ACMS Applied Math Seminar

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Thursday, November 8, 2018

154 Hurley Hall

3:30 – 4:40 PM

Random Walk Models and Applied Chemical Ecology or How Big Is A Lattice Point?

Hitting probabilities play a key role in a theory of insect trapping developed in recent years using a combination of random walk models and field experiments. The goal of this theory, which is still under development, is to provide a sound scientific framework for farmers and pest managers to make decisions about when to apply chemical pesticides based on numbers of pests captured in monitoring traps. In this talk I will briefly describe the scientific background briefly and then turn to the mathematical story of the associated random walk models.

Suppose we wish to compute the probability for a random walk to hit a particular set T within a given time. In light of Donsker's invariance principle, it is natural to approximate this hitting probability by the probability for Brownian motion to hit *some set* T' over the same time. But which set T' should we use? For walks in two dimensions this is a subtle problem because the probability for Brownian motion to eventually hit any disk is one, regardless of the radius. I will present strong numerical evidence for a conjectured "renormalization" of trap radii that is needed for the invariance principle analysis for these random walks. Finally, I will present recent work, borrowing ideas from spectral theory and the physics of renormalization, which provides an exact analysis of certain lattice models to compute "effective Brownian radius" for a lattice point, which can be used to obtain the best approximation of random walk hitting probabilities. I will close the talk with some conjectures about the numerical error in this approximation.

This talk is based on joint work with A. Becerra, T. Weicht (undergraduate students), Z. Tilocco (graduate student), and J. Miller and C. Adams (MSU Entomology).

The Department of Applied and Computational Mathematics and Statistics

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