Graduate Course in Stochastic Calculus, Spring 2001

Time. The course will start around the first of February 2001 (meaning week 5 or possibly week 6). Preliminary, there will be an introductory meeting in room S2 at 12.30 am. Tuesday 30 January (but this could be changed). The course will last for two to three months.

Credits. Stochastic Calculus is a quite big subject, and there will be a lot of things to learn for most students. Therefore the usual 5-credit format for graduate courses has been partially abandoned, and there will be a possibility to choose between two different "course-tracks". The first slightly less complete track gives the usual 5 credits, while a second more complete one gives 8 credits (and naturally involves a correspondingly larger amount of work).

Grading. Grading will be handeled by means of active participation in certain exercise sessions, possibly in combination with completion (by means of written reports) of a few individual exercise tasks.

Literature. We will use the book "*Fima C. Klebaner (1998): Introduction to Stochastic Calculus with Applications. (Imperial College Press, London)*", together with lecture notes, written in a more proof style manner, that will be distributed during the course.

Prerequisites. Except for basic *Measure Theoretic Probability Theory*, Stochastic Calculus relies on things such as *Brownian Motion*, *Lévy Processes* and other *Stochastic Processes*, together with theory for *Martingales* and *Markov processes*. It is not at all a requirement to have taken courses in all these things, but knowledge about a few of them will help (so that not everything that is used in Stochastic Calculus is completely new). A background in *Mathematical Finance* can replace such knowledge.

Specifically the graduate course labeled "*almost sure convergence*" offered this fall teaches *Martingales*, and therefore is very useful knowledge for Stochastic Calculus. As is the graduate course about *Brownian Motion* offered a year ago. And are the undergraduate courses TMA 155 about *Mathematical Finance*, TMA 421 about *Stochastic Processes*, and TMA 710 about *Markov processes*. Again, clearly it is not necessary to have taken all these courses, but one or a few of them will help.

Students are wellcome to contact Patrik Albin to discuss prerequisites.

About Stochastic Calculus. Stochastic Calculus is also labeled *Stochastic Differential Equations* (sde's), *Stochastic Integration* [referring to so called weak (integral sense) solutions to the sde's], and *Diffusion Theory*.

Stochastic Calculus is quite demanding from a mathematical point of view. The importance of Stochastic Claculus in applications to for example *Mathematical Finance* has made necessary non-technical introductory texts, with a non-mathematical presentation of the subject, without proofs. The book by Klebaner represents one of quite a few recent such efforts. [Another, even more elementary, text of this kind is "T. Mikosch (1998): Elementary Stochastic Calculus with Finance in view". For an example of a mathematically satisfying text, that is still quite accessible, we men-

tion "P. Protter (1990): Stochastic Integration and Differential Equations" (labeled "Stochastic Integration without Tears" in an early draft version).]

The area of Mathematical Finance, which gives Stochastic Calculus a face (of finance), is a very active one indeed. In a typical display of new books in mathematical statistic there will be a considerable fraction (perhaps as much as a third) devoted to this subject. It is a very active research area on a variety of technical levels, and in many different academic and other environments.

On the homepage `palbin@math.chalmers.se`, the preface to the quite advanced book "I. Karatzas and S. Shreve (1998): Methods of Mathematical Finance" has been made available, because it gives a nice non-technical and introductory view of the use of Stochastic Calculus in Mathematical Finance.