

**INDIAN STATISTICAL INSTITUTE
STAT-MATH UNIT, KOLKATA
SEVENTY NINTH ANNUAL REPORT
(APRIL 2010 - MARCH 2011)**

TEACHING AND TRAINING

CONVOCATION

RESEARCH AND OTHER SCIENTIFIC ACTIVITIES

MATHEMATICS and STATISTICS

Research activities:

Quantum isometry groups: I have been able to prove that there is if a compact quantum group acts faithfully and 'linearly' in a suitable sense on the homogeneous space G/T where G is a semisimple, compact, connected, centreless Lie group and T its maximal torus, then the quantum group must be commutative as a C^* algebra, i.e. of the form $C(K)$ for some compact group K .

(Debashish Goswami)

Exit time asymptotics for quantum Brownian motion: Some general results about exit time asymptotics of quantum Brownian motions on noncommutative homogeneous spaces have been obtained.

(Biswarup Das and Debashish Goswami)

We have given a generic construction of an Identity Based Signcryption Scheme. We prove that if the underlying encryption and signature schemes are secure, then the signcryption obtained is also secure. We also show that by instantiating with some known signature and encryption schemes the resulting signcryption compares well wrt to efficiency with many efficient signcryption schemes.

Sumit Pandey and Rana Barua

We have taken another look at the generic construction of the public key signcryption scheme due to An, Dodis and Rabin. We show that by suitably modifying the construction, one can obtain an unforgeable signcryption scheme even when the underlying encryption scheme is taken to be secure in a weaker model.

Sumit Pandey and Rana Barua

We have introduced simplicial version of Bredon–Illman cohomology with equivariant local coefficients system and proved its classifications. We have investigated its relationship to simplicial equivariant twisted cohomology. As an application, we have derived equivariant reduced power operations in simplicial Bredon-Illman cohomology with local coefficients system.

Goutam Mukherjee

It was shown how half independence arises in the context of spectral distribution of random matrices and the connection of this notion to product convolution was shown. Analogue of the central limit theorem and of the Cramer's theorem was proved for half independent variables. The symmetrised Rayleigh distribution plays the same role as the normal distribution in this context.

Arup Bose (joint work with Rajat Subhra Hazra and Koushik Saha)

Distributional convergence of the upper order extreme eigenvalues was established for several circulant type matrices. An interesting result on the tail behaviour of k -fold product of i.i.d. exponential variables was established for all positive integers k .

Arup Bose (joint work with Rajat Subhra Hazra and Koushik Saha)

Detailed asymptotic properties of Pfiefer records were established.

Arup Bose (joint with Sreela Gangopadhyay).

Spectral limits of k -circulant matrices were obtained when the entries are heavy tailed.

Arup Bose (joint work with Rajat Subhra Hazra, Koushik Saha and Suman Guha)

Limiting distribution of some band matrices were established where the amount of banding was assumed to be flexible.

Arup Bose (joint work with Anirban Basak)

Limiting spectral distribution was obtained for some balanced versions of the Toeplitz and Hankel matrices.

Arup Bose (joint work with Anirban Basak)

Limiting spectral distribution of random matrices was studied when the number of diagonals with possibly nonzero entries is finite. This provides some interesting insight into the Wigner law and also may lead to other interesting studies for such matrices.

Arup Bose (joint work with Sanchayan Sen)

Significant progress has been made on the study of the limiting spectrum of the sample variance covariance matrix for observations from a stationary time series.

Arup Bose (joint work with Anirban Basak and Sanchayan Sen)

It was shown that suitable patterned matrices which are not the usual Wigner matrices also have the semicircle law as their limiting spectral distribution, thereby establishing the robustness of the limit to variations in the pattern.

Arup Bose (joint work with Sayan Bannerjee)

On Lagrangian Floer cohomology and Fukaya category of symplectic orbifolds in collaboration with C.-H. Cho of Seoul National University. This is related to Homological Mirror Symmetry conjecture of M. Kontsevitch.

Mainak Poddar

On torus actions on orbifolds in collaboration with S. Hu of Wilfrid Laurier University and S. Sarkar, S. Ganguli of ISI.

Mainak Poddar

Research in Non-Commutative Geometry

Research in Commutative Algebra

In the study of affine fibrations and locally nilpotent derivations, one often encounters commutative R -algebras A which are obtained as the intersection of $A[1/x]$ and $A[1/y]$ where both $A[1/x]$ and $A[1/y]$ are polynomial algebras in one variable over $R[1/x]$ and $R[1/y]$ respectively. We call such an algebra as an A^1 -patch. When R is the polynomial ring $k[x,y]$ over a field k , a structure theorem has been obtained which describes and classifies all algebras which arise as A^1 -patch over R by x and y .

[Amartya Kumar Dutta, Neena Gupta and Nobuharu Onoda]

Research in Algebraic Topology

Research in Statistics

Research in Differential Topology

Partial isometries of sub-Riemannian manifolds in Euclidean spaces have been studied following the theory of $\mathcal{H}$ -principle.

[Mahuya Datta]

Research in Harmonic Analysis

Research in Probability Theory

A class of probability measures is constructed on the space of Lipschitz isometric maps of a compact 1-manifold in $\mathbb{R}^2$.

[Amites Dasgupta, Mahuya Datta]

Research in History of Mathematics

Narayana's treatment of Pell's equation and his applications has been examined in the framework of the theory of continued fractions.

[Amartya Kumar Dutta]

4. INTERNALLY/EXTERNALLY FUNDED PROJECTS

4.1 Internally Funded Projects (completed)

Sl. No.	Name of the Project	Principal Investigators	Unit involved
1	Young Visitors Program	Dr. Mrinal Kanti Das	Stat-Math Unit
2	Growth Curve Estimation	Prof. Ratan Dasgupta	Stat-Math Unit

4.2 Externally Funded Projects (ongoing)

Sl. No.	Name of the project	A/c. No.	Principal Investigators	Unit involved	Funded by
1	Non Commutative Geometry groups and non-Commutative probability	248	Dr. Debashish Goswami	Stat-Math Unit	DST
2	Atiyah-Singer Index theorem and Gauge-theoretic Physics	229	Prof. Amiya Mukherjee	Stat-Math Unit	DST
3	J.C.Bose Fellowship		Prof. Arup Bose	Stat-Math Unit	DST
4	Harmonic Analysis on Riemannian Symmetric spaces Damek-Ricci spaces Homogenous Tress	203A	Prof. Rudra P. Sarkar	Stat-Math Unit	NBHM

5. CONFERENCES, SYMPOSIA, WORKSHOPS, LECTURES & SEMINARS (organised by the institute)

5.1 Symposia and Conferences

Seventh Annual Conference on Models and Methods in Economics, February 02-03, 2011, Economics Research Unit.

Conference supported by J.C. Bose Fellowship of Arup Bose.

Seminar on Probability and Statistics, Stat.-Math. Unit, Indian Statistical Institute, Kolkata, January 06-07, 2011.

Supported by J.C. Bose Fellowship of Arup Bose.

5.3 Lectures and Seminars

1. Arijit Chakraborty, Indian Institute of Science, Bangalore(01.06.2010): Large deviations for truncated heavy-tailed random variables.
2. Satyaki Mazumder, Department of Mathematical Sciences, University of Texas at Dallas(07.06.2010): Improving the Robustness of the Sample Spatial Outlyingness Functions through Spatial Trimming.
3. Rajat Subhra Hazra, ISI, Stat-Math, Kolkata(08.07.2010): free subexponentiality and regular variation.
4. Radhendushka Srivastava, ISI, Stat-Math, Kolkata(12.07.2010): spectrum estimation with uniformly and non-uniformly sampled data: some challenges and strategies.
5. B. V. Rao, Chennai Mathematical Institute(13.07.2010): SLE.
6. Anilesh Mohari, Inst. of Math. Sciences, Chennai(26.07.2010): G. Birkhoff's problem in irreversible quantum dynamics.
7. Rejesh P. Singh, ISI, Stat-Math, Kolkata(26.07.2010): Multivariate Cryptology.
8. Subhojit Dutta, ISI, Stat-Math, Kolkata(16.07.2010): Statistical Discriminant Analysis in Finite and Infinite Dimensional Spaces.
9. Adityanand Guntuboyina, Yale University, USA(21.07.2010): Minimax Lower bounds.
10. Gautami Bhowmik, Universite de Lille 1, France(09.08.2010): Zero sum sequences of groups.

11. David Wright, Department of Mathematics Washington University, St. Louis(16.08.2010): New conjectures related to the Jacobian Conjecture.
12. Raazesh Sainudiin, Department of Mathematics and Statistics, University of Canterbury, Christchurch, New Zealand(06.09.2010): Statistical algorithms over a dense tree of ordered binary trees.
13. Ritabrata Munshi, School of Mathematics, T.I.F.R.(16.09.2010): L-functions and applications.
14. Neena Gupta, ISI, Stat-Math, Kolkata(13.09.2010): On locally quasi A^* -algebras in codimension-one.
15. Nobuharu Onoda, University of Fukui, Japan(22.09.2010): Patching results on certain algebras.
16. Sutanu Roy, Dept. of Mathematics University of Goettingen, Germany(25.10.2010): Homomorphism of quantum groups.
17. Probal Chaudhuri, ISI, Stat-Math, Kolkata(01.11.2010): Mahalanobis' Fractile Graphs: Some History and Recent Developments.
18. Probal Chaudhuri, ISI, Stat-Math, Kolkata(08.11.2010): Mahalanobis' Fractile Graphs for Multidimensional covariates.
19. Basudeb Datta, Indian Institute of Science, Bangalore(26.11.2010): A triangulation of CP^2 as a symmetric square of S^2 .
20. Ajay Thakur, Institute of Mathematical Sciences, Chennai(24.11.2010): Complex Structures on Product of Circle Bundles over Compact Complex Manifolds.
21. Saibal Ganguli, ISI, Stat-Math, Kolkata(22.11.2010): Blowdown and McKay correspondence for quasitoric orbifolds.
22. Amitava Bhattacharya, School of Mathematics, TIFR(02.12.2010): Alternating reachability in colored graphs and matching theory.
23. Rajendra Bhatia, ISI, SMU, Delhi(29.12.2010): Geometry and Geometric Mean.
24. Bolla Marianna, Budapest University of Technology and Economics(31.12.2010): Mathematical Models in Biology.
25. Arijit Dey, IIT, Chennai(27.12.2010): An introduction to Moduli of Torsion free sheaves.

26. Arijit Dey, IIT, Chennai(28.12.2010): An introduction to Moduli of Torsion free sheaves.
27. Manjunath Krishnapur(30.12.2010): How many real zeros does a random polynomial of degree n have?
28. Manjunath Krishnapur(31.12.2010): The Single Ring Theorem.
29. Bolla Marianna, Budapest University of Technology and Economics (31.12.2010): Mathematical Models in Biology.
30. Bolla Marianna, Budapest University of Technology and Economics (03.01.2011): Spectral graph clustering.
31. Sreekar Vadlamani, TIFR Centre for Applicable Mathematics, Bangalore(31.01.2011): Geometry of random fields in an infinite dimensional setting.
32. Sreekar Vadlamani, TIFR Centre for Applicable Mathematics, Bangalore(03.02.2011): Geometric evolution under stochastic flows.
33. Abhiman Das, RBI, Mumbai(04.02.2011): Forecast distribution plot and its applications.
34. Saugata Basu, Purdue University(07.02.2011): Quantitative and effective questions in real algebraic geometry.
35. Narasimha Kumar, TIFR, Mumbai(11.02.2011): On Local Galois Representations attached to Automorphic Form.
36. Sarang Sang, TIFR, Mumbai(11.02.2011): Euler class groups and Chow-Witt groups.
37. Neena Gupta, ISI, Stat-Math, Kolkata(17.02.2011): On locally Laurent polynomial algebras.
38. Prosenjit Das, University of Burdwan(18.02.2011): Planes of the form $b(X,Y)Z^n - a(X,Y)$ over a DVR.
39. Chiranjib Mukherjee, Max-Planck Institute for Mathematical Sciences, Leipzig(18.02.2011): Large deviations for Brownian intersection measures.
40. T. Asanuma, University of Toyama, Japan(28.02.2011): Topological aspects of the Jacobian conjecture.
41. K.R. Parthasarathy, ISI, Stat-Math, Delhi(22.03.2011): Gaussian states in quantum theory.

42. B. Rajeev, ISI, Stat-Math, Bangalore(24.03.2011): Strong solutions of SDE with coefficient in F -prime.

6. PUBLICATIONS OF THE INSTITUTE

7. SCIENTIFIC PAPERS AND PUBLICATIONS

7.1 Books Published

7.2 Papers published in journals :

Goswami, Debashish, Bhowmick, J. and Skalski, A.: Quantum isometry groups of 0-dimensional manifolds, Trans. AMS 363, no. 2, 901-921, 2011.

Goswami, Debashish and T. Banica: Quantum isometries and noncommutative spheres, Commun. Math. Phys. 298, no. 2, 343-356, 2010.

Goswami, Debashish and Bhowmick, J.: Some counterexamples in the theory of quantum isometry groups, Lett. Math. Phys. 93, no. 3, 279-293, 2010.

Mukherjee, Goutam: Equivariant simplicial cohomology with local coefficients and its classifications, (with Debasis Sen), Topology and its applications, 157:1015-1032, 2010.

Mukherjee, Goutam: On a Theorem of Eilenberg in simplicial Bredon-Illman cohomology with local coefficients, (with Debasis Sen), International Journal of Modern Mathematics, 5(3):339-359, 2010.

Mukherjee, Goutam: Steenrod's reduced power operations in simplicial Bredon-Illman cohomology with local coefficients. To appear in Homology, Homotopy and applications, 2011.

Datta, Mahuya: Immersions in a manifold with a pair of symplectic forms. J. of symplectic Geometry 9, no. 1, 11 – 32, 2011.

Dhar, Subhra, S. and Chaudhuri, Probal: "On the statistical efficiency of robust estimators of multivariate location". (Statistical Methodology, vol. 8, pp. 113-128), 2011.

Dutta, Subhajit, Ghosh, Anil, K. and Chaudhuri, Probal: "Some intriguing properties of Tukey's half-space depth". (Bernoulli, In Press), 2011.

Sen, Bodhisattva and Chaudhuri, Probal: "On fractile transformation of covariates in regression". (Journal of the American Statistical Association, In Press), 2011.

Dhar, Subhra, S. and Chaudhuri, Probal: "On the derivatives of trimmed mean". (Statistica Sinica, In Press), 2011.

Basak, Anirban and Bose, Arup: Balanced random Toeplitz and Hankel matrices. Electronic Communications in Probability, 15, 134-148, 2010.

Bose, Arup: The ET interview: B.L.S. Prakasa Rao. Econometric Theory, 27, 1—39, 2011.

Bose, Arup; Gangopadhyay, Sreela and Sen, Arnab: Limiting spectral distribution of XXX' matrices. Annales de l'Institut Henri Poincaré--Probabilités et Statistiques. Vol. 46, No. 3, 677—707, 2010.

Bose, Arup; Hazra, Rajat Subhra and Saha, Koushik: Spectral norm of circulant type matrices with heavy tailed entries. Electronic Communications in Probability, 15, 299—313, 2010.

Bose, Arup; Hazra, Rajat Subhra and Saha, Koushik: Spectral norm of circulant type matrices. Journal of Theoretical Probability. Volume 24, Number 2, Pages 479-516, 2011.

Bose, Arup; Pal, Debashis and Sappington, David: Asymmetric treatment of identical agents in teams. European Economic Review, 54, 947—961, 2010.

Bose, Arup; Pal, Debashis and Sappington, David: On the performance of linear contracts. Journal of Economics & Management Strategy. Volume 20, Number 1, 159—193, 2011.

Bose, Arup; Pal, Debashis and Sappington, David: Pareto-improving inefficiency. Oxford Economics Papers. 63(1), 94—110, 2011.

Biswas, I. and Poddar, M.: Chen-Ruan cohomology of some moduli spaces, II, Internat. J. Math. 21, no. 4, 497–522, 2010.

Poddar, M. and Sarkar, S.: On quasitoric orbifolds, Osaka J. Math. Vol. 47, No. 4, 1055-1076, 2010.

7.3 Papers published in Conference Proceedings :

Dutta, Amartya, Kumar: Kuttaka, Bhavana and Cakravala, Studies in the History of Indian Mathematics, editor: C.S. Seshadri, Hindustan Book Agency, Culture and History of Mathematics 5, 145-199, 2010.

Basak, G.K., Ghosh, M.K. and Goswami, A.: "Risk Minimizing Option Pricing for a Class of Exotic Options in a Markov-Modulated Market." *Stochastic Analysis and Applications*, 29, 2, 259-281, 2011.

Basak, G.K., Ghosh, M.K. and Mukherjee D.: ``Influence of Big Traders on the Stock Market: Theory and Simulation." *Dynamic Games and Applications*, to appear, doi 10.1007/s13235-011-0011-x, 2011.

Bose, Arup; Hazra, Rajat Subhra and Saha, Koushik: Patterned random matrices and method of moments. Proceedings of the International Congress of Mathematicians Hyderabad, India, 2010, 2203--2230. (Invited article). World Scientific, Singapore and Imperial College Press, UK, 2010.

7.4 Papers published in books

8. VISITING SCIENTISTS

Ray, Swagato K., Department of Mathematics & Statistics, IIT, Kanpur, July 01, 2010 to July 31, 2010.

Basu, Samik, Department of Mathematical Sciences, Universitetspark 5, Copenhagen, Denmark, July 06, 2010 to August 25, 2010.

Majumder, Satyaki, Department of Mathematical Sciences, The University of Texas at Dallas, U.S.A., July 01, 2010 to December 09, 2010.

Singh, Rajesh, Pratap, IIT, Guwahati, July 20, 2010 to June 20, 2011.

Raha, Asit, Baran, ISI, Stat-Math Unit, Kolkata, July 01, 2010 to November 30, 2010.

Wright, David, Washington University, August 14, 2010 to August 19, 2010.

Molla, Anisur, Rahaman, ISI, Stat-Math Unit, Kolkata, August 17, 2010 to January 17, 2011.

Mukherjee, Amiya, ISI, Stat-Math Unit, Kolkata, December 01, 2010 to November 01, 2011.

Sarkar, Swagata, ISI, Stat-Math Unit, Kolkata, August 01, 2010 to June 01, 2012.

Sen, Suparna, Indian Institute of Science, Bangalore, January 01, 2011 to December 31, 2011.

Ganguly, Satadal, TIFR, Mumbai, January 01, 2011 to April 30, 2011.

Dey, Arijit, IIT, Madras, December 23, 2010 to December 30, 2010.

Krishnapur, Manjunath, Indian Institute of Science, Bangalore, December 28, 2010 to January 01, 2011.

Onoda, N., University of Fukui, September 08, 2010 to September 28, 2010.

Asanuma, T., University of Toyama, February 15, 2011 to March 03, 2011.

Marjit, Sugata, Director, CSSSC - Kolkata, Reserve Bank of India Professor of Industrial Economics, 16-26 November, 2010.

9. HONOURS AND AWARDS

Goswami, Debashish :

Swarnajayanti Fellowship for the year 2009 (the grant received in May 2010).

Bose, Arup:

International Congress of Mathematicians, August 18--27, 2010, Hyderabad, India--Invited speaker.

Bose, Arup:

Selected Member of the Sectional Committee for Mathematical Sciences, Indian National Science Academy.

10. SCIENTIFIC ASSIGNMENTS

10.1 Editorship

Chaudhuri, Probal:

Appointed a new Editor of International Statistical Review. Continued as an associate editor for Journal of the American Statistical Association, Statistica Sinica and Advances in Statistical Analysis.

Bose, Arup:

Editorial Board Member--Lecture Note Series of Ramanujan Mathematical Society;

Editorial Board Member--Indian Journal of Pure and Applied Mathematics; Associate

Editor--Statistical Methodology; Associate Editor--Statistics and Probability Letters;

Associate Editor--IMS Collection, Institute of Mathematical Statistics.

10.2 Scientific Assignments/Academic Visits Abroad

Basak, Gopal, Krishna:

Visited Department of Mathematics, Hong Kong University of Science and Technology, Hong Kong (SAR), May 25 - June 2, 2010.

Goswami, Debashish:

Visited University of California at Berkeley (USA) during January-April 2011.

Barua, R.:

Visited Kyushu University, Japan during February 19-26, 2011 Gave a seminar in the Dept of Math. at Kyushu University.

Chaudhuri, Probal:

Invited speaker at the International Conference on Robust Statistics (ICORS 2010), June 28 - July 2, 2010 held in Prague, Czech Republic.

Chaudhuri, Probal:

Invited speaker at the workshop on Level Sets and Depth Contours in High Dimensional Data held during Feb. 27 - March 5, 2011 in Oberwolfach, Germany.

Bose, Arup:

Visited Department of Economics, University of Cincinnati, May 10, 2010--June 18, 2010.

Bose, Arup:

Visited Department of Economics, University of Cincinnati, October 01, 2010--November 19, 2010.

Bose, Arup:

Visited Dept. of Mathematics, IUPU at Indianapolis, October 25, 2010.

Bose, Arup:

Visited Dept. of Statistics, Indiana University, November 15, 2010.

Poddar, Mainak:

May-June 2010, KAIST, Korea, and Seoul National University, Korea.

Poddar, Mainak:

Jan-Dec 2011, Universidad de los Andes, Bogota.

10.3 Scientific Assignments/Academic Visits in India

Dutta, Amartya, Kumar:

Visited IIT Madras and University of Madras during October 25--26, 2010 for the INSA Seminar on History of Science and delivered an invited talk on "Narayana's Treatment of Vargaprakrti" on 25 October, 2010.

Dutta, Amartya, Kumar:

Visited IISc, Bangalore, during December 6--10, 2010, for the International Conference on Commutative Algebra and Algebraic Geometry and delivered an invited talk titled "On A^1 -patch by a regular sequence" on 8 December 2010.

Dutta, Amartya, Kumar:

Delivered the R.C. Gupta Endowment Lecture of AMTI on 28 December 2010 on "Brahmagupta's Contributions to Algebra.

Dutta, Amartya, Kumar:

Delivered a series of talks on Rings and Ideals to students of mathematics at Sri Aurobindo International Centre of Education, Pondicherry, during 6--15 January 2011.

Dutta, Amartya, Kumar:

Delivered lectures on "Mathematics and Astronomy in Ancient India" at the Ramakrishna Mission Institute of Culture, Kolkata, on February 1, 15 and March 12, 2011, as part of a course on Indology. Was a moderator and examiner for the Indology examination of RMIC in June 2010.

Dutta, Amartya, Kumar:

Delivered a talk on "Gems from Ancient Indian Mathematics" on March 4, 2011, organised by the British Council and the JBNSTS.

Barua, R.

Chaired a session of INDOCRYPT 2010 at Hyderabad, December 12-15, 2010

Basak, Gopal, Krishna:

Invited talk in a National Conference on Quantitative Finance at Institute of Mathematics and Applications, Bhubaneswar, 26-27 February, 2011.

Basak, Gopal, Krishna:

Organised and chaired an invited session on Mathematical Finance in the ICM 2010

Satellite Conference in Probability and Stochastic Processes. ISI, Bangalore, August 13-17, 2010.

Datta, Mahuya:

Lectures delivered at the Annual Foundation School I – Bhaskaracharya Pratisthan, Pune.
28 June – 13 July, 2010

Datta, Mahuya:

Lectures delivered at the School on Analysis, Algebra and Topology - Kerala
School of Mathematics, Kozikode. 13 – 22 December, 2010

Datta, Mahuya:

Gave a talk titled 'From Morse functions to handle-body decompositions' at University of Kalyani, March 4, 2011

Chaudhuri, Probal:

Invited speaker at the International Congress of Mathematicians (ICM 2010), August 19 - 27, 2010 held in Hyderabad.

Bose, Arup:

ICM Satellite Conference on Probability and Stochastic Processes, Indian Statistical Institute, Bangalore August 13-17, 2010--Invited speaker, organizer of a session on Random Matrix and Member, Local Organizing Committee.

Poddar, Mainak:

Visited Jan 2010, IMSC Chennai.

Poddar, Mainak:

Visited Feb 2010, IIT Bombay.

Poddar, Mainak:

Visited Aug 2010, IISc Bangalore.

Poddar, Mainak:

Visited Aug 2010, ICM at Hyderabad.

Invited speaker at the ICM 2010, Aug 19-27, 2010, Hyderabad.