ON THE ERGODICITY OF A CLASS OF 1-DIMENSIONAL PROBABILISTIC CELLULAR AUTOMATA WITH SIZE-3 NEIGHBOURHOODS

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Consider an infinite 2-dimensional lattice, in which each site $(x, y) \in \mathbb{Z}^2$ is assigned, independently, a label that reads 'trap' with probability p, 'target' with probability q, and 'open' with probability $1 - p - q$, where $p, q \in [0, 1]$ and $0 < p + q \leqslant 1$. Two players take turns to make moves, where a *move* involves relocating the token from where it is currently located, say the site (x, y), to any one of the sites $(x, y+1)$, $(x+1, y+1)$ and $(x+1, y+2)$. A player wins if she is either able to move the token to a site labeled a target, or force her opponent to move the token to a site labeled a trap. The recurrence relations arising from this game are represented via a suitable *probabilitic cellular automaton* (PCA) $F_{p,q}$. We show that the probability of draw in the above-mentioned *site percolation game* is 0 if and only if $F_{p,q}$ is *ergodic*, following which, employing the rather intriguing method of *weight functions* or *potential functions*, we show that $F_{p,q}$ is ergodic whenever $p + q > 0$ (i.e. at least one of p and q is strictly positive).

THE DIMER MODEL IN 3 DIMENSIONS

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The dimer model, also referred to as domino tilings or perfect matching, are tilings of the $\mathbb{Z}^d$ lattice by boxes exactly one of whose sides has length 2 and the rest have length 1. This is a very well-studied statistical physics model in two dimensions with many tools like height functions and Kasteleyn determinant representation coming to its aid. The higher dimensional picture is a little daunting because most of these tools are limited to two dimensions. In this talk I will describe what techniques can be extended to higher dimensions and give a brief account of a large deviations principle for dimer tilings in three dimensions that we prove analogous to the results by Cohn, Kenyon and Propp (2000).

This is joint work with Scott Sheffield and Catherine Wolfram.

LIMIT THEOREMS AND PHASE TRANSITIONS IN TENSOR CURIE-WEISS ISING AND POTTS MODELS

Somabha Mukherjee

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In this talk, I will discuss about some recent developments in the area of asymptotics of the magnetization and the inverse temperature/magnetic field estimates in p-spin Curie-Weiss Ising and Potts models, two well-known models in statistical physics that capture multi-body interactions. The results are characterized by surprising phase transition phenomena and limit theorems of the empirical magnetization on different regions of the parameter space, the existence of a critical curve in the interior of this space on which the estimators have mixture-limiting distributions and a surprising superefficiency phenomenon at the boundary point(s) of this critical curve. The efficiencies of two competing estimators in this framework will also be briefly discussed, if time permits.

NONPARAMETRIC ESTIMATION OF SHAPE-CONSTRAINED TIME SERIES REGRESSION MODEL

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In this work, we consider a general nonparametric time series regression model where the conditional mean function $\mu(.)$ and the conditional variance function $\sigma(.)$ are unknown with minimal assumptions. This covers a wide range of conventional models, including econometric models with heteroskedastic properties. A widely popular method of estimating such a regression model is to make use of the Nadaraya-Watson kernel estimator. However, often in econometric applications, the above functions are known to follow certain shape constraints, the information of which is not taken into account by the usual kernel estimate unless explicit constraints are added. In this work, we define appropriate shape-enforcing operators which, when implemented on an arbitrary initial estimator, offer substantial improvements without compromising on its quality or the original interpretation. Under suitable probabilistic framework, we theoretically show that

these operators are capable of making the initial estimator better both as point and interval estimate, requiring no major assumptions on the underlying dependence structure of the data. Such estimates can be especially useful for modelling monotone and quasi-convex production functions with unknown smoothness in economics. We conclude with illustration of the performance of the shape constrained estimators on various simulated and real-life datasets.

This is a joint work with Archi Roy and Somabha Mukherjee.

THE SPREAD OF AN EPIDEMIC: A GAME-THEORETIC APPROACH

Sayar Karmakar

University of Florida

We introduce and study a game-theoretic model to understand the spread of an epidemic in a homogeneous population. A discrete-time stochastic process is considered where, in each epoch, first a randomly chosen agent updates their action trying to maximize a proposed utility function, and then agents who have viral exposures beyond their immunity get infected. Our main results discuss asymptotic limiting distributions of both the cardinality of the subset of infected agents and the action profile, considered under various values of two parameters (initial action and immunity profile). We also show that the theoretical distributions are almost always achieved in the first few epochs.

COMMITTEE FORMATION UNDER CONSTRAINTS THROUGH RANDOMIZED VOTING RULES ON SEPARABLE DOMAINS

Soumyarup Sadhukhan

IIT Kanpur

We consider the problem of choosing a committee from a set of available candidates through a randomized social choice function when there are restrictions on the committee to be formed and agents have separable preferences over the committees. We show that when the set of feasible

committees is non-vacuously restricted, that is, cannot be seen as the set of all committees with a subset of members, a random social choice function is onto and strategy-proof if and only if it is random dictatorial.

MEMORIES IN MOTION - UNDERSTANDING THE EFFECT OF MEMORY ON RANDOM WALKS

Krishanu Maulik

ISI Kolkata

Elephant random walk is now a popular model of random walk in Statistical Physics, which introduces memory and exhibits phase transition and anomalous diffusion. Yet, the usual model of elephant random walk is Markovian. The next location of the elephant, conditioned on the past, depends on a linear function of the present location. In this talk, we shall investigate how the dynamic of the walk changes if we replace the linear function with more general functions. We shall also extend this investigation to several variations of the elephant random walk.

This talk is based on joint work with Parthanil Roy and Tamojit Sadhukhan.

CONVERGENCE OF DRAINAGE NETWORKS TO BROWNIAN WEB AND SOME APPLICATIONS

Anish Sarkar

ISI Delhi

We consider various models of directed random trees, originating from various fields such such drainage network models, percolation models etc.. Most of these models, under a suitable scaling, converge to the Brownian web. The Brownian web can be loosely described as the a coalescing system of Brownian paths, with paths starting from every point of the two dimensional plane. This convergence can further be exploited to derive results about the models and we will provide couple of examples.

CLUSTERING OF LARGE DEVIATIONS IN MOVING AVERAGE PROCESSES: SHORT AND LONG MEMORY REGIMES

Arijit Chakrabarty

ISI Kolkata

We describe the cluster of large deviations events that arise when one such event occurs. We work in the framework of an infinite moving average process with a noise that has finite exponential moments. The cluster turns out to have different shapes in the cases when the moving average process has short memory and long memory.

This is a joint work with Gennady Samorodnitsky.

AN ASYMMETRIC K-EXCLUSION PROCESS

Arvind Ayyer

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We study an interacting particle process on a finite ring with L siteswith at most K particles per site, in which particles hop to nearestneighbors with rates given in terms of t-deformed integers and asymmetryparameter q, where $t > 0$ and $q \geq 0$ are parameters. This model, which we callthe (q, t) K-ASEP, reduces to the usual ASEP on the ring when $K = 1$ andto a model studied by Schütz and Sandow (Phys. Rev. E, 1994) when $t = q = 1$. We show that the steady state does not depend on q and is ofproduct form in terms of t-binomial coefficients, generalizing the samephenomena for the usual ASEP. We prove various properties of the $(q, t)K$-ASEP. Lastly, we construct a two-dimensional exclusion process on adiscrete cylinder with height K and circumference L which projects tothe (q, t) K-ASEP and whose steady state distribution is also of productform.

This is joint work with Samarth Misra (arXiv:2310.03343).

ON THE DIAMETER OF THELINIAL-MESHULAM MODEL

Kartick Adhikari

IISER Bhopal

The Erdos-Renyi graph is a random graph with n vertices and each edge is connected independently with probability p_n. The diameter of a graph is the maximum graph distance between any two vertices. For instance, the diameter of a complete graph is one, and the diameter of a disconnected graph is infinity. In 1981, Bela Bollobas proved that, under appropriate choice of p_n, the diameter of the Erdos-Renyi graph can take only two values.

In this talk we shall discuss the diameter of the Linial Meshulam Model, a generalization of the Erdos-Renyi graph. The Linial-Meshulam Model is a random d-dimensional simplicial complex on n vertices with a complete $(d-1)$-skeleton, in which each d-dimensional simplex is added independently with probability p_n. The diameter of a d-dimensional simplicial complex is the maximum distance of any two $(d-1)$-dimensional simplexes. We shall extend the result of Bollobas to higher dimensions. As an immediate consequence, reconstructibility of random simplicial complexes will also be discussed.

PARTIAL DIVISIBILITY OF RANDOM SETS AND POWERS OF COMPLETELY MONOTONE FUNCTIONS

Biltu Dan

IISc Bangalore

We study exponents which preserve complete monotonicity of functions on lattices. We prove that for any completely monotone function f on a finite lattice, f^α is completely monotone for all $\alpha \geq c$, where c is explicitly described. For finite distributive lattices we show that the bound c is sharp. An important example of completely monotone function is void functional of a random closed set. We prove that if $V_{\mathcal{X}}$ is the void functional of a random subset $\mathcal{X}$ of $[n]$, then $V_{\mathcal{X}}^\alpha$ is void functional of some random closed set for $\alpha \geq n-1$. The results are analogous to the result of FitzGerald and Horn on Hadamard powers of positive semi-definite matrices. Also, we study the

question of approximating an m-divisible random set by infinitely divisible random sets, and its generalization to lattices. This talk is based on a joint work with Jnaneshwar Baslingker.

INFERENCE AND RANKING IN MIXED-MEMBERSHIP MODELS

Sohom Bhattacharya

University of Florida

Network data is prevalent in numerous big data applications including economics and health networks. In this talk, we will discuss the Mixed Membership model where it is of prime importance to understand the latent structure of the network. We derive novel finite-sample expansion for the membership profiles which allows us to obtain asymptotic distributions and confidence intervals of the membership mixing probabilities and other related population quantities. We further develop a ranking scheme of the vertices based on the membership mixing probabilities on certain communities and perform relevant statistical inferences. We will provide numerical examples to complement our theoretical findings.

This is a joint work with Jianqing Fan, Jikai Hou.

ELICITATION WITH RANDOM MECHANISMS: A CHARACTERIZATION

Souvik Roy

ISI Kolkata

We consider a voting game with finite number of actions/choices. There is a finite set of choices and a partition of the set of possible preferences (linear orders) on the choices. The objective is to identify the element of the partition to which the "true preference" belongs. Each element of the partition is called a type and the entire partition is called a type space. Given a set of possible preferences that the agents can have and a type space of interest, the goal is achieved by devising an incentive-compatible random social choice function (RSCF) so that reporting true type is a strictly dominant strategy for each player/agent in the game induced by the RSCF. If such an incentive-compatible RSCF exists for a given type space, then

we say that the type space is elicitable. The question that we ask is the following: given a set of possible preferences, what are all elicitable type spaces?

For the full set of preferences, we show that a type-space is elicitable if and only if there exists an "edge-weight" function on a specific class of cycles. If the preferences are single-peaked (or, single-dipped), we show that a type-space is elicitable if and only if it satisfies the "no-cycles condition".

Joint work with Prof. Sukanta Pati (IIT Guwahati), and Dr. Ujjwal Kumar (Hausdorff Center for Mathematics, Universität Bonn, Germany)