ACTL30005
Models for Insurance and Finance

SUBJECT GUIDE

Second Semester 2013

Prepared by
Daniel Dufresne

Centre for Actuarial Studies
Department of Economics
Faculty of Business and Economics
Subject Outline

This subject prepares you for advanced financial mathematics (and, to a smaller extent, risk theory) that you will study in 4th year (or in CT6 and CT8). The goal is to give a minimal background in the required theory of probability, including some measure theory, and an introduction to Brownian motion and stochastic calculus. There will be a few proofs, but the aim is not to do pure maths but to give you the tools that will be essential in understanding risk theory and derivative pricing. All the material covered is of use in those applied areas. Connections with subjects you have already done will also be made.

**Exercises** have more than one function, they check that we understand the material, introduce topics that are either easier or else will be used in subsequent lectures, and also (to some degree) serve as practice for the exam. Not all exercises are of same type as exam questions, and learning the exercises and their solutions by heart is not the best way to study for the exam. The latter will be made of questions that are of similar difficulty to the exercises but are not very long to solve. Understanding is the most important point as far as the exam is concerned. **Assignments** contain longer questions that deepen understanding, they are often not of the kind you would find in an exam, but what is covered in assignments is definitely exam material.

Topics that are not exam material will be specifically identified. In particular, there will be exercises labelled “Not in exam”. Those sometimes relate to topics covered in 4th year, or they are of a more advanced nature. You do not have to do those exercises nor learn them for the exam.

The topics covered this semester are:

1. Probability spaces, random variables, expectations.
2. Conditional expectations.
3. Convergence in distribution, in probability.
4. Random walks, mean reversion.
5. Brownian motion.
7. Martingales.
Lecture Notes and References

There is no prescribed text, only lecture notes. Some published references will be given in the lecture notes, but none is required reading. The following remarkable paper


is available for free at

http://projecteuclid.org/DPubS?service=UI&version=1.0&verb=Display&handle=euclid.pja/1195572786

and might be of interest to some students. In this paper, Itô defines the concept of stochastic integral in greater generality than had been done before. Although for many years Itô calculus remained unknown to all but a handful of mathematicians, the Itô integral and chain rule revolutionized finance in the 1970s. What is surprising is that Itô’s paper is quite readable, for someone who has some knowledge of probability theory.

Software

I will use Mathematica to prepare graphs and do computations, but it is not required for students to use it. Mathematica will be used in Advanced Financial Mathematics II, if I teach it next year. Those who have a strong interest for financial mathematics (or any application of mathematics) should consider buying a Mathematica student license, which is ridiculously inexpensive compared to an ordinary license. Purchasing instructions will be given for those who are interested.

Excel will be used for some computations.

Exercises

Exercises will be given every week; solutions will be put up on the LMS the following week. Exercises do not necessarily follow the lectures exactly. For instance, an exercise may be useful preparation for a topic to come later. At the end of semester, you will be able to see that absolutely all the exercises were about the topics covered.
Assessment

This subject is assessed by a two-hour end of semester examination worth 80%, and two assignments worth 10% each. The timetable for assignments will be given at beginning of semester and put up on the LMS.

Note that, for the exam, only one non-programmable calculator will be allowed; dictionaries and other personal materials will not be allowed.

Practical Information

This subject has three lecture hours per week. There are no tutorials, but many exercises will be solved in class. All the material will be available from the ACTL30005 page in the Learning Management System (LMS), at http://www.lms.unimelb.edu.au/

Contact Details

Room 325, FBE building (111 Barry Street), tel. 8344 5324, email: dufresne@unimelb.edu.au

The weekly office hour for students enrolled in this subject will be announced in class and put up on the LMS.

Recording of lecture

Permission will not be granted to record lectures.