# Stochastic Differential Equations with Applications

Course: APM598, Stochastic Differential Equations with applications
Instructor: Hal Smith, WXLR 631, halsmith@asu.edu
Where & When: WXLR 309, TTh 4:30-5:45.

Course will cover basic theory following Oksendal text and consider applications from the texts by Allen. We begin with Brownian motion, stochastic calculus, and then basic well-posedness for stochastic differential equations (SDEs). I may follow text by Oksendal but students need not purchase this text as the material can be found in the online texts.

Students will be expected to do a project which they present in class. This could be a class presentation of a portion of one of the texts.

Prerequisites: Measure theory and familiarity with stochastic processes. For example, APM506, APM541, MAT570.

One possible SDE version of Logistic growth:

$$dX(t) = rX(t)(1 - X(t)/K)dt + \sqrt{rX(t)}dW(t)$$

References:

**Stochastic differential equations and applications, 2 ed., Xuerong Mao, available online through ASU library**

Mathematically rigorous, nice chapters on stability of equilibria, on linear systems, on systems with time delay.

**Modeling with Ito Stochastic Differential Equations, E. Allen, Springer, available online through ASU library**

Least technical introduction to SDE based on Hilbert-space methods; especially good for numerical simulations (lots of matlab programs), parameter estimation, and a very good final chapter on how to construct SDE models from discrete-time, discrete-valued, stochastic processes. See intuitive derivation of the Forward Kolmogorov (Fokker-Planck) Equation in sec. 4.7.

**Stochastic Differential Equations, 6th ed., B. Oksendal, Springer, 2007.**

Very polished introduction, mathematically rigorous. Not much help for modeling.

**An Introduction to Stochastic Differential Equations, L.Evans, Amer. Math Soc. 2013.**

Very brief introduction. Nice construction of Brownian motion via Haar wavelets.