Partial Differential Equations and Diffusion Processes
Math 227, Winter 2008

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Course Description: This is an introductory graduate-level course in partial differential equations emphasizing connections with diffusion processes and applications in financial mathematics. We will discuss parabolic and elliptic partial differential equations. We will also cover some nonlinear equations and their relation to optimal control problems. This course will be good preparation for Stats220 (Continuous time stochastic control) which will be offered in the Spring 2008 quarter.

Prerequisites: MATH 131 and Math136/Stats 219 (or the equivalent) are prerequisites. The course will be well-suited to students taking Math 236 (introduction to stochastic differential equations) concurrently, but this is not required. You do not need to be experienced with stochastic calculus. Basically, you must have a strong foundation in ODE's and multivariable calculus, and you should be familiar with basic concepts related to Brownian motion and martingales, at the level of Math136/Stats219. The course notes for Math136/Stats219 may be found online, in case you need to review. Contact me if you have questions about the prerequisites.

Texts: There is no text for the course. Lectures will be based on material from various sources, and I will distibute lecture notes. Here are a few texts that will be on reserve in the library:

- W. Strauss, *Partial Differential Equations: An Introduction*, John Wiley and Sons, 1992. – This is a very good introduction to PDE if you are new to the subject. The author covers a wide variety of techniques for solving linear PDE, some of which we will not cover in this course.
- L.C. Evans, *Partial Differential Equations*, AMS, 1998. – This is a more advanced text on the general theory of partial differential equations. The author treats PDE's in a more general context than in the Strauss book. Also, there is a good introduction to deterministic optimal control and its relation to PDE.
- B. Oksendal, *Stochastic Differential Equations: An Introduction with Applications*, Springer-Verlag 2003. – This book is a good introduction to Brownian motion and stochastic calculus. This is the principal reference for Math 236.
- I. Karatzas and S. Shreve, *Brownian Motion and Stochastic Calculus*, Springer, 1991. – This is a more advanced text on Brownian motion and stochastic calculus.
- R. Korn and E. Korn, *Option Pricing and Portfolio Optimization*, American Mathematical Society, 2001. – This book gives a good introduction to some basic concepts in financial math and stochastic processes. It also contains a derivation of the Black-Scholes equation, and a discussion of optimal control.

- J. Hull, *Options, Futures, and Other Derivative Securities*, 4th Ed., Prentice Hall, 2000. – An introduction to many concepts in financial mathematics.
- P. Wilmott, S. Howison, J. Dewynne, *The Mathematics of Financial Derivatives*, Cambridge University Press, 1995. – Introduction to derivative pricing from a PDE point of view, including discussion of numerical methods.
- I also will post links to recent research articles as the quarter progresses.

Evaluation: Your course grade will be determined by:

- **Midterm (25%)** There will be a midterm on **Tuesday, February 12, 7-9pm**. If you cannot make this time, please let me know as soon as possible. The make up date will be Wednesday, February 13, 7-9pm.
- **Homework (35%)** I will collect homework roughly every two weeks, depending on the schedule. Unless otherwise stated, it will be due at the beginning of class on the due date.
- **Final Exam (40%)** The final exam we be **Thursday, March 20, 12:15-3:15 pm**, as scheduled by the registrar's office. The exam will be a cumulative, closed book exam.