Submittee: David Brydges
Date Submitted: 2009-07-11 16:30
Title: 2009 Summer School in Probability
Event Type: Summer-School

Location:
UBC

Dates:
June 8 - Jul3 2009

Topic:
Probability and Statistical Mechanics

Methodology:
Two courses, each consisting of 16 1.5 hour lectures and student presentations on a voluntary basis for an additional 6 hours per course making a total of 30 hours per course so that they count as graduate courses under the Western Deans Agreement. Social activities, hikes and a picnic on the beach and a film also took place.

Objectives Achieved:
Training in advanced mathematics providing preparation to read papers in Stochastic Population dynamics and statistical mechanics. Formation of friendships between students is useful in their future 87 students from all over the world attended. This gives Canada visibility and makes us attractive to bright students and postdocs planning their future

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Scientific Highlights:
Fisher Wright evolution and more complex models that include mutation and selection and infinitely many types Gromov metric and other beautiful topics that emerge in studying the Kingman Coalescant and trees identified with random measures on the real line Phase transitions, outstanding open problems in statistical mechanics, Gaussian measures on high dimensional spaces Combinatorial objects counted by Feynman diagrams and the role of supersymmetry Analysis and existence of scaling limits by Renormalisation Group Role of duality in proving that martingale problems are well posed

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Organizers:
Brydges, David, Mathematics, UBC Perkins, Edwin, Mathematics, UBC Slade, Gordon, Mathematics, UBC

Speakers:

Math 608D Stochastic Population Systems - Don Dawson Math 609E Statistical Mechanics and the Renormalisation Group - David Brydges   Stochastic Population Systems - Don Dawson Historically, the modelling of biological populations has been an important stimulus for the development of stochastic processes. The revolutionary changes in the biological sciences over the past 50 years have created many new challenges and open problems. At the same time probabilists have developed new classes of stochastic processes such as interacting particle systems and measure-valued processes and made advances in stochastic analysis that make possible the modelling and analysis of populations having complex structures and dynamics. This course will focus on these developments. In particular stochastic processes that model populations distributed in space as well as their genealogies and interactions will be considered. This will include branching particle systems, interacting Wright-Fisher diffusions, Fleming-Viot processes and superprocesses. Basic methodologies including martingale problems, diffusion approximations, dual representations, coupling methods, random measures and particle representations will be involved. A principal objective is to describe the dynamics and structure of populations in large and small space and time scales using dual processes asymptotics, mean-feld methods and multiscale analysis. Some recent developments based on the use of these methods and models to approach some challenging problems in evolutionary biology, genetics, ecology and epidemiology will be described. Finally, we will discuss some open problems in stochastic population processes and their applications to modelling biological populations.   Statistical Mechanics and the Renormalisation Group - David Brydges Course Outline   * Some canonical models in equilibrium statistical mechanics and connections between them   o ideal gas = Poisson field   o lattice Gaussian field   o hard core gas   o Ising model   o mean field models   o self-avoiding walk and random walk   * Gibbs measures, correlations   o program to classify scaling limits   o relation to CLT and the Newman-Wright theorem   * Central role of the lattice Gaussian field   o graphical expansions   o Hermite polynomials   * Generalisations of Gaussian field   o Grassmann variables versus differential forms   o supersymmetry   o self-avoiding walk as a Gaussian integral   o matrix tree theorems   * Symmetry breaking and phase transitions   o the basic phenomenon at the lattice Gaussian field level   o proof of symmetry breaking by infra-red bounds   o Osterwalder-Schrader positivity   * Hierarchical lattice   o Renormalisation Group (RG) for models on the hierarchical lattice   o Relevant, Irrelevant interactions   o critical models and tuning the initial mass   o Why four dimensions is special   * RG for models on the Euclidean lattice   o space of interactions defined in analogy to hierarchical case   o theorems on local existence of RG flow   o global existence for critical models   o When scaling limits are Gaussian

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Links:

http://www.math.ubc.ca/~db5d/SummerSchool09/index.html
