

Curriculum Vitae

Rajeeva Laxman Karandikar

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Academic qualifications :

Ph. D. , December 1981, Indian Statistical Institute, Calcutta.
M. Stat. , July 1978, Indian Statistical Institute, Calcutta.
B. Sc. , June 1976, University of Indore, Indore.

Awards, Fellowships :

- Received *Young Scientist Medal* from The Indian National Science Academy, 1985.
- Elected Fellow of the Indian Academy of Sciences, 1994.
- Awarded *S. S. Bhatnagar* prize by the Council for Scientific and Industrial Research, 1999.
- Awarded *National Award in Statistics in honour of Professor C. R. Rao* by the Ministry of Statistics and Programme implementation, Government of India.
- Elected Fellow of the Indian National Science Academy, 2005.

Previous positions held:

- Associate Professor, Indian Statistical Institute, Delhi (1984-1989).
- Professor, Indian Statistical Institute, Delhi (1989-2006).
- Executive Vice President, Cranes Software International Limited (2006-2010).

Administrative positions held:

- Professor-in-Charge, Division of Theoretical Statistics and Mathematics, Indian Statistical Institute, Kolkata (2000-2002).
- Head, Delhi center, Indian Statistical Institute, (2000) and (2004-2006).

Research interests:

- Stochastic calculus, Semimartingales, General theory of processes, Pathwise approximations of solutions to Stochastic differential equations.
- Markov processes, Diffusion processes, Martingale problems.
- Filtering theory, linear and non linear.
- Finitely additive probability theory.
- Limit theorems.
- White noise calculus: finitely additive approach.
- Stochastic differential equations in infinite dimensions.
- Financial applications of Stochastic processes.
- Boltzman equation and associated Stochastic process.
- Psephology in the context of Indian Elections.
- Cryptography. Block ciphers.
- Monte Carlo simulation.
- Bioinformatics- gene identification

Courses taught (at graduate level):

- Probability theory, Measure theory.
- Real Analysis.
- Complex Analysis.
- Markov chains, Applied stochastic processes.
- Martingale theory : discrete and continuous time.
- Semimartingales and Stochastic calculus.
- Diffusion processes and Markov processes.
- Large sample theory.
- Regression techniques.

Other (visiting) positions held:

- University of North Carolina at Chapel Hill, U. S. A. : June 1982 - June 1984; August 1986 - October 1986; November 1987 - December 1987; April 1990 - June 1990; March 1992 - July 1992, June 1994-July 1994, August 1996 - June 1997.
- Institute of Mathematics and applications, University of Minnesota at Minneapolis, U. S. A. : October 1985 - December 1985.
- Erasmus University, Rotterdam, Netherlands. : May 1989 - July 1989; April 1993 - June 1993.
- University of Twente, Enschede, Netherlands. : August 1991-September 1991.
- University of California, Santa Barbara, U. S. A. : September 1991 - March 1992.

Consultancy and other activities:

- Conducted and analyzed Nationwide opinion polls for Indian Parliamentary elections as well as opinion polls for various state assemblies during 1998-2007 on behalf of several media companies in India including Doordarshan, T V Today (Aaj Tak), Network 18 (CNBC and CNN-IBN), Hindustan times, Hindu, Indian express.
- Conducted intensive training programs on Stochastic Calculus for ICICI and for personnel from other financial organizations.
- Developed a module on MCMC- Markov Chain Monte Carlo for SYSTAT (a general purpose statistical software)
- Was consulted by CBI (Central Bureau of Investigation, India) in a case involving cheating in a multiple choice examination.
- Was consulted by CBSE (Central Board for secondary education, India) for evolving a grading system for class X and XII examinations.
- Was consultant to a state power board in a legal dispute involving statistical issues.
- Developed a secret Block cipher and its implementation on software.
- Was heading the product development group at Cranes Software.

Publications

Books Published:

- **White Noise Theory of Prediction, Filtering and Smoothing.** (*with G. Kallianpur*) Gordon and Breach, London, 1988.
- **Introduction to Option Pricing Theory**(*with G. Kallianpur*) Birkhauser, Boston, 2000.

Books edited:

- Stochastic Processes : A Festschrift in honour of Gopinath Kallianpur(*edited jointly with S. Cambanis, J. K. Ghosh and P. K. Sen*) Springer Verlag, New York, 1992.

Published papers

1. Pathwise solution of stochastic differential equations. SANKHYA A, 43, 1981, pp.121-132.
2. A general principle for limit theorems in finitely additive probability. TRANSACTIONS OF THE AMERICAN MATHEMATICAL SOCIETY, 273, 1982, pp.541-550.
3. A. S. approximation results for multiplicative stochastic integrals. SEMINAIRE DE PROBABILITES XVI, Lecture notes in Mathematics 920, Springer-Verlag,Berlin, 1982, pp.384-391.
4. Multiplicative decomposition of non-singular matrix valued continuous semimartingales. THE ANNALS OF PROBABILITY, 10, 1982, pp.1088-1091.
5. A remark on paths of continuous martingales. EXPOSITIONE MATHEMATICAE, 1, 1983, pp. 67-69.
6. Towards a theory of non-commutative semimartingales adapted to Brownian motion and quantum Ito formula. (*with K. R. Parthasarathy and R. L. Hudson*) THEORY AND APPLICATIONS OF RANDOM FIELDS ed. G. Kallianpur *Lecture notes in control and information sciences 49*, Springer-Verlag,Berlin 1983, pp.96-110.
7. Stochastic integration w. r. t. continuous local martingales. STOCHASTIC PROCESSES AND THEIR APPLICATIONS, 15, 1983, pp.203-209.
8. On quadratic variation process of a continuous martingales. ILLINOIS JOURNAL OF MATHEMATICS, 27, 1983, pp.178-181.
9. Multiplicative stochastic integrals HARMONIC ANALYSIS AND PREDICTION THEORY (*ed. Salehi and Manderekar*), North Holland, Amsterdam, 1983, pp..

10. Girsanov type formula for a Lie group valued Brownian motion. SEMINAIRE DE PROBABILITES XVII, Lecture notes in Mathematics 986, Springer-Verlag, Berlin, 1983, pp. 198-204.
11. Interchanging the order of stochastic integration and ordinary differentiation. SANKHYA A, 45, 1983, pp.120-124.
12. A finitely additive white noise approach to non linear filtering. (with G. Kallianpur) APPLICATIONS OF MATHEMATICS AND OPTIMIZATION, 10, 1983, pp.159-185.
13. Measure valued equations for the optimal filter in finitely additive non linear filtering theory. (with G. Kallianpur) Z. WAHRSCH. VERW. GEBIETE, 66, 1984, pp.1-17.
14. Some recent developments in non linear filtering theory. (with G. Kallianpur) ACTA APPLICANDAE MATHEMATICAE, 1, 1983, pp.399-434.
15. The non linear filtering problem for the unbounded case. (with G. Kallianpur) STOCHASTIC PROCESSES AND THEIR APPLICATIONS, 18, 1984, pp.57-66.
16. The Markov property of the filter in the finitely additive white noise approach to non linear filtering theory. (with G. Kallianpur) STOCHASTICS, 213, 1984, pp.177-198.
17. Limiting distributions of functionals of Markov chains. (with V. G. Kulkarni) STOCHASTIC PROCESSES AND THEIR APPLICATIONS, 19, 1985, pp.225-235.
18. A finitely additive white noise approach to non linear filtering. (with G. Kallianpur) MULTIVARIATE ANALYSIS VI ed. P. R. Krishnaiah, North-Holland, Amsterdam, 1985 pp.335-344.
19. Analytic and sequential Feynman integrals on abstract Wiener and Hilbert spaces and the Cameron-Martin formula. (with G. Kallianpur and D. Kannan) ANNALS DE LA INSTITUTE HENRI POINCARRE, 21, 1985, pp.323-361.
20. White noise calculus and non linear filtering theory. (with G. Kallianpur) **Special invited paper** THE ANNALS OF PROBABILITY, 13, 1985, pp.1033-1107.
21. On the Feynman-Kacs formula and its applications to filtering theory. APPLICATIONS OF MATHEMATICS AND OPTIMIZATION, 16, 1987, pp.263-276.
22. The filtering problem for infinite dimensional processes. (with G. Kallianpur) STOCHASTIC DIFFERENTIAL SYSTEMS, STOCHASTIC CONTROL THEORY AND APPLICATIONS ed. W. Fleming and P. L. Lions, Springer-Verlag, New-York, 1988 pp..

23. A general principle for limit theorems in finitely additive probability: the dependent case. JOURNAL OF MULTIVARIATE ANALYSIS, 24, 1988, pp.189-206.
24. Smoothness properties of conditional expectation in finitely additive probability. (with H. Hucke and G. Kallianpur) JOURNAL OF MULTIVARIATE ANALYSIS, 27, 1988, pp.261-269.
25. Embedding a stochastic difference equation into a continuous time process. (with L. deHaan) STOCHASTIC PROCESSES AND THEIR APPLICATIONS, 32, 1989, pp.225-235.
26. On Metivier-Pellaumail inequality, Emery topology and pathwise formulae in stochastic calculus. SANKHYA A, 51, 1989, pp.121-143.
27. Martingale problems associated with the Boltzman equation. (with J. Horowitz) SEMINAR ON STOCHASTIC PROCESSES (ed. Cinlar et al.), Birkhauser, Boston, 1989 pp.75-122.
28. On a. s. convergence of modified Euler-Peano approximations to the solution of a stochastic differential equation SEMINAIRE DE PROBABILITES XVII, Lecture notes in Mathematics 1485, Springer-Verlag, Berlin, 1991, pp. 113-120.
29. Multiplicative decomposition of non-singular matrix valued semimartingales. SEMINAIRE DE PROBABILITES XVII, Lecture notes in Mathematics 1485, Springer-Verlag, Berlin, 1991, pp.262-269.
30. Convergence of moments of Markov and semi-Markov processes. (with V. G. Kulkarni) PROBABILITY, STATISTICS AND DESIGN OF EXPERIMENTS, PROCEEDINGS OF R. C. BOSE SYMPOSIUM, NEW DELHI (ed. Bahadur et al.), Wiley Eastern, New Delhi, 1991 pp.453-459.
31. Martingale problems associated with the Boltzman equation. (with J. Horowitz) PROBABILITY, STATISTICS AND DESIGN OF EXPERIMENTS, PROCEEDINGS OF R. C. BOSE SYMPOSIUM, NEW DELHI (ed. Bahadur et al.), Wiley Eastern, New Delhi, 1991 pp.383-390.
32. The maximum of n-independent processes. (with A. A. Balkama and L. deHaan) JOURNAL OF APPLIED PROBABILITY, 30, 1993, pp.66-81.
33. A Trotter type formula for semimartingales. SANKHYA A, 55, 1993, pp.202-213.
34. An introduction to white noise analysis and nonlinear filtering. (with G. Kallianpur) MATHEMATICAL THEORY OF CONTROL (ed. M. C. Joshi et al.), Marcel Dekkar, New York, 1993 pp.173-184.

35. Weak Convergence to a Markov Process: the Martingale approach. *(with A. G. Bhatt)* PROBABILITY THEORY AND RELATED FIELDS, *96*, 1993, pp.335-351.
36. Invariant measures and evolution equations for Markov processes characterized via Martingale Problems. *(with A. G. Bhatt)* THE ANNALS OF PROBABILITY, *21*, 1993, pp.2246-2268.
37. White noise theory of robust nonlinear filtering with correlated state and observation noises. *(with A. Bagchi)* SYSTEMS AND CONTROL LETTERS, *23*, 1994, pp.137-148.
38. Nonlinear transformations of the canonical Gauss measure on Hilbert space and absolute continuity. *(with G. Kallianpur)* ACTA APPLICANDAE MATHEMATICAE, *35*, 1994, pp.63-102.
39. Mean rates of convergence of empirical measures in the Wasserstein metric *(with J. Horowitz)* JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS, *55*, 1994, pp.261-274.
40. A generalized binomial model and option formulae for subordinated stock price processes *(with S. T. Rachev)* PROBABILITY AND MATHEMATICAL SCIENCES, POLISH ACADEMY OF SCIENCES, *15*, 1995, pp. 427-447.
41. Evolution equations for Markov processes: Application to the white noise theory of filtering. *(with A. G. Bhatt)* APPLICATIONS OF MATHEMATICS AND OPTIMIZATION, *31*, 1995, pp.327-348.
42. On pathwise stochastic integration STOCHASTIC PROCESSES AND THEIR APPLICATIONS, *57*, 1995, pp.11-18.
43. Uniqueness and robustness of solution of measure-valued equations of nonlinear filtering *(with A. G. Bhatt and G. Kallianpur)* THE ANNALS OF PROBABILITY, *23*, 1995, pp.1895- 1938.
44. Second-order fluid flow model of a data-buffer in random environment *(with V. G. Kulka-rni)* OPERATIONAL RESEARCH, *43*, 1995, pp.77-88.
45. Some properties of the Kullback- Leibler number *(with N. R. Changanty)* SANKHYA A, *58*, 1996, pp.69-80.
46. Evolving aspirations and cooperation *(with D. Mookherjee, D. Ray and F. Vega-Redondo)* JOURNAL OF ECONOMIC THEORY, *80*, 1998, pp.292-331.
47. On Hilbert Space valued diffusions *(with A. G. Bhatt, G. Kallianpur and J. Xiong)* APPLICATIONS OF MATHEMATICS AND OPTIMIZATION, *37*, 1998, pp.151-188.

48. Robustness of the nonlinear filter (with A. G. Bhatt and G. Kallianpur) STOCHASTIC PROCESSES AND THEIR APPLICATIONS, 81, 1999, pp.247-254.
49. Characterization of the optimal filter: the non-Markov case (with A. G. Bhatt) STOCHASTICS AND STOCHASTICS REPORTS, 66, 1999, pp.177-204.
50. Opinion Polls and Statistics CALCUTTA STATISTICAL ASSOCIATION BULLETIN, 49, 1999, pp.193-194.
51. Path continuity of the nonlinear filter (with A. G. Bhatt) STATIST. PROBAB. LETT. , 54, 2001, pp.75-78.
52. System identification: a learning theory approach (with M. Vidyasagar) CONTROL AND MODELING OF COMPLEX SYSTEMS (ed. Koichi Hashimoto et al.), Trends Math. , Birkhuser Boston, Boston, MA, 2001 pp.89-104.
53. Predicting the 1998 Indian parliamentary election (with Payne, C. and Yadav, Y. ELEC-TROL STUDIES, 21, 2002, pp.69-89.
54. Robustness of the nonlinear filter: the correlated case. (with A. G. Bhatt) STOCHASTIC PROCESSES AND THEIR APPLICATIONS, 97, 2002, pp.41-58.
55. Rates of uniform convergence of empirical means with mixing processes (with M. Vidyasagar) STATIST. PROBAB. LETT. , 58, 2002, pp.297-307..
56. Martingale problems and Path properties of solutions (with A. G. Bhatt) SANKHYA, 65, 2003, pp.733-743.
57. On filtering with Ornstein-Uhlenbeck process as noise (with A. G. Bhatt) J. INDIAN STATIST. ASSOC. , 41, 2003, pp.205-220.
58. Measure free martingales (with M. G. Nadkarni) PROC. INDIAN ACADEMY OF SCI-ENCES, 115, 2005, pp.111-116.
59. On characterization of Markov processes via martingale problems (with A. G. Bhatt and B. V. Rao) PROC. INDIAN ACADEMY OF SCIENCES, 116, 2006, pp.83-96.
60. A Learning Theory Approach to System Identification (with M. Vidyasagar) PROB-ABILISTIC AND RANDOMIZED METHODS FOR DESIGN UNDER UNCERTAINTY (ed. Giuseppe Calafiore and Fabrizio Dabbene), Birkhuser Boston, Boston, MA, 2006 pp.265-302.
61. Introduction to Cryptography. E-BUSINESS PROCESS MANAGEMENT ((ed. Jayavel Sounderpandian and Tapen Sinha)), IGI Publishing, 2007, pp..