Advanced Instructional School on Stochastic Processes (2023)

Speakers and Syllabus

Name of the Speaker with affiliation	No. of Lectures	Detailed Syllabus
Suprio Bhar (SB), IIT, Kanpur	10	Measure theoretic Probability I: Caratheodory extension theorem , Monotone class theorem, Dynkin's pi-lambda theorem, MCT, Fatou's Lemma, DCT, Fubini's theorem. Probability spaces, random variables and random vectors, expected value and its properties.
Anish Sarkar (AS), ISI, Delhi	10	Measure theoretic Probability II: Independence. Various modes of convergence and their relation. The Borel-Cantelli lemmas. Weak Law of large numbers for i.i.d. finite mean case. Kolmogorov 0-1 law, Kolmogorov's maximal inequality. Statement of Kolmogorov's three-Series theorem (proof if time permits). Strong law of large numbers for i.i.d. case. Characteristic functions and its basic properties, inversion formula, Levy's continuity theorem. Lindeberg CLT, CLT for i.i.d. finite variance case, Lyapunov CLT.
Manjunath Krishnapur (MK), IISc, Bengaluru	10	Conditional probability and martingales I: Absolute continuity and singularity of measures. Hahn-Jordon decomposition, Radon-Nikodym Theorem, Lebesgue decomposition. Conditional expectation – Definition and Properties. Regular conditional probability, proper RCP. Regular conditional distribution.
Soumendu Sudar Mukherjee (SSM), ISI, Kolkata	10	Brownian Motion I: Introduction to Brownian Motion, Kolmogorov Consistency theorem, Kolmogorov Continuity theorem, Construction of BM. Basic Martingale Properties and path properties – including Holder continuity and non-differentiability.
Arup Bose (AB), ISI, Kolkata	10	Conditional probability and martingales II: Discrete parameter martingales, sub-and super-martingales. Doob's Maximal Inequality, Upcrossing inequality, martingale convergence theorem, Lp inequality, uniformly integrable martingales, reverse martingales, Levy's upward and downward theorems. Stopping times, Doob's optional sampling theorem. Discrete martingale transform, Doob's Decomposition Theorem. Applications of martingale theory: SLLN for i.i.d. random variables.
Alok Goswami (AG), IACS, Kolkata	10	Brownian Motion II: Quadratic variation. Markov Property and strong Markov property of BM, reflection principle, Blumenthal's 0-1 law. Distributions of first passage time and of running maximum of BM.

References:

1. Probability and Measure Theory: Robert B. Ash and Catherine A. Doleans-Dade
2. A Course in Probability Theory: Kai Lai Chung.
3. Probability and Measure: Patrick Billingsley
4. Probability Theory: Leo Breiman
5. Brownian motion: P. Morters and Y. Peres

(Lecture notes from the speakers, if available)

Time-Table

Day	Date	Lec 1&2 9.00 to 11.00	Tea 11.05 to 11.25	Tut 11.30 to 12.30	Lunch 12.30 to 2.25	Lect 3&4 2.30 to 4.30	Tea 4.35 to 4.55	Tut 5.00 to 6.00	Snacks 6.05 to 6.30
		(name of the speaker)		**(name of the speaker + tutors)**		**(name of the speaker)**		**(name of the speaker + tutors)**	
Mon	June 20 – July 01	SB		SB & SC		AS		AS & PS	
Tues		SB		SB & SC		AS		AS & PS	
Wed		SB		SB & SC		AS		AS & PS	
Thu		SB		SB & SC		AS		AS & PS	
Fri		SB		SB & SC		AS		AS & PS	
Sat		Tutorial (NKJ, SC, PS)		Tutorial (NKJ, SC, PS)		Tutorial (NKJ, SC, PS)		Tutorial (NKJ, SC, PS)	
SUNDAY : OFF									
Mon	July 03 – July 08	SSM		SSM & SC		MK		MK & PS	
Tues		SSM		SSM & SC		MK		MK & PS	
Wed		SSM		SSM & SC		MK		MK & PS	
Thu		SSM		SSM & SC		MK		MK & PS	
Fri		SSM		SSM & SC		MK		MK & PS	
Sat		Tutorial (NKJ, SC, PS)		Tutorial (NKJ, SC, PS)		Tutorial (NKJ, SC, PS)		Tutorial (NKJ, SC, PS)	
SUNDAY : OFF									
Mon	July 10 - July 14	AG		AG & SC		AB		AB & PS	
Tues		AG		AG & SC		AB		AB & PS	
Wed		AG		AG & SC		AB		AB & PS	
Thu		AG		AG & SC		AB		AB & PS	
Fri		AG		AG & SC		AB		AB & PS	