Graduate Course **Foundations of Mathematical Finance** **Winter 2010**

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Description: This is a PhD level course focusing on foundational aspects of Mathematical Finance, in particular its relations with other areas of mathematics, such as functional analysis, probability, convex analysis and stochastic calculus. The emphasis will be underlying unifying themes of Math Finance, such as no-arbitrage, duality, risk measure, utility theory, equilibrium and optimality, instead of practical applications. Put in another way, this is a course to help PhD student identify promising research topics for their thesis, rather than train them to get a job in a bank.

Prerequisites: Because this is NOT meant to be an "introductory" (i.e MSc level) course geared towards making students get up to speed with option pricing techniques (Black-Scholes and the like), it will be assumed that students already took a "first course" in Math Finance at MSc level (for example using either Bjork's or Shreve's (vol II) textbooks below), so they will know topics like the Ito formula, pricing PDEs, etc.

Texts: The main texts for the course will be

1. F. Delbaen and W. Schachermayer, *The Mathematics of Arbitrage*, Springer Finance, 2006.
2. H. Föllmer and A. Schied, *Stochastic Finance: an introduction in discrete time*, de Gruyter Studies in Mathematics, 2002.

We will also be drawing material from a number of other sources:

1. T. Björk, *Arbitrage Theory in Continuous Time*, Oxford UP, 1998
2. D. Duffie, *Dynamic Asset Pricing Theory*, Princeton UP, 1996 (concise, difficult, but full of information
3. B. Øksendal, *Stochastic Differential Equations: an Introduction with Applications, 5th Ed.*, Springer, 1998 (A mathematically rigorous, but accessible treatment of the basics of stochastic calculus.)
4. S. Shreve, *Stochastic Calculus for Finance II: Continuous Time Models*, Springer Finance 2004.
5. J. M. Steele, *Stochastic Calculus and Financial Applications*, Springer 2003

Required course work: This will consist of regular homework assignments (60%) and a final essay (40%) on a topic individually selected by each student.