, Harmonic Analysis and Operator Theory, Indian Institute of Science Education and Research (IISER), Bhopal, March 20-23, 2014; (2) Invited speaker, Workshop on Probability, Functional Analysis and Related Topics, Indian Academy of Science, Coorg, February, 2014; (3) Colloquium speaker, Department of Mathematics, Indian Institute of Science, Bangalore, India, December, 2013; (4) Colloquium speaker, Department of Mathematics, Indian Institute of Technology, Kanpur, November 11-13, 2013.

Sastry, N.S.N.:

(1) Attended and given talk, 9th Annual Conference on Discrete Mathematics, Dharwad, Karnataka, June 11–12, 2013; (2) Attended and lectured, International Conference on Algebraic Geometry and Coding Theory, IIT, Mumbai, December 02-06, 2013.

Sreekantan, Ramesh:

(1) Visited and given a talk, IISER, Mohali, November 07-15, 2013; (2) Visited, Harish-Chandra Research Institute, Allahabad, March 02–09, 2014; (3) Visited, TIFR, Mumbai, March 22-29, 2014.

Sury, B.:

(1) Gave lectures, Advanced instructional school in group theory, Univ. of Delhi, June 05-11, 2013; (2) Gave invited talk, Conference on analytic number theory, IMSc, Chennai, December 08-13, 2013; (3) Gave ten lectures, Advanced ATM workshop, IISER, Pune, December 19-26, 2013; (4) Gave a talk, Two-day Academy workshop, Jain College, Bangalore, December 27, 2013; (5) Gave a talk, IIIT, Bangalore, January 01, 2014.

Stat-Math Unit, Chennai

Ponnusamy, S.:

(1) Gave a lecture, Sri Venkateswara University, Tirupati, March 31, 2014; (2) Gave lecture, One Day Colloquium in Ramanujan Institute for Advanced Study in Mathematics, University of Madras, Chennai, March 28, 2014; (3) Gave two days lecture series, Ayya Nadar Janaki Ammal College, Sivakasi, TN, March 10-12, 2014; (4) Gave keynote address and talk, Two Day National Conference on Partial Differential Equations and Applications, Bharathiar University, Coimbatore, January 30-31, 2014; (5) Gave Inaugural Address and Plenary Talk, SRM University, Tamil Nadu, January 05, 2014; (6) Gave a talk, SRM University, Tamil Nadu, December 31, 2013; (7) Gave a plenary and concluding talks, international symposium on Complex Analysis and Conformal mappings (ISCACG 2013), IIT, Indore, December 28-30, 2013; (8) Delivered a lecture, DST sponsored science camp, Science Pursuit for Inspired Research (INSPIRE) programme, September 07-11, 2013; (9) One of the members, Panel discussion, Emerging Opportunities in Mathematical Science; (10) Gave a lecture, Department of Mathematics, University of Kashmir, South Campus, Srinagar, September 05-11, 2013; (11) Attended (as a UGC Nominee) and gave a talk, Fifth Advisory Committee Meeting of UGC-SAP(DRSII), Gandhigram Rural University, Dindigul, August 30, 2013; (12) Gave two days lecture series, Bharathidasan University, Tiruchirappalli, July 16-17, 2013; (13) Gave a series of lectures,

Editorial and other Assignments

Advance Training in Mathematics Schools, Central University of Rajasthan, Jaipur, July 10-14, 2013; (14) Participated and also as an Executive Committee member, RMS Conference, RMS, Bangalore, June 26-29, 2013.

Applied Statistics Division

Applied Statistics Unit

Biswas, Atanu:

(1) Organized invited session and delivered invited talk, 3rd IIMA International Conference on Advanced Data Analysis, Business Analytics and Intelligence, Indian Institute of Management Ahmedabad, April 13-14, 2013; (2) Session chair and invited talk, STATISTICS 2013 Conference, CRRao AIMSCS, Hyderabad, December 28-31, 2013; (3) Invited talk, National Conference on Recent Advances in Statistics with Application in Finance and Actuarial Science (RASAFAS 2014), Central University of Rajasthan, Jaipur, February 14-15, 2014.

Dewanji, Anup:

International Workshop on Reliability Theory and Survival Analysis, Department of Statistics, CUSAT, Cochin, December 31, 2013-January 02, 2014.

Pal Choudhury, Pabitra:

(1) Delivered lecture, Dept. of Computer Science, Institute of Engineering and Management, Salt Lake, Kolkata, January 16, 2014; (2) Delivered lecture, Dept. of Applied Mathematics, Birla Institute of Technology, Ranchi, February 28, 2014; (3) Academic visit, International Centre for Theoretical Sciences of the Tata Institute of Fundamental Research (*ICTS-TIFR*), Bangalore, March 24-30, 2014; (4) Delivered lecture, International Centre for Theoretical Sciences of the Tata Institute of Fundamental Research (*ICTS-TIFR*), Bangalore, March 24, 2014.

SenGupta, Ashis:

(1) Member, Program Advisory Committee of Mathematical Sciences, DST, Govt. of India; (2) Delivered invited lecture, STATISTICS 2013 Conference, CR Rao AIMSCS, Hyderabad, December 28, 2013; (3) Chairman, key-note and felicitation session and invited lecture, Indo-USA (SAMS) session, International Conference in celebration of Golden Jubilee of Dept. of Statistics, University of Pune, Pune, December 16, 2013; (4) Plenary lecture, International Conference on Operations Research for Data Analytics and Decision Analysis, ORSI, Srinagar, Kashmir, October 21-23, 2013; (5) Key-note lecture and invited session chair, International Conference on ADABAI, Indian Institute of Management Ahmedabad, April 13, 2013; (6) Joint Organizer, Indo-USA International Workshop on Statistical Methods for Bioinformatics, Indian Institute of Science, Bangalore, December 12-14, 2013; (7) External Member, Board of Studies, Dept. of Statistics, Central University of Bihar, Patna, 2013; (8) Evaluator, Mathematics Department, Indian Institute of Technology, Kharagpur; 2013; (9) External Project Guide, Central University of Rajasthan, Jaipur, 2013; (10) Invited Project Advisor, University of Guwahati, Guwahati, 2013; (11) Served for Confidential services, Indian Institute of Technology Patna, 2013-14; (12) Invited Seminar, Indian Institute of Technology, Gandhinagar, 2013.

Bayesian Interdisciplinary Research Unit

Basu, Ayanendranath:

(1) Delivered lectures, Workshop on Astronomy Data Analysis, Inter-university Centre for Astronomy & Astrophysics (IUCAA) Resource Centre (IRC) and North Bengal University, North Bengal University, West Bengal, December 16-17, 2013; (2) Invited Talk, Statistics 2013, Socio-Economic Challenges and Sustainable Solutions, C.R. Rao AIMSCS, Hyderabad, December 28-31, 2013; (3) Delivered lectures, STATQUEST 2014, Department of Statistics, Calcutta University, Kolkata, March 27, 2014.

Bose, Smarajit:

Delivered lectures, short-term course on Research Methodology: Facts & Fiction, Department of Education, University of Calcutta, Kolkata, March 01, 2014.

Pal, Amita:

Delivered lecture, National Level Workshop on Recent Trends in Multimedia Technology, RCC Institute of Information Technology, Kolkata, July 11, 2013.

Applied Statistics Unit, Chennai

Kattumannil, S.K.:

(1) Delivered lecture, International conference, Pune University, Pune, December 16-18, 2013; (2) Delivered lecture, Farooq College Calicut, Kozhikode, December 20-24, 2013; (3) Invited talk, Advanced Training Programme in Statistics for College Teachers and Research Scholars in Statistics, Government Arts and Science College, Pondicherry, November 18-22, 2013; (4) Invited talk, Financial Modeling Workshop, Indian Institute of Technology, Chennai, November 05, 2013; (5) Delivered lecture, Carmel College, Mala, Kerala, India, October 10, 2013.

Sen, R.:

(1) Delivered lectures, Certificate Program in Applied Mathematical Finance for Engineers, Indian Institute of Quantitative Finance, Mumbai, April-May, 2013; (2) Invited talk, University of Madras, Chennai, August 16, 2013; (3) Invited talk, Advanced Training Programme in Statistics for College Teachers and Research Scholars in Statistics, Government Arts and Science College, Pondicherry, November 18-22, 2013; (4) Invited talk, Training Program for Doctoral Students, Tirunelveli University, Tamil Nadu, November, 2013; (5) Visited and delivered lecture, IIM, Bangalore, January 6-10; (6) Invited talk, SDNB Vaishnav College, Chennai, February 28, 2014; (7) Delivered lecture, Econophysics Kolkata VIII Conference, March 14-17, 2014.

Computer and Communication Sciences Division

Advanced Computing and Microelectronics Unit

Banerjee, A.:

(1) Served, Technical Program Committee of International Conference in VLSI Design, 2014; (2) ACM-IEEE International Conference on Formal Methods and Models for Codesign MEMOCODE, 2013; (3) Delivered talks, CSA, Indian Institute of Science, Karnataka; (4) CS department, IIIT, Delhi; (5) CS department, IIT, Mumbai; (6) Microsoft Research Labs, Bangalore; (7) Synopsys India Pvt. Ltd., Bangalore.

Bhattacharya, B.B.:

(1) Attended, and delivered keynote address, 17th International Symposium on VLSI Design and Test (VDAT), Jaipur, July 27-30, 2013; (2) Delivered a Plenary address, 2nd International Conference on Eco-Friendly Computing & Communication Systems, JUIT, Wagnaghat, Himachal Pradesh, October 17-19, 2013; (3) Delivered a tutorial, International Conference on VLSI and Signal Processing, IIT Kharagpur, January 10-12, 2014; (4) Delivered a keynote address, International Conference on Applied Algorithms, January 13, 2014; (5) Delivered a keynote address, Workshop on Emerging Trends in VLSI, NIT, Durgapur, February 17-21, 2014; (6) Delivered an invited talk, NIT, Suratkal, March 05, 2014; (7) Delivered an invited talk, National Seminar on Emerging Trends of Information Technology in Development, Fakir Mohan University, Balasore, March 11, 2014.

Editorial and other Assignments

Das, N.:

(1) Served, Member of Board of Governors of NIT, Durgapur; (2) Member, PhD Committee, Bengal Engineering and Science University, Shibpur, Howrah, and Jadavpur University, Kolkata; (3) Member, Expert Committee, Staff Selection Commission; (4) PC member of ICDCN 2014, ICETACS 2013, NCC 2013, ICIT 2014, ETCC 2014, ICAA 2014, ICACNI 2014; (5) Delivered invited talks, NIT, Surathkal, January 2014; (6) NIT, Durgapur; (7) AWCN 2013, Oct. 2013; (8) ETCC 2014, Kolkata, February, 2014; (9) Tutorial, AiMOC 2014, Jadavpur University, Kolkata, February, 2014; (10) UGC Refresher Course in Information Technology, University of Calcutta, Kolkata, January 2014; (11) Workshop on Fundamentals of fiber and wireless communications for the next generation systems, University of Calcutta, Kolkata, January 2014.

Sinha, B.P.:

(1) Served as the visitor's nominee (for faculty recruitment) National Institutes of Technology; (2) Served as the Panel Co-Chair, IEEE International Conference on Advanced Networking and Telecommunication Systems (IEEE ANTS), Chennai, December 15-18, 2013; (3) General Vice-Chair, IEEE International Conference on Advanced Networking and Telecommunication Systems (IEEE ANTS), Delhi, 2014.

Sur-Kolay, S.:

(1) PC member, chaired a session and delivered an invited tutorial, International Conference on VLSI Design, IIT, Bombay, 2014; (2) Attended, Bhubaneswar to present a paper, ICDCIT, Odisha, KIIT, 2014.

Computer Vision and Pattern Recognition Unit

Bhattacharya, U.:

(1) Attended and presented a paper, fourth National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG) Conference, Jodhpur, Rajasthan, December 18-21, 2013; (2) Delivered a lecture on Machine Learning and Biometric Authentication, Malaviya National Institute of Technology, Jaipur, Rajasthan, December 23, 2013; (3) Delivered a talk, North-East Workshop on Theory and tools for language and document analysis research, Sikkim University, Gangtok, March 28, 2014.

Chaudhuri, B.B.:

(1) Delivered a crash course lecture on Data compression, IITDM, Jabalpur, October 30- Nov 2, 2013; (2) Delivered Keynote Address and Expert address, National workshop on Multilingual technology In NLP and Pattern Recognition, Punjabi University, Panjab, November 11, 2013; (3) Chaired a session, conference on Computational Intelligence: Modelling, Techniques and Applications (CIMTA), Kalyani University, West Bengal, September, 2013; (4) Chaired a session, Pattern Recognition and Machine Intelligence (PReMI) Conference, Kolkata, December, 2013; (5) Acted as expert for evaluation of Inspire fellowship, Kalyani, Barasat, Calcutta and Coimbatore University.

Garain, Utpal:

(1) Delivered a talk, National Workshop on Multi-Lingual Technology (NWMLT), Punjabi University, Patiala, November 11, 2013; (2) Delivered a talk, North-East Workshop on Theory and tools for language and document analysis research, Sikkim University, Gangtok, March 27, 2014.

Pal, Umapada:

(1) Delivered a talk, MNIT, Jaipur, December, 2013; (2) Attended the fourth National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), Jodhpur, Rajasthan, December 18-21, 2013.

Electronics and Communication Sciences Unit

Bagchi, Aditya:

(1) Delivered a keynote lecture, International Conference on Recent Advances in Information Technology (RAIT 2014), Dhanbad, March 13-15, 2014; (2) Delivered a plenary lecture, National Conference on Emerging Trends in Computing & Communication (ETCC-2014), B.P. Poddar Institute of Management & Technology, Kolkata, March 22-23, 2014; (3) Delivered a seminar lecture, Recent Advances in Computer Science, Kolkata, March 31, 2014; (4) Served as the Program Co-Chair, 9th International Conference on Information Systems Security (ICISS 2013), Kolkata, December 16-20, 2013.

Chanda, Bhabatosh:

(1) Delivered seminar lecture, C.M.R. Institute of Technology, Bangalore, India, April 24, 2013; (2) Delivered seminar lecture, JIS College of Engineering, Kalyani, India, November 16, 2013; (3) Delivered invited lecture, Evaluation Program on Soft Computing and Its Application in Computation, Narula Institute of Technology, Kolkata, India, November 11-16, 2013; (4) Delivered invited lecture, Workshop on Video Image Processing, Tripura Institute of Technology, Agartala, India, January 24-26, 2014; (5) Chaired a Session, PReMI'13, Kolkata, December 10-14, 2013.

Das, Swagatam:

(1) Keynote lecture, 2nd International Conference on Frontiers of Intelligent Computing and Applications (FiCTA) 2013, Bhubaneswar Engineering College, Bhubaneswar, November 14-15, 2013; (2) Pre-conference Tutorial on Differential Evolution, 4th International Conference on Engineering, Nirma University, Gujrat, November 28-30, 2013 Organized by Institute of Technology, Nirma University, Ahmedabad, Gujarat; (3) Invited lecture, one week Continuing Education Program (CEP) on Soft Computing & Its Application in Computation, Narula Institute of Technology, Kolkata, November 11-16, 2013.

Mukherjee, Dipti Prasad:

(1) Delivered invited talk, Academic Staff College, University of Calcutta, Kolkata, January 06, 2014; (2) Delivered invited talk, National Student Convention, 48th Computer Society of India Annual National Convention, Vishakapattanam, December 12, 2013; (3) Delivered invited talk, National Level Faculty Development Programme on Image and Video Processing, RCC Institute of Information Technology, West Bengal, December 09, 2013; (4) Face and Emotion Recognition, TCS Innovation Lab workshop, November 22, 2013; (5) Delivered invited talk, JIS College of Engineering, Kalyani, November 16, 2013; (6) Delivered invited talk, NIELIT, Kolkata, June 07, 2013; (7) Delivered invited talk, National Workshop on Image and Video Analysis, Bhubaneswar, May 16-18, 2013;

Pal, Nikhil Ranjan:

(1) Invited talk, Fourth IEEE International Advance Computing Conference (IACC), Gurgaon, February 21-22, 2014; (2) Invited talk, National Programme for Training of Scientists & Technologists Working in Government Sector on Soft Computing Techniques for Optimization, Gwalior, February 17- 21, 2014; (3) Keynotespeech, International Conference on Issues and Challenges in Intelligence Computing Technologies, February 06-07, 2014.

Machine Intelligence Unit

Bandyopadhyay, S.:

(1) Member, Board of Governors, NIT, Warangal, 2011-2013; (2) Member, Wellcome Trust/DBT-India Alliance Early Career Fellowships Selection Committee; (3) Member, Board of Studies in Computer Science, NIT, Rourkela; (4) External Expert, Board of Research Studies in Computer Science, Burdwan University, West Bengal; (5) Keynote lecture, First International Conference on Computational Intelligence: Modeling, Techniques and Applications (CIMTA), Kalyani University, West Bengal, September 27, 2013; (6) Keynote lecture, National Conference on Research Trends in

Editorial and other Assignments

Computer Science and Applications, Siliguri Institute of Technology, West Bengal, February 08, 2014; (7) Member, Roundtable Discussion on Big Data, Research Council of UK, India, New Delhi, November 13, 2013; (8) Invited talks, NIIS Institute of Business Administration, Bhubaneswar, June 01, 2013; (9) Maulana Azad National Institute of Technology, MANIT, Bhopal, July 01, 2013; (10) University Institute of Technology, Burdwan University, West Bengal, July 04, 2013; (11) Taught, Short Term Course on Computational Biology, Bioinformatics & Their Application to Healthcare, IIT, Kharagpur, November 01, 2013; (12) Indo-US workshop on Statistical Methods for Bioinformatics, Indian Institute of Science, Bengaluru, December 14, 2013; (13) Inaugural lecture on Research Scholars Day, Department of Information Technology, IIT, Kharagpur, January 11, 2014.

Ghosh, A.:

(1) DST MAC meeting, Amity University, Noida Campus, Uttar Pradesh, June 18, 2013; (2) PhD Viva-voce, Indian Institute of Technology, Kharagpur, November 18, 2013; (3) Invited talk, Workshop on Recent Trends in Machine Intelligence, Data Mining and Soft Computing techniques and its impact on Research and Development, Dr. B.C. Roy Engineering College, Durgapur, November 23, 2013; (4) Invited Talk, Utkal University, Odisha, December 15-18, 2013; (5) Invited talk, Workshop on Data-warehouse and Data Mining, Central University of Jharkhand, Ranchi, February 05-08, 2014; (6) DST MAC meeting, DAV University, Jalandhar, February 24, 2014; (7) Invited talk, Central University of Jharkhand, Ranchi, March 12-15, 2014; (8) Invited lecture, School of Studies in Electronics & Photonics, Pt. Ravishankar Shukla University, Raipur, March 19, 2014. (9) Speaker, ISI-TU North East Winter School on Pattern Recognition and Image Processing, Tripura University, Tripura, March 25-29, 2014;

Ghosh, K.:

(1) Invited talk, Faculty Updating Program, Center for Development of Advanced Computing (C-DAC), Kolkata, July 03, 2013; (2) Delivered lecture, National Institute of Science and Technology, Odisha, September 28, 2013; (3) Chaired a session, 5th World Congress on Paraconsistency (WCP5), Kolkata, February 13-17, 2014.

Maji, P.:

(1) Invited Speaker, Workshop on Modern Trend in Soft Computing and Security Issues, National Institute of Science and Technology, Berhampur, Orissa, September 23-28, 2013; (2) Invited Speaker, Continuing Education Programme under TEQIP-II on Machine Intelligence, Department of Information Technology, Heritage Institute of Technology, Kolkata, West Bengal, July 17, 2013; (3) Invited Speaker, One week National Level Staff Development Programme on Soft Computing, UIT, Burdwan University, West Bengal, July 01, 2013; (4) Invited Speaker, Short-Term Course on Social Media Analysis and Data Mining, Bengal Engineering and Science University, Shibpur, West Bengal, June 11, 2013; (5) Coordinator and Speaker, ISI-TU North East Winter School on Pattern Recognition and Image Processing, Tripura University, Tripura, March 25-29, 2014; (6) External Examiner, Department of Computer Science and Engineering, Indian Institute of Technology, Kharagpur, April 30, 2013.

Mitra, S.:

(1) Member, Board of Studies, Tezpur University, Assam; (2) Member, Board of Studies, Govt. College of Engineering and Ceramic Technology, Kolkata; (3) Invited talk, Advanced Faculty Training Program, CDAC, Kolkata, July 05, 2013; (4) IEEE Computational Intelligence Society (CIS), Hyderabad Section sponsored talk on Hybridization with rough sets, University of Hyderabad, Hyderabad, July 08, 2013; (5) Theme Meeting on Fuzzy and Interval based Uncertainty Modeling, NIT, Rourkela, July 19, 2013; (6) IEEE GOLD Affinity Group, Kolkata Section sponsored talk on Soft Computing for Pattern Recognition, Faculty Development Program Workshop, Govt. College of Engg. and Ceramic Technology, Kolkata, August 31, 2013; (7) Invited talk, Workshop on Soft Computing Techniques in Engineering Applications, KIIT University, Bhubaneswar, October 28, 2013; (8) Invited talk, National Seminar on Modern Trends in Power Electronics, Control and Machine Drives, RCC Institute of Information Technology, Kolkata, March 27, 2014.

Murthy, C.A.:

(1) Member, Governing Council of NCSM; (2) Attended the meeting as an expert for curriculum formulation of their Bachelor's and Masters programmes in Computer Science, ISM, Dhanbad, April 2013; (3) visited for delivering a lecture, Kalyani University, West Bengal, April; (4) visited for delivering a lecture, Burdwan University, West Bengal, June, 2013; (5) Visited as external expert for conducting viva voce examination, IIT, Delhi, September, 2013; (6) visited for a selection committee meeting, Tezpur University, Assam, November 2013; (7) visited for a meeting, IDRBT, Hyderabad, December 2013.

Documentation, Research and Training Centre, Bangalore

Dutta, Biswanath:

(1) Delivered special lecture, National Institute of Technology, Durgapur, January 24, 2014; (2) Attended, Open Linked Data and eGovernance brainstorming session, January 27-29, 2014.

Krishnamurthy, M:

(1) Attended, Ph.D Programme Viva-voc meeting, Periyar Maniammai University, Tamil Nadu, May 27, 2013; (2) Attended, project review meeting, Amrita Vishwa Vidyapeetham university, Coimbatore, July 22, 2013; (3) Invited to give lecture, Library Connect Seminar, Bangalore, November 20, 2013; (4) delivered a lecture, UGC sponsored workshop, Bharthidans University, Trichy, December 23, 2013.

Madalli, Devika P:

(1) Attended, Karnataka Evaluation Authority Meeting, Govt. of Karnataka, Bangalore, July 20-September 21, 2013; (2) Attended, Ph.D Committee meeting, Library and Information Science, University of Calcutta, Kolkata, July 2013; (3) Attended, Open Access module Writers review Meeting on Open Access, Commonwealth Educational Media Centre for Asia and JNU, New Delhi, October 22, 2013; (4) Invited for Expert discussions on Innovative use of ICT in Libraries, SACITIL-2014, Variable Energy Cyclotron Centre, Dept. of Atomic Energy, Kolkata, January 28-30, 2014; (5) Attended, Inaugural function of National Mission on Libraries, Rashtrapati Bhawan, New Delhi, February 03, 2014.

Prasad A.R.D:

(1) Invited, Member of Selection Committee, National Mission on Libraries, Kolkata and Delhi, April 04-05, 08-09 and 12-13, 2013; (2) Attended, Member of Board of Studies Meeting, Mizoram University, Mizoram, April 15, 2013; (3) Attended, Experts committee meeting, National Mission on Libraries, Kolkata, July 08-09, 2013; (4) Invited as a member, Advisory Committee meeting of PGDLAN Programme, University of Hyderabad, Hyderabad, August 23, 2013; (5) Attended, 2nd meeting of the Sub-Committee on Conducting Public Library Survey, NML, Kolkata, September 18, 2013. (6) Invited as one of panellist, UNESCO conference, New Delhi, October 21, 2013; (7) Delivered Keynote address, national seminar NCRACK-2013, Vijayawada, October 25, 2013; (8) Invited to deliver a special lecture, ICDL2-13, New Delhi, November 27-29, 2013; (9) Invited as an Expert to discuss the modalities for establishing social science knowledge and research E-Network, ICSSR, New Delhi, January 17, 2014; (10) Attended the Selection Committee Meeting, JNU, New Delhi, January 29, 2014; (11) Attended the Inaugural function of National Mission on Libraries, Rashtrapati Bhawan, New Delhi, February 03, 2014. (12) Attended the Advisory Board Meeting, National Library, Kolkata, March 06, 2014.

Systems Science and Informatics Unit

Majumdar, Kaushik:

(1) Delivered Invited Lecture, Infosys Limited, Bangalore, April 30, 2013; (2) Delivered Invited Lecture, 3rd Bangalore Cognition Workshop, Indian Institute of Science, Karnataka, December 08-21, 2013; (3) Delivered Invited Lecture, National Institute of Technology, Surathkal, Karnataka, March 30, 2014.

Editorial and other Assignments

Meher, S. K.:

(1) Doctoral Expert Committee Member, Doctoral review committee for the Research Scholar of R. V. College of Engineering, Bangalore; (2) Delivered a series of lectures, workshop on Image Pattern Analysis and Applications, Amrita School of Engineering, Bangalore, November 09-10, 2013; (2) Delivered a lecture on Introduction to Machine Learning, Workshop on Autonomic, Cloud and Green Computing, Bangalore, India, February 06-08, 2014.

Sagar, B.S.D.:

(1) Member of Doctoral Committees, University of Hyderabad, Hyderabad, 2013-14; (2) Indian Institute of Space Science and Technology, Trivandrum, 2013-14; (3) Delivered series of lectures, ISTE-Short Term Training Program, Kongu Engineering College, Erode, Tamil Nadu, May 08-09, 2013; (5) Convener for a Session, 16th International Association for Mathematical Geoscience (IAMG) Conference, New Delhi, India, October 17-20, 2014, (6) Delivered lectures, Workshop on Image Pattern Analysis and Applications, Amrita School of Engineering, Bangalore, November 09-10, 2013; (7) Delivered Invited Lecture, Electronics & Radar Development Establishment (LRDE)-DRDO, Bangalore, November 13, 2013; (8) Delivered plenary lecture, Contact Programme Workshop on Earth Surface Dynamics, Indian Institute of Technology, Gandhinagar, Gujarat, December 10, 2013; (9) Delivered Inaugural Lecture, National Seminar on Recent Trends and Developments in the Field of Computer Vision, VR Siddhartha Engineering College, Vijayawada, AP, December 20-21, 2013; (10) Delivered Lecture, Faculty Development Programme on Intelligent Machines and Systems, BMS College of Engineering, Bangalore, January 23, 2014; (11) Delivered Lectures, workshop on Spatial Information Analytics: Mathematical Morphology and Pattern Recognition, PES University, Bangalore, February 28, 2014; (12) IEEE Bangalore Section Chapter of the Geoscience and Remote Sensing Society, 2013.

Computer Science Unit, Chennai

Francis, Mathew. C.:

(1) Delivered lectures, Workshop on Design and Analysis of Algorithms, Indian Association for Research in Computer Science (IARCS) and the Indian Institute of Information Technology and Management - Kerala (IITM-K), Kerala, September 06-10, 2013; (2) Gave a talk, conference FSTTCS 201, Indian Institute of Technology, Guwahati; (3) Visited for collaborative research work, Indian Institute of Science, Bangalore, January 08-21, 2014; (4) Delivered a talk, Indian Institute of Science, Karnataka, January 21, 2014; (5) Taught a one-day course on Amortized Analysis, February 18, 2014, College of Engineering, Trivandrum.

Ghosh, Sujata:

(1) Delivered an invited talk, Workshop on Mathematical modeling in Computer Science and Information Technology, VIT University, Vellore, February, 2014; (2) Delivered an invited talk, GImInAL, Indo-French workshop on imperfect information games, Institute of Mathematical Sciences, Chennai, December, 2013; (3) Delivered an invited talk, Seminar on Logic and Cognition, Jadavpur University, Kolkata, October-November, 2013.

Karthick, T.:

(1) Delivered an invited talk, International Conference on Computational Mathematics (ICCM 2013), Loyola College, Chennai, July 23-25, 2013; (2) Delivered an invited talk, National Conference on Graph Coloring and its Applications, Dr. Ambedkar Institute of Technology, Bangalore, July 27-28, 2013.

Sekar, Gautham:

Delivered an invited talk, National Level Workshop on Developments in Statistical Methods for Data Analysis of Excluded Groups, March 20, 2014.

Venkateswarlu, Ayineedi:

Attended, 14th International Conference on Cryptology in India – INDOCRYPT 2013, Homi Bhabha National Institute, Mumbai, December 07-10, 2013.

Physics and Earth Sciences Division

Geological Studies Unit

Das, Shiladri Shekhar:

Participated and presented paper, XXIV Indian Colloquium on Micropaleontology and Stratigraphy, Dehradun, Uttarakhand, November 18-21, 2013.

Patranabis-Deb, Sarbani:

Delivered lectures, Workshop and Panel Discussion with De Beers, India Exploration Group, Bangalore May 06-20, 2013.

Saha, Dilip

(1) Presented a plenary lecture, 3rd International conference on Precambrian Continental Growth and Tectonism, Bundelkhand University, Jhansi, November 23-26, 2013; (2) Presented an invited lecture, Conference on Magmatism, Tectonism and Metallogeny, University of Kumaun, Nainital, March 26-29, 2014.

Physics and Applied Mathematics Unit

Ghosh, D.:

(1) Invited talk, National Workshop on Various Aspects of Engineering Mathematics & Quantum Physics, College of Engineering & Management, Kolaghat, Purba Medinipur, December 23-24, 2013; (2) Delivered Lecture, National Workshop on Nonlinear Dynamics and Applications, Tezpur University, Assam, March 14-15, 2014.

Kar, G.:

(1) Academic collaboration, Institute of Mathematical Sciences, Chennai, November 19-26, 2013; (2) Invited talk, International Conference on Quantum Correlations and Logic, Language and Set Theory (ICQIQL), Indian Institute of Technology Jodhpur, Rajasthan, December 06-13, 2013; (3) Invited talk, International Program on Quantum Information (IPQI), Institute of Physics, Bhubaneswar, February 24-28, 2014.

Maiti, S.K.:

(1) Invited talk, International Conference on Advanced Nanomaterials & Emerging Engineering Technologies (ICANMEET), Sathyabama University, Chennai, July 24-26, 2013; (2) Invited talk, Jadavpur University, Kolkata, August 16, 2013; (3) Invited talk, Annual Conference on Frontiers in Physics (FIP), School of Physics, University of Hyderabad, Hyderabad, September 20-22, 2013.

Parashar, P.:

(1) Invited talk, International Conference on Quantum Information Processing and Applications (QIPA), Harish Chandra Research Institute, Allahabad, December 02-06, 2013; (2) Invited talk, National Conference on Quantum Correlations: Foundations and Applications, Kolkata, March 04-05, 2014.

Pal, S.:

(1) Delivered Lectures, IUCAA-BITS Autumn School on Cosmology, BITS, Pilani, November 05-15, 2013; (2) Invited talk, Topical Conference on Gravity and Cosmology, Saha Institute of Nuclear Physics, Kolkata, December 13, 2013.

Editorial and other Assignments

Roy, S.:

(1) Delivered key note address and chaired a session, workshop on Buddhist Philosophy and Modern Science, Tibet House, New Delhi, November 29, 2013; (2) Delivered a talk, center of cognitive science, Jadavpur University, Kolkata, January 03, 2014; (3) Delivered a talk, workshop on Modern Science and Psychology, New Delhi, January 29-30, 2014; (4) Programme Director, International Conference on Complex Dynamical Systems and its Applications, March 10-12, 2014.

Biological Sciences Division

Biological Anthropology Unit

Bharati, P.:

School of Studies in Anthropology, Pt. Ravishankar Shukla University, Raipur, Chattisgarh. January 17-19, 2014.

Mukhopadhyay, B.:

(1) School of Studies in Anthropology, Pt. Ravishankar Shukla University, Raipur, Chattisgarh. January 17-19, 2014; (2) Department of Anthropology, Dibrugarh University, Dibrugarh, Assam, February 21-23, 2014.

Mukhopadhyay, S.:

(1) School of Studies in Anthropology, Pt. Ravishankar Shukla University, Raipur, Chattisgarh. January 17-19, 2014; (2) Department of Anthropology, Dibrugarh University, Dibrugarh, Assam, February 21-23, 2014.

Vasulu, T.S.:

(1) Indian Society of Human Genetics ISHG 38th Annual Conference, Ahmadabad, January 22-25, 2014; (2) Indo-USA International Workshop, Dept Mathematics, IISc, Bangalore, December 12-14, 2013; (3) 3rd Annual Conference of the Society, NIMHANS, Banagalore December 19–20, 2013.

Social Sciences Division

Economic Research Unit

Kabiraj, Tarun:

(1) Presented paper, Conference on Contemporary Issues in Development Economics, Department of Economics, Jadavpur University, Kolkata, January 06-07, 2014; (2) Special Lectures, Department of Economics, Vidyasagar University, West Bengal, March 24–25, 2014.

Majumder, Amita:

Member, Working Group on Terms of Trade between the Agricultural and Non-agricultural Sectors, Govt. of India, Ministry of Agriculture, Dept. of Agriculture and Cooperation, Directorate of Economics and Statistics (IAC Division), since 2012.

Pal, Manoranjan:

Invited Speaker, National Conference on Recent Advances in Statistics and Applications (RSA), School of Studies in Statistics, Pt. Ravishankar Shukla University, Raipur, India, November 15-17, 2013.

Sarkar, Nityananda:

(1) Invited talk, 3rd International Conference on Advanced Data Analysis, Business Analytics and Intelligence, Indian Institute of Management, Ahmedabad, April 12-15, 2013; (2) Invited talk, Banasthali University, Rajasthan, September 25-30, 2013; (3) Delivered lectures, Training Workshop on Research Methodology in Economics, Burdwan University, West Bengal, September 19, 2013.

Linguistic Research Unit

Dasgupta, Probal:

(1) Invited lecture, Esperanto in the European Union's language testing system, National Meeting on Esperanto, Goethe-Zentrum, Hyderabad, October 26-27, 2013; (2) Invited lecture, Seminar on India and Lithuania: Antanas Poska, Herman Kallenbach and others, Department of History, University of Kolkata, Kolkata, November 18, 2013; (3) 3rd International Congress of Bengal Studies, University of Kolkata, Kolkata, November 19-22, 2013; (4) 11th International Conference on South Asian Languages, Banaras Hindu University, Uttar Pradesh, January 23-25, 2014; (5) 30th South Asian Languages Analysis Roundtable, University of Hyderabad, Hyderabad, February 06-08, 2014; (6) International seminar on Recovering Conceptual Histories, Centre for the Study of Developing Societies, Delhi, February 13-15, 2014; (7) Invited talk, Dept of Linguistics, University of Kolkata, Kolkata, February 26, 2014; (8) First Annual Conference on Cognitive Science, India International Centre, Delhi, March 03-05, 2014; (9) Invited talk, Dept. of HSS, IIT, Guwahati, March 14, 2014.

Dash, Niladri Sekhar:

(1) Invited Lectures, Faculty Development Programme in Computational Linguistics, College of Engineering, Cherthala, Kerala, India, July 22-26, 2013; (2) Content Evaluator, Braahman Net Solutions, New Delhi, July-August, 2013; (3) Expert Consultant, Cognizant Technology Solutions, Chennai, September-October, 2013; (4) Invited Lecture, National Translation Mission, Ministry of HRD, Govt. of India, July, 2013; (5) Invited Lecture, Jadavpur University, Kolkata, October 23-24, 2013; (6) Invited Lectures, National Translation Mission, Central Institute of Indian Languages, Mysore, December 17-18, 2013; (7) Invited Lectures, UGC Academic Staff College, Manipur University, Imphal, January 13-16, 2014; (8) Session Chair, 35th Annual and 1st International Conference of the Linguistic Society of India (ICOLSI-1), Central Institute of Indian Languages, Mysore, India, November 27-29, 2013; (9) Co-ordinator, Translator's Orientation Programme in Bangla, National Translation Mission, Central Institute of Indian Languages, Karnataka, Ministry of HRD, Govt. of India, July 01-05, 2013; (10) Session Chair, 11th International Conference of South Asian Languages and Literatures (ICOSAL 11), Banaras Hindu University (BHU), Varanasi, India, January 23-25, 2014; (11) Session Chair, 30th South Asian Languages Analysis Roundtable (SALA 30), Centre for Applied Linguistics and Translation Studies, University of Hyderabad, Hyderabad, February 06-08, 2014; (12) Language Expert, Office of the Registrar General-India (ORGI), Language Division, Ministry of Home Affairs, Govt. of India, March, 2014.

Psychology Research Unit

Dutta Roy, D.:

(1) Chaired a session, 3rd InSPA National Conference on School Psychology, Chennai, November 22-24, 2013; (2) Chaired a session and conducted, workshop on Psychoinformatics, National Academy of Psychology, Rourkella, December 13-15, 2013; (3) Chaired session, 49th National and 18th International Conference of Indian Academy of Applied Psychology, Ahmedabad, Gujarat, March 01-03, 2014; (4) Invited talk, Mithibhai College, Mumbai, January 04, 2014; (5) Barkatullah University, Bhopal, July 24-26, 2013; (6) Conducted course work, Two-week Capacity Building Workshop for Young Faculty in Social Sciences (ICSSR), Andhra Pradesh University, Vizag, February 15-16, 2014; (7) Conducted, workshop on SPSS and its application, B.M. Institute of Mental Health and Jai Narain Vyas University, Ahmedabad, Gujarat, February 28, 2014; (8) Conducted,

Editorial and other Assignments

teaching course on Business Research Method, Indian institute of Management, Shillong, March 7-10, 2014.

Ghosh, Anjali:

Visited as an expert, Department of Management Studies, Indian Institute of Technology, Chennai, April, 2013 and March, 2014.

Gupta, Rumki:

Presented paper, National seminar on Social Change in Contemporary India: Psychological Dimensions and Social Response, Sri Aurobindo college, Malviya Nagar, New Delhi, March 21-22, 2014.

Sampling and Official Statistics Unit

Chattoapdhyay, Nachiketa:

(1) Member, Working Group on Drug Abuse Survey, National Statistical Commission; (2) Delivered invited lecture, Official Statistics for Students of Fellow Programme, Indian Institute of Management, Calcutta.

Mitra, Sandip:

(1) Lecture, IGC, Bihar, July 19-20, 2013; (2) Lecture, South Asia Growth Conference, July 18, 2013; (3) Invited Talk, Some Experiments on Development Institute of Financial Management and Research, September 05-07, 2013; (4) Presentation on Surveys and Experiments in Social Sciences, Gauhati University: ICSSR Training Programme on Computer and Statistical Methods in Social Science Research, Assam, April 18-27, 2013.

Mukherjee, Diganta:

(1) Technical Advisor, Index Committee of MCX-SX, 2013; (2) Member of the Core group, Working group, 72nd round of NSS, NSSO, 2013; (3) Member, Pratap Narain Committee on National Accounts, Indian Association for Research in National Income & Wealth, 2014.

Pathak, Prasanta:

(1) Member, Working Group for formulating survey methodology, etc., 71st Round of NSS; (2) Member, Project Management Unit, Strategic Statistical Plan and 13th Finance Commission for Department of Statistics and Programme Implementation, Government of West Bengal; (3) Invited as Special Guest, Fourth National Seminar on Industrial Statistics, September 26, 2013; (4) Worked as consultant, Bureau of Energy Efficiency, New Delhi, November 21, 2013; (5) Worked as consultant, evaluation of 36 NAIP projects, December 03-04, 2013; (6) Invited to attend, workshop in the Conference hall, Shram Shakti Bhawan, Rafi Marg, New Delhi, Ministry of Labour, Government of India, December 09, 2013; (7) Presented paper as an invited speaker, DSA-sponsored National Seminar on Application of Statistics in Social Sciences, Department of Statistics, Calcutta University, Kolkata, March 27-28, 2014.

Sociological Research Unit

Behera, Hari Charan:

(1) Presented paper, Achieving SMART Governance in Land Administration-17th TWF, 33rd SKOCH Summit, New Delhi, September 04, 2013; (2) Delivered lecture on Survey Methodology, programme on Science and Technology for Rural Societies, Centre for Disaster Management, LBSNAA, Assam, November 18, 2013.

Chakroborty, Sonali:

Paper Presented, Employment Situation in Jharkhand, National Conference on Interdisciplinary Research in Social Science in Eastern India with special reference to Jharkhand, February 27-28, 2014.

Ghosh, Bhola Nath:

(1) Resource Person and Taught on Research Design Manuscript Writing in Technical Session – I, 2013; (2) Resource Person and Taught, Workshop on Manuscript writing for publication in Journals, November 29-30, 2013; (3) Four thesis of Gulbarga University have been evaluated and all of them were awarded Ph. D. Degree, Karnataka, 2013; (4) Delivered Key Note Address, National Seminar on Phenomenon of Witch Hunting in the North-East: A Major Challenge to Women, S.B.M.S. College, Sualkuchi, Guwahati, Assam, September 27-28, 2013; (5) Delivered a lecture on Research Methodology, Department of Physical Education, Jadavpur University, Kolkata, 2013; (6) Presented Lecture, Role of Self-help Groups in the Society, Hiralal Majumdar Memorial College for women, West Bengal, March 10, 2013; (8) Presented Lecture, Elementary Concepts in Research Methodology: A Sociological Perspective, P.G. Department of Sociology, University of Kashmir, Naseem Bagh, Srinagar, May 10, 2013; (9) Presented Empowerment of Women in North East, Department of Social Work, University of Kashmir, Naseem Bagh, Srinagar, May 13, 2013.

Jana, Rabindranath:

(1) Invited teacher to deliver two lectures, Vivekananda University, Ramakrishna Mission Ashrama, Narendrapur, West Bengal, April, 2013; (2) Designated as a member of the PhD Supervisory Committee, Faculty Centre for Integrated Rural Development and Management (IRDM), Ramakrishna Mission Vivekananda University (RKMVU), Narendrapur, South 24 Parganas, West Bengal.

Economics and Planning Unit, Delhi

Farzana, Afridi:

(1) Visited, NCAER-Brookings India Policy Forum, New Delhi; (2) Visited, Indian Econometric Society's Golden Jubilee Conference (DSE).

Ghate, Chetan:

(1) Visited, 15th Neemrana-NBER Conference, Neemrana, December, 2013; (2) Visited, Indian Institute of Management, Indore, March, 2013.

Mukhopadhyay, Abhiroop:

Visited, IGIDR, Mumbai, December, 2013-January 03, 2014.

Mishra, Debasis:

Tata Institute of Fundamental Research, Mumbai, May, 2013.

Ray, Tridip:

(1) Indira Gandhi Institute of Development Research, Mumbai, August 02, 2013; (2) Centre of Studies in Social Sciences, Kolkata, October 08-09, 2013.

Ray Chowdhury, Prabal:

(1) Visited, Jadavpur University, Kolkata; (2) Visited, Indian School of Business, Hyderabad; (3) Visited, Delhi School of Economics, Delhi.

Ramaswami, Bharat:

(1) Indian Econometric Society Meeting, Indira Gandhi Institute of Development Research, Mumbai, December, 2013; (2) Attended, Conference on Political Economy of Policy Reform, University of Mumbai, Mumbai, February, 2014.

Editorial and other Assignments

Sen, Arunava:

(1) Indian Institute of Science, Karnataka, April, 2013; (2) Tata Institute of Fundamental Research, Mumbai, May, 2013.

Economic Analysis Unit, Bangalore

Ramachandran, V.K.:

(1) Foundation for Agrarian Studies Tenth Anniversary Conference, Kochi, January 09-12, 2014; (2) Department of Economics, Madras Christian College, Chennai, January 23, 2014.

Swaminathan, Madhura:

(1) Azim Premji University, Bangalore, August 02, 2013; (2) Annual Conference of Indian Society of Labour Economics, JNU, New Delhi, December 16-18, 2013; (3) Foundation for Agrarian Studies Tenth Anniversary Conference, Kochi, January 09-12, 2014; (4) Department of Agricultural Economics and Extension, University of Agricultural Sciences, Bangalore, January 28, 2014; (5) Department of Statistics, University of Mysore, Karnataka, March 21, 2014.

Statistical Quality Control and Operations Research Division

SQC & OR Unit, Kolkata

Das, Prasun:

(1) Invited Talk, University of Pune, Pune, December 18, 2013; (2) Invited Talk, Workshop on Genetic Algorithm: Concepts and Applications, BUIE, W.B., November 20, 2013; (3) Invited Talk, Intl. Conf. on Mathematical Techniques in Engineering Applications, Graphic Era University, Dehradun, October 24, 2013; (4) Invited Talk, Mgmt Dev. Programme on TQM in Technical & Higher Education, Burdwan University, Burdwan, August 07, 2013.

Mukherjee, Arup R.:

Delivered a talk, seminar on Building Process Excellence in Manufacturing, Bengal Chamber of Commerce and Industries Auditorium, Kolkata, January 17, 2014.

Pradhan, Biswabrata:

Delivered a talk, Nizam's Institute Medical Science (NIMS), Hyderabad, March 15, 2014.

SQC & OR Unit, Delhi

Neogy, S.K.:

Delivered talks, Linear Programming in Refresher Course in Mathematical Sciences, Delhi University, December 24, 2013.

SQC & OR Unit, Bangalore

Gijo, E.V.:

(1) Delivered invited talk, Nirmala College, Muvattupuzha, Kerala, October, 2013; (2) Delivered invited talk, Sir Syed College, Taliparamba, Kannur, Kerala, March, 2014.

John, Bobby:

(1) Delivered invited lecture, Dr. Ambedkar Institute of Technology, Bangalore, April, 2013; (2) Delivered invited talk, Sri Ramakrishna Engineering College, Coimbatore, April, 2013; (3) Delivered invited talk, Canara Engineering College, Benjanapadavu, Mangalore, July, 2013; (4) Delivered talk on Sri Siddhartha Institute of Technology, Tumkur, Karnataka, September, 2013; (5) Delivered lecture, Vellore Institute of Technology, Chennai, October, 2013; (6) Delivered invited lecture, BVB College of Engineering, Hubli, Karnataka, November, 2013; (7) Delivered invited lecture, Defence Food Research Laboratory (DFRL), Mysore, Karnataka, December, 2013; (8) Delivered invited talk, Velalar College of Engineering and Technology, Erode, Tamil Nadu, March 2014.

Perumallu, P.K.:

(1) Delivered a Guest lecture, QATS, Air Force Station, Jalahalli, Bangalore, February, 2014; (2) Delivered a Invited Talk, SSBN Degree College, Ananthapur, AP, February, 2014.

Ray, Somnath:

Delivered Invited talk, Nirmala College, Muvattupuzha, Kerala, October, 2013.

Ray, Sanjit:

(1) Delivered Invited Talk, R V College on engineering, Bangalore, December 28, 2013.

SQC & OR Unit, Chennai

Pal, Surajit:

Served as External Examiner, Jadavpur University, Kolkata; (2) Jury Member, KAIZEN competition, CII.

Raman, D. Sampangi:

(1) Served as member of Doctoral Committee, Centre for Research, Anna University, Chennai; (2) jury member, KAIZEN competition, CII; (3) Jury Member, QC Circle, CII.

SQC & OR Unit, Hyderabad

Murthy, G.S.R.:

(1) Delivered Invited Talk, Institute of Chemical Technology, Mumbai, January 23, 2014.

SQC & OR Unit, Mumbai

Sarkar, Ashok:

Served as Panelist, Lean and Six Sigma Excellence Awards 2013, Symbiosis Centre for Management and Human Resource Development, Pune, October 7-8, 2013.

Library, Documentation and Information Science Division

Library, Kolkata

Ganguly, Nibedita:

(1) Acted as resource person and delivered lecture, DLIS, University of Calcutta, Kolkata, September 07, 2013; (2) Delivered a lecture, International Conference on Recent Trends in Science &

Editorial and other Assignments

Technology, College of Engineering and Management, Kolaghat, December 28, 2013; (3) Delivered lecture, ONGC, WDF, Kolkata, March 08, 2014.

Pal, Jiban K.:

(1) Completed a certification-training, National Workshop on A-VIEW e-Learning Software, Amrita University, Kerala under the National Mission on Education through ICT (NMEICT), MHRD, Govt. of India, July 08, 2013; (2) Invited as Resource Person, IGNOU [for Interactive Radio Counseling of BLIS course, GyanVani FM Radio Station (105.4 MHz)], Kolkata, July 21, 2013; (3) Received invitation as Academic Counselor-cum-Evaluator, IGNOU for BLIS and MLIS courses; (4) Participated and received the First Prize of Mega Online Quiz Contest, E-Content 2013: National Seminar Series on Publisher ~ Library Partnership, Informatics (India) Limited, Kolkata, October 25, 2013.

Raychaudhury, Arup:

(1) Delivered invited 4 lectures, UGC Sponsored Refresher Course in Library and Information Science, University of Calcutta, Kolkata; (2) Delivered lecture, Workshop on Designing and Management of Web Based Library Services at Department of Library & Information Science, Mizoram University, Aizawl, March 11-15, 2014.

Center for Soft Computing Research: A National Facility

Chakraborty, M.K.:

(1) Invited talk, Workshop on Rough Sets and Knowledge Technologies, JNTUH College of Engineering, Hyderabad, November 10-11, 2013; (2) Programme Chair, 5th World Congress on Paraconsistency (WCP5), Kolkata, February 13-17, 2014.

Ghosh, A.:

(1) Invited Talk, Utkal University, Odisha, December 15-18, 2013; (2) Invited talk, Workshop on Data-warehouse and Data Mining, Central University of Jharkhand, Ranchi, February 05-08, 2014; (3) Invited talk, Central University of Jharkhand, Ranchi, March 12-15, 2014; (4) Invited lecture, School of Studies in Electronics & Photonics, Pt. Ravishankar Shukla University, Raipur, March 19, 2014.

Ghosh, K.:

(1) Delivered Lecture, Workshop on Modern Trends in Soft Computing & Security Issues (MTSCS2013), NIST, Berhampore, Odisha, September 23-28, 2013; (2) Invited talk, 5th World Congress on Paraconsistency (WCP5), Kolkata, February 13-17, 2014; (3) President, Jury Board in the Contest: Picturing Contradiction, 5th World Congress on Paraconsistency (WCP5), Kolkata, February 13-17, 2014; (4) Delivered lecture, Department of Mathematics, Tripura University, Agartala, March 29, 2014.

Pal, S.K.:

(1) Invited Talk, Workshop on Contemporary and Future Perspectives of Bio-Engineering in Technology, NIT-Agartala, Tripura, July 09, 2013; (2) Invited Talk, Workshop on Recent Trends in Multimedia Technology (RTMT), RCC Institute of Technology, Kolkata, July 11, 2013; (3) Invited Talk, Seminar on Science, Technology, Society Interface, Meghnad Saha Auditorium, Calcutta University, Kolkata, July 26, 2013; (4) 23rd Faraday Memorial Lecture, IEEE Hyderabad Section, Hyderabad, September 22, 2013; (5) Keynote Talk, Workshop on Modern Trends in Soft Computing and Security Issues, NIST, Behrampore, September 23-28, 2013; (6) Keynote Talk, Workshop on Pattern Analysis and Machine Intelligence, St. Thomas' College of Engineering and Technology (STCET), IEEE Computational Intelligence Society, Kolkata Chapter, October 09, 2013; (7) Keynote Talk, Rough Set Day Celebration Workshop on Rough Sets and Knowledge Technology, JNT University, Hyderabad, November 10-11, 2013; (8) Chief Guest Speech, 2nd International Conference on Computing, Communication and Sensor Network Hotel Peerless Inn, Kolkata, November 22-24, 2013; (9) General Chair, 5th International Conference on Pattern Recognition and Machine Intelligence (PReMI-13),

Kolkata, December, 2013; (10) Advisory Committee Member, 4th National Conference on Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG 2013), Jodhpur, India, December 19-21, 2013; (11) Invited Talks, Prof. Ram Meghe College of Engg. & Management, Amravati University, Maharashtra, January 19-22, 2014; (12) Chief Guest Speech, First Foundation Day of IEEE Student Branch, IIT, Patna, January 25, 2014; (13) 1st IEEE Distinguished Lecture of IEEE Mangalore Section, NITK-Surathkal, Karnataka, February 22, 2014; (14) Keynote Talk, BIG LEARN'14, NITK-Surathkal, Karnataka, February 22-23, 2014; (15) Steering Committee Member, International Symposium on Signal Processing and Intelligent Recognition Systems (SIRS-2014), (IIITM-K), Trivandrum, March 13-15, 2014; (16) Keynote Talk, International Symposium on Signal Processing and Intelligent Recognition Systems (SIRS-2014), IIITM-K, Trivandrum, March 13-15, 2014; (17) Keynote Talk, International Conference on Computational Intelligence, Bombay University, Mumbai, March 21-22, 2014.

R.C. Bose Centre for Cryptology and Security

Paul, Goutam:

(1) Delivered Invited Talk, Govt. College of Engineering & Textile Technology, Berhampore, Murshidabad, West Bengal, September 22, 2013; (2) Delivered Invited Talk, Lecture at Staff Development Programme on Cryptography & Information Security, Govt. College of Engineering & Textile Technology, Berhampore, Murshidabad, West Bengal, September 21, 2013.

Rana, Barua:

(1) Delivered Invited Talk, International Conference on Socio-Economic Challenges and Sustainable Solutions, CR Rao AIMSCS, Hyderabad, December 31, 2013; (2) Delivered Invited Talk, Workshop on Number Theory and Cryptography, Ramanujam Mathematical Society, Lady Sriram College, Delhi, November 08-09, 2013; (3) Delivered Invited Talk, Public Key Cryptography, Workshop on Cryptography, IIT, Patna, April 07, 2013.

Ruj, Sushmita:

(1) Delivered Invited Talk,, National Workshop on Cryptology, October 03, 2013; (2) Delivered Invited Talk, Central University, Rajasthan, November 29, 2013; (3) Delivered Invited Talk, IEST, Shibpur, March 26, 2014.

9. REGIONAL MATHEMATICAL OLYMPIAD 2013 AND INDIAN NATIONAL MATHEMATICAL OLYMPIAD 2014

Regional Mathematical Olympiad (RMO) 2013: West Bengal Region

RMO-2013 was held on December 01, 2013, at the Kolkata centre of Indian Statistical Institute and in 113 centres, located in different parts of West Bengal. INMO-2014 was held on February 02, 2014, at the Kolkata centre of Indian Statistical Institute.

Prof. Rana Barua of the Stat-Math Unit, Kolkata and Prof. Sumitra Purkayastha of the Applied Statistics Unit, Kolkata acted as Regional Coordinators. Apart from this, the office of Applied Statistics Unit played the central role in organizing RMO-2013 and INMO-2014.

Regional Mathematical Olympiad (RMO) 2013: Karnataka Region

Regional Mathematical Olympiad (RMO), Karnataka region, is being conducted by ISI Bangalore center for the past several years. Prof. Anita Naolekar continued to serve as the Regional Coordinator in 2013. A total of 2708 students from all over Karnataka registered for the examination, which was held on 1st December, 2013, in 25 centres across the state.

With the help of some faculty members, post-doctoral fellows and research scholars, 1841 answer scripts were evaluated at ISI Bangalore. The number of students who qualified to write the national-level test INMO was 35. Another 21 were selected for attend the INMO training camp, along with the top 35, at ISI Bangalore.

A week-long training camp was organized at ISI Bangalore for these students, to make them familiar with advanced problem-solving techniques before they appear for the national level test. Several distinguished speakers were invited for this purpose. Participants were provided with food and accommodation at ISI Bangalore. Prof. B. Sury handles this activity.

Indian National Mathematical Olympiad (INMO) 2014

The Mathematical Olympiad Programme in India, which leads to participation of Indian students in the International Mathematical Olympiad (IMO) is organized by the Homi Bhabha Centre for Science Education (HBCSE) on behalf of the National Board for Higher Mathematics (NBHM) of the Department of Atomic Energy (DAE), Government of India. Its main purpose is to spot mathematical talent among pre-university students in the country. For the purpose of training and selection of students for the Olympiad, 25 regions all over the country have been designated and each assigned a Regional Coordinator. Additionally, three groups [Central Board of Secondary Education (CBSE), Navodaya Vidyalaya Samiti (NVS) and Kendriya Vidyalaya Sangathana (KVS)] have a 'Regional Coordinator' each.

The Kolkata centre of Indian Statistical Institute organizes both the Regional Mathematical Olympiad (RMO) at West Bengal, followed subsequently by Indian National Mathematical Olympiad (INMO), whose participants are those who have cleared the RMO test and are primarily from West Bengal.

PART II. ADMINISTRATION AND OFFICE BEARERS

10. GENERAL ADMINISTRATION

Administrative Services Division

The Administrative Services Division at the Headquarters caters to various needs of the Scientific workers in all the Scientific Units of the Institute engaged in various scientific, research and academic activities and provides them with necessary infrastructural facilities in their pursuit of excellence. The centres at Delhi, Bangalore, Chennai and Tezpur, each having a number of scientific units are, by and large, getting administrative support from the administrative units/sections there. The Administrative Services Division has the following units at the Headquarters in Kolkata:

Sl. No.	Name of the Unit	Sl. No.	Name of the Unit
1.	Accounts Section	17.	Import & Travel Cell
2.	Audio-Visual Unit	18.	Internal Audit Cell
3.	Binding Unit	19.	Legal Cell
4.	Canteen	20.	Medical Expenses Reimbursement Unit
5.	Cash	21.	Medical Welfare Unit
6.	C E (A & F)'s Office	22.	Personnel Unit
7.	Central Office & Despatch Unit	23.	Provident Fund Unit
8.	Central Stores & Tailoring Unit	24.	Public Relations Unit
9.	Council Section	25.	Printing and Publication Unit
10.	Director's Office	26.	Official Language Cell
11.	Electrical Maintenance Unit	27.	Retirement Benefit Cell
12.	Engineering Unit	28.	Sankhya Office
13.	Estate Office	29.	Security Unit
14.	Guest House	30.	Telephone Unit
15.	Hostels	31.	Transport Unit
16.	House Building Advance Cell	32.	SC / ST / OBC Cell

Apart from the Units mentioned above, there are some small cells dealing with Budget, and other issues to take care of the specific needs of the Institute. The Administrative Services Division also looks after the running of hostels for students, research scholars and International Statistical Education Centre (ISEC) trainees and also the running of Canteen for the workers and students of the Institute. The other outlying Units are controlled directly by the Headquarters at Kolkata. The Administrative Services Division takes the responsibility for all new constructional activities of the Institute at its Headquarters and also at outlying centres/branches. A brief report on the constructional activity in the current year is narrated in the subsequent paragraphs.

The Administrative activities in four different Centres, namely Delhi, Bangalore, Chennai and North East Centre at Tezpur and in other outlying Units of the Institute and in its Giridih Office, are more or less similar to the Headquarters but on a much smaller scale.

Office bearers of the Institute Administration during the year:

<i>Director</i>	:	Bimal K. Roy
<i>Professors-in-Charge of Scientific Divisions</i>	:	T.S.S.R.K. Rao (Theoretical Statistics & Mathematics)

Administration

Mausumi Bose (Applied Statistics)
 Probal Roy Chowdhury (Social Sciences)
 Saswati Bandyopadhyay (Physics & Earth Sciences)
 Subrata Kr. Roy (Biological Sciences)
 C.A. Murthy (Computer & Communication Sciences)

Head, SQC & OR : Ashis Kr. Chakraborty
Head, Delhi Centre : Satya P. Das
Head, Bangalore Centre : N.S.N. Sastry
Head, Chennai Centre : S. Ponnusamy
Dean of Studies : Pradipta Bandyopadhyay
Chief Executive (A & F) : S.K. Iyer

List of workers who joined/retired/voluntarily retired/resigned/terminated/died during the year
Appointments

Scientific / Technical Workers

Srl. No.	Name	Srl. No.	Name
1.	Sushmita Ruj	8.	Regil Nadh CM
2.	Biswanath Dutta	9.	Jyotishman Bhowmick
3.	T. Karthick	10.	Sm. Kalpana T.M.
4.	Goutam Kumar Paul	11.	Satadal Ganguly
5.	Hari Charan Behera	12.	Souvik Roy
6.	Mathew C. Francis	13.	Debapriyo Majumdar
7.	Prabuddha Chakraborty	14.	Abhishek Mukherjee

Non-Scientific Workers

Srl. No.	Name	Srl. No.	Name
1.	Prabhu Periyasamy M	7.	Ashwini N.
2.	Shovan Khatua	8.	Saikat Majumder
3.	Tapas Samanta	9.	Prantik Ray
4.	Suprativ Biswas	10.	Satyajit Naskar
5.	Durgam Giri	11.	Dinesh Kumar
6.	Sreemoyee Bhowmick		

Retirement/Voluntary Retirement

Scientific & Technical Workers

Srl. No.	Name	Srl. No.	Name
1.	Nanda Dulal Chatterjee	8.	Ranjan Gupta
2.	M.C. Malashetti	9.	Malay Kr. Kundu
3.	Subhas Ch. Kundu	10.	Subir Kr. Bhattacharyya
4.	Birendra Prasad Das	11.	Subrata Gangopadhyay
5.	N.S.S. Narayana	12.	Ranajit Bhandary
6.	K. Narasimha	13.	Sankar Narayan Das
7.	Aniruddha Chakraborty		

Non-Scientific Workers

Srl. No.	Name	Srl. No.	Name
1.	Top Bahadur	23.	Pradip Roy
2.	E.V. Narayana	24.	Ardhendu Bhattacharya
3.	Nemai Chandra Biswas	25.	Biswanath Porel
4.	Sankar M. Roy	26.	N. Vijaya Kumar
5.	Dorilal Balmiki	27.	Shyamal Chatterjee
6.	Narayan Ch. Saha	28.	Raju Mallick
7.	Sahadeb Das	29.	K. Kondaiah
8.	Samarendra Nath Dutta Banik	30.	S.S. Sethi
9.	Samir Kundu	31.	Bedna Shaw
10.	Nitai Chandra Paul	32.	Ashok Chatterjee
11.	Biva Nath	33.	Swapan Kr. Mukherjee
12.	Shakuntala Pashi	34.	Subhas Mukherjee
13.	Subrata Mukherjee	35.	Sajjan Singh
14.	Madan Tewari	36.	Sanichar Orum
15.	Swapan Kr. Dey	37.	Mahinder Ram
16.	Tapan Kr. Dey	38.	Tapan Kumar Das
17.	Malati Chatterjee	39.	Munna Roy
18.	Shyamal Chandra Chakraborty	40.	Samir Kumar Chakraborty
19.	Subrata Paul	41.	Tapan Kr. Dutta
20.	Rina Das	42.	Dinabandhu Paul
21.	Ram Chandra Shaw	43.	Biswanath Prasad Pandey
22.	K. Sundara Rajan		

Resignation/Termination

Scientific Worker

Srl. No.	Name
1.	Sharmila Sengupta
2.	Abhishek Bhattacharya

Administration

Non-Scientific Worker

Srl. No.	Name
1.	Vishwabandhu
2.	Sumita De
3.	Pradip Sarkar

Death

Scientific Worker

Srl. No.	Name
1.	Basudeb Kr. Sarkar
2.	Anupam Pal

Non - Scientific Worker

Srl. No.	Name
1.	Dhananjoy Bera
2.	Dilchand Mallick
3.	Dilip Nayak

Number of workers in the Institute as on 31st March 2014 (A.N.)

Number of workers in the Institute as on 31st March 2014:

(i)	Scientific and Technical Workers	-	438
(ii)	Non-Scientific Workers	-	<u>571</u>
	Total	:	<u>1009</u>

Breakup of manpower by Gender, Social category and Disability group as on 31st March 2014 (A.N.)

Total Strength		Physically Handicapped (PH)	Scheduled Caste (SC)	Scheduled Tribe (ST)	Other Backward Class (OBC)	Minorities
Male	849	05	103	28	73	19
Female	160	Nil	15	01	03	01
Total	1009	05	118	29	76	20

Applications received and action taken by the Institute under RTI Act, 2005

Name of the Appellate Authority: Professor Bimal K. Roy, Director of the Institute.

Name of Central Public Information Officer: Shri S.K. Iyer, Chief Executive (Admn. & Finance) of the Institute.

A total number of 168 (One sixty eight) applications were received by the Central Public Information Officer of the Institute during 2013-14. Central Public Information Officer provided information against 168 (One sixty eight) applications within the stipulated date. The summary statement in this regard for the year 2013-14 is appended below:-

No. of Applications received	No. of cases accepted	Decisions where requests were fully or partially rejected		No. of decisions from Appellate Authority	C I C decision			Amount collected (Rs.)		
		Fully rejected	Partially rejected		No. of decisions received	Penalty imposed	Disciplinary action, if any	Fee	Other Charges	Penalty amount
168	168	Nil	Nil	31	1	NIL	NIL	1602	1644	NIL

Budget and Finance

For the year 2013-2014, Section 8(1) Committee recommended Rs.17174.00 lakhs (Government Grant Rs.16824.00 lakhs and ISI internal receipt Rs.350.00 lakhs) under Non-Plan (BE) and Rs.11216.93 lakhs under Plan (BE). The Government approved a sum of Rs.10500.00 lakhs and of Rs.4300.00 lakhs for Non-Plan and Plan expenditure respectively. At the revised estimate stage, the Institute sought for a grant of Rs.17208.00 lakhs and Rs.8250.00 lakhs under Non-Plan and Plan respectively which was also recommended by the Section 8(1) Committee. The Government sanctioned a grant of Rs.12799.00 lakhs (including the unutilized amount of Rs.3.21 lakhs during the financial year 2012-2013) under Non-Plan and the Plan RE allocation was fixed at Rs.4375.70 lakhs (including the unutilized amount of Rs.509.88 lakhs during the financial year 2012-2013 and Rs.464.22 lakhs fund pertaining to R.C. Bose Centre of Cryptology). The plan expenditure during report was well within the budget allocation sanctioned by the Government. However, the non-plan expenditure was more by Rs 1801.03 lakhs over the fund allotted by the Ministry. The Audited Annual Accounts of the Institute for the year 2013-2014 has been furnished in Part IV of this report.

Major Construction / Renovation works taken up by the Institute during 2013-2014

Kolkata

Interior Finishing Works of the 7th floor Platinum Jubilee Academic Building at ISI.

The work of interior finishing and LAN works of the vacant 7th floor have been completed.

Administration

Construction of JBS Haldane Bhawan

The Institute took up the construction of the ISEC Building (JBS Haldane Bhawan) at the 202, B.T. Road campus for providing ISEC students with all facilities under one roof. The building has been designed to have space for all facilities like Classrooms, Seminar room, Library, accommodation for students and Visiting Faculties, Gymnasium, Dining hall, etc. The structural work of the building has been completed and the finishing works like fire-fighting and fire-alarm system, lift installation, air-conditioning and LAN have also been completed. The interior works including furniture and electrical works have also been completed. A separate electrical sub-station for the building has also been commissioned to ensure stable and trouble free power supply. The area development of the 202 B.T. Road campus i.e. the vicinity of the newly constructed ISEC Building has been started and the work is nearing its completion.

Major Renovation/construction works

The Institute took up miscellaneous works like the renovation/construction of boundary walls, staff quarters, toilets, sewerage system, drainage system, internal roads, security pathway, various units, parking space, hostel rooms, water-supply lines, etc. during 2013-2014.

The work for renovation of the 3rd floor of the P.N. Haksar Bhavan has been started and going on full swing.

The work pertaining to R.C. Bose Centre for Cryptology & Security at Gupta Niwas Campus has been given to NBCC and the same work is in planning stage at present.

Delhi

Land and Construction

- a) No Major construction/ renovation work was undertaken by ISI Delhi Centre during the financial year 2013-14.
- b) Miscellaneous civil/ electrical maintenance works undertaken by the Centre during the year includes the followings:
 - i) Providing and laying the interlocking paver blocks near parking area.
 - ii) Repair and renovation of mess/ canteen.
 - iii) Repair and renovation of D type flats.
 - iv) Painting works in Old Hostel rooms of the Campus.
 - v) Library water proofing work.
 - vi) Illumination of badminton and volleyball courts and re-wiring work in workers' canteen and laying of cables.

Bangalore

Major construction / renovation works completed / undertaken by the Bangalore Centre during 2013 - 2014.

Construction work of Research Scholar Hostel building

The construction works of Research Scholar Hostel building in ISI Bangalore Centre is completed with a total construction cost of Rs.4,46,37,485/- (Rupees four crore forty six lakh thirty seven thousand four hundred eighty five) only. The total built up area of the building is 1687.95 square metres.

We have a plan to propose construction of 5 more floors with lift facilities in this building with an approximate cost of Rs.18.6 crore.

Construction of 2nd floor of the Guest House and expansion of its Dining Hall

The work pertaining to the construction of one additional floor on the Guest House and the expansion of its Dining Hall is in preliminary approval stage. The construction is expected to commence by early 2014-15.

Renovation of students Mess & Kitchen

This particular work is also in preliminary stage. The process of selecting architect and consultant is in final stage. Physical activities are expected to commence by early 2014-15.

Miscellaneous repairing/ renovation work

- i) The repair and renovation work of the toilets in Administrative Block was taken up in phases. The renovation of toilets in the 1st floor has already being completed and opened to the employees for use. The work pertaining to remaining part of the renovation work is in progress.
- ii) The Platinum Jubilee Auditorium reconstruction work is also in the verge of completion and likely to be opened for use by early 2014-15.
- iii) The construction of toilet cum clock rooms near Gate no. – 2 (South Gate) is in preliminary stage.
- iv) The construction of RCC board, containing the name of the Institute, is nearing completion.
- v) The work pertaining to canopy over the main building is in the preliminary stage.
- vi) Construction of toilet for physically challenged is also in the preliminary stage.
- vii) The renovation work of the football ground has been completed and put to use for the students and employees.

Other activities

We have celebrated Prof. P.C. Mahalanobis Day (Statistics Day), Republic Day, Independence Day and Dr. B.R. Ambedkar's Day during the financial year. We have also celebrated Karnataka Rajyotsava Day with cultural programmes.

Tezpur

There are was no new recruitment, retirement, resignation or report of death from the Centre during the financial year.

No major construction / renovation work was taken up by the Centre during 2013-2014.

Society Type Activities

Membership: April 2013 – March 2014

- 1) During the period 35 persons became Ordinary Members of the Institute.
- 2) 25 Ordinary Members became Life Members of the Institute.

The membership position as on 31 March, 2014 is as follows:

Ordinary Members	-	295
Life Members	-	985
Institutional Members	-	03
Total	-	<u>1283</u>

Finance Committee Meetings: The Finance Committee met twice on 25th September, 2013 and 19th November, 2013. Besides the decisions taken on various financial matters, the Finance Committee recommended RE 2013-14 and BE 2014-15 (both Plan and Non-Plan) in its meeting held on 25th September, 2013. The Annual Report including Audited Statement of Accounts for the year 2012-2013 was considered and recommended in the meeting of the Finance Committee held on 19th November, 2013.

Council Meetings: During the period under report (2013-14), the Council met three times on 27th July, 2013, 23rd November, 2013, and 8th March, 2014, to take decisions on various academic and administrative matters of the Institute. The Budget Proposals of the Institute both for Plan and Non-Plan (RE for 2013-14 and BE for 2014-15) were considered in the meetings of the Council held on 23rd November, 2013, as recommended by the Finance Committee in its meeting held on 25th September, 2013. The Annual Report including the Audited Statement of Accounts for the year 2012-2013 was considered and approved by the Council in its meeting held on 23rd November, 2013.

A list containing the names of the President of the Institute, Chairman and members of the Council of the Institute and lists of members of different committees constituted by the Council are given in the Back Cover page and in Chapter 11 respectively.

Annual General Meetings: During the period under report (2013-14), the General Body of the Institute met on 27th November, 2013. The Annual Report of the Institute for the year 2012-2013 and Audited Statement of Accounts for the year 2012-2013 together with the Auditor's comments and replies of the Administration thereto were adopted in the meeting of the General Body held on 27th November, 2013.

11. LIST OF MEMBERS OF THE ACADEMIC COUNCIL AND OTHER COMMITTEES OF THE INSTITUTE AS ON 31 MARCH 2014

Academic Council

Bimal K. Roy, Director (Chairman)

Pradipta Bandyopadhyay, Dean of Studies (Convener)

Theoretical Statistics and Mathematics Division

T.S.S.R.K. Rao, B.V. Rajarama Bhat, N.S. Narasimha Sastry, Bhaskar Bagchi, S. Ramasubramanian, K. Ramamurthy, Pl. Muthuramalingam, Mohana Delampady, Sunanda Bagchi, B. Rajeev, V. Pati, B. Sury, V.R. Padmawar, Siva Athreya, C. Robinson Edward Raja, S.M. Srivastava, Probal Chaudhuri, Rana Barua, Alok Goswami, Arup Bose, Goutam Mukherjee, Ratan Dasgupta, Gopal Krishna Basak, Pradipta Bandyopadhyay, Amartya Kumar Dutta, Debashish Goswami, Rudra Pada Sarkar, Mahuya Datta, S. Pannusamy, Rajendra Bhatia, Rahul Roy, R.B. Bapat, Abhay Gopal Bhatt, Arup Kumar Pal, Isha (Bagai) Dewan, Anish Sarkar, Jishnu Gupta Biswas, Amites Dasgupta.

Applied Statistics Division

Sushama M. Bendre, Bimal Kr. Roy, Debasis Sengupta, Anup Dewanji, Mausumi Bose, Palash Sarkar, Ashis SenGupta, Debapriya Sengupa, Tapas Samanta, Atanu Biswas, Subhamoy Maitra, Pabitra Pal Choudhury, Ayanendranath Basu, Tapas Kumar Chandra, Subir Kumar Bhandari, Smarajit Bose, Rita Saha Ray, Arun Kumar Adhikary, Amita Pal, Kishan Chand Gupta.

Social Sciences Division

V.K. Ramachandran, Madhura Swaminathan, Satya Ranjan Chakravarty, Amita Majumder, Abhirup Sarkar, Nityananda Sarkar, Manash Ranjan Gupta, Tarun Kabiraj, Monoranjan Pal, Krishna Majumder, Manipushpak Mitra, Indraneel Dasgupta, Anjali Ghosh, Arunava Sen, Bharat Ramaswami, Satya P. Das, E. Somanathan, Prabal Roy Chowdhury, Prasanta Pathak, Tridip Roy, Ptobal Dasgupta.

Biological Sciences Division

Joydev Chattopadhyay, Anjana Dewanji, Arunava Goswami, Premananda Bharati, Barun Mukhopadhyay, Subrata Kr. Roy, Bibha Karmakar, Parasmani Dasgupta, P.P. Majumder, Bidyut Roy, Saurabh Ghosh, Pabitra Banik.

Physics and Earth Sciences Division

Dilip Saha, Chandan Chakraborty, Dhurjati Prasad Sengupta, Soumendra Nath Sarkar, Bidyut Kr. Pal, Saswati Bandyopadhyay, Sisir Roy, Pinaki Roy, Subir Ghosh, Barnana Roy, P.K. Das, Banasri Basu, Guruprasad Kar, Parthasarathi Ghosh, Preeti Parashar.

Computer and Communication Sciences Division

Bhabani Prasad Sinha, Bhargab Bikram Bhattacharya, Subhas Chandra Nandy, Nabanita Das, Susmita Sur-Kolay, Krishnendu Mukhopadhyay, Sandip Das, Bidyut Baran Chowdhuri, Swapan Kr. Parui, Umapada Pal, A.R.D. Prasad, Bhabatosh Chanda, Nikhil Ranjan Pal, Kumar Sankar Roy, Dipti Prasad Mukherjee, Srimanta Pal, Aditya Bagchi, Sankar Kumar Pal, C.A. Murthy, Sushmita Mitra, Ashish Ghosh, Sanghamitra Bandyopadhyay, Rajat Kumar De, Sambhu Nath Biswas, Pradipta Maji, Mandar Mitra.

Administration

Statistical Quality Control and Operations Research Division

Kalyan Kumar Chowdhury, P.K. Perumallu, Ashim Roy Chowdhury, U. Haridas Acharya, Surajit Pal, A. Rajagopal, Samir Kr. Neogy, B. Mohan Reddy, G.S.R. Murthy, A.L.N. Murthy, Amitava Bandyopadhyay, Dipak Kr. Manna, Arup Kumar Das, Ranjan Sett, Arup Ranjan Mukhopadhyay, Abhijit Gupta, Prasun Das, Ashis Kr. Chakraborty, Nandini Das, Sugata Adhikari, Somnath Ray.

Library, Documentation and Information Sciences Division

Chief Librarian

Computer and Statistical Service Centre (CSSC)

Debashis Roy, Amitava Datta,

Member-Secretary, ISEC

Prasanta Pathak.

Other Committees of the Institute

A. Finance Committee

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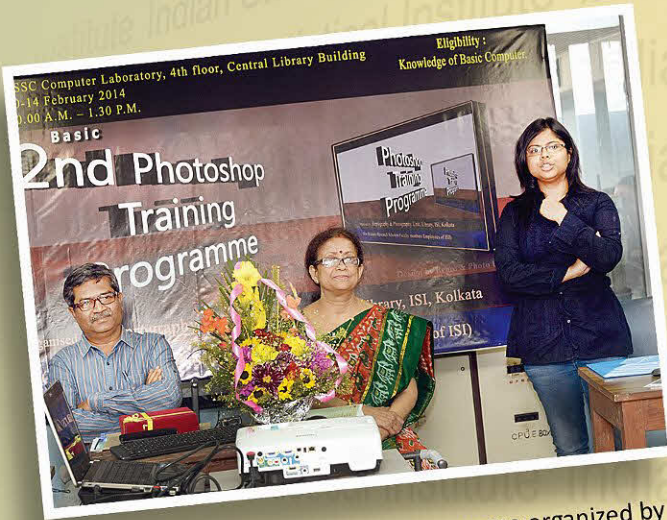
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Prof. Bimal K Roy, Director ISI delivering Inaugural speech at ISI North East Centre Tezpur on 22 July 2013



3rd West Bengal Growth Workshop organized by SOSU during 26-27 December 2013



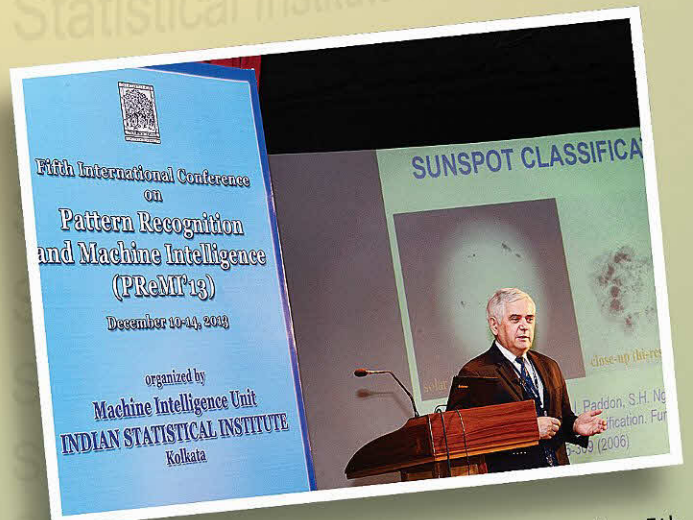
2nd Basic Photoshop Training Programme organized by Reprography & Photography Unit, Library at ISI during 10-14 February 2014



66th Convocation of the International Statistical Education Centre (ISEC) at ISI, Kolkata on 30 May 2013



Celebration of 122nd Birth Anniversary of Dr. B. R. Ambedkar organized by ISI SC/ST/BC Employees' Coordination Council on 21 August 2013



Prof. A. Skowron delivering lecture at the 5th International Conference on PREMI'13 organized by MIU at ISI during 10-14 December 2013



● Hon'ble President, Govt. of India Shri Pranab Mukherjee awarding Degrees at the 48th Convocation of ISI on 10 January 2014



● Felicitation of Prof. J. K. Ghosh, recipient of Padmasri at ISI Kolkata on 11 February 2014



● Shri Yaswant Sinha, former Finance Minister, Govt. of India visiting ISI Giridih Branch on 21 April 2013



● Inspection of ISI by the Third Sub-Committee of the Committee of Parliament on Official Language at Kolkata on 4-5 October 2013



● Dr. R. Chidambaram, Principal Scientific Adviser to the Govt. of India, speaking at 120th Birth Anniversary of Prof. Prasanta Chandra Mahalanobis



● Book Release Ceremony by Reprography & Photography Unit, Library on 29 July 2013. on the dias (L to R) Prof. Dilip K. Sinha, Prof. Bimal K Roy, Justice Chittatosh Mookerjee