Math 544 Spring 2010
Stochastic Dynamics

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Class Hours: Tu & Th 3:15pm-4:30pm in E1 Room 244
Office Hours: Tu & Th 2pm- 3pm or by appointment

This is an introductory course about modeling, analysis, simulation and prediction for stochastic systems described by stochastic differential equations. It is specially appropriate for graduate students who would like to use stochastic methods in their research, or to learn such methods for long term career development.

Stochastic differential equations arise as mathematical models of random phenomena in engineering, science, and other areas. Examples from applications are used throughout the course to motivate and illustrate the ideas and concepts. Basic methods and techniques in random dynamical systems are introduced. Advanced materials are approached from an elementary viewpoint.

Topics include:
Stochastic differential equations; numerical simulation of stochastic differential equations via *Matlab*; Fokker-Planck equation; dynamical behavior of nonlinear systems under random influences; dynamical systems approach for stochastic differential equations; invariant measures; Lyapunov exponents and multiplicative ergodic theorem; invariant manifolds and their approximation; bifurcation; phenomena induced by noise; quantifying model uncertainty; quantifying the impact of noise; deterministic vs. stochastic and macroscopic vs. microscopic modeling

Pre-requisite: Math 543 (Stochastic Analysis) or similar background

Textbook:
J. Duan: A Glimpse of Stochastic Dynamics, preprint

References: (On reserve in library)
B. Oksendal: Stochastic Differential Equations — An Introduction with Applications, Springer-Verlag; 6th edition, 2003.
L. Arnold: Random Dynamical Systems, Springer-Verlag, 1998.
J. Guckenheimer and P. Holmes: Nonlinear Oscillations, Dynamical Systems and Bifurcations of Vector Fields. Springer-Verlag, New York, 1983.
P. E. Kloeden and E. Platen: Numerical solution of stochastic differential equations, Springer-Verlag, 1992.
F. C. Klebaner: Introduction to Stochastic Calculus with Applications, 2nd ed., 2005.
I. Karatzas and S. E. Shreve: Brownian Motion and Stochastic Calculus

Grading: A: 90–100; B: 80–89; C: 70–79