



The University of Southern Queensland

Course Specification

Description: Random Processes To Financial Mathematics

| Subject | Cat-Nbr | Class | Term | Mode | Units | Campus |
|---------|---------|-------|---------|------|-------|--------|
| MAT | 3104 | 25250 | 2, 2003 | ONC | 1.00 | TWMBA |

| | |
|------------------------|--------|
| Academic Group: | FOSCI |
| Academic Org: | FOS003 |
| HECS Band: | 2 |
| ASCED Code: | 010101 |

STAFFING

Examiner: Dmitry Strunin
Moderator: Patricia Cretchley

PRE-REQUISITES

Pre-requisite: MAT2100 and STA2300

RATIONALE

Of fundamental importance to science, finance and engineering, are processes with random effects. The analysis of queues is one example of the modelling of random transitions. Some graduates will work in financial and commercial applications of mathematics where stochastic differential equations (SDEs) are of fundamental importance. SDEs also apply in many other areas in science and engineering and have many qualitatively new characteristics. Developing technical communication is also essential as preparation for the workplace.

SYNOPSIS

This course begins by developing the modelling of processes with random effects. The application is developed to the classification and performance of queues subject to fluctuations in arrivals and services. Stochastic differential equations reflect volatility in finance and occur in other areas. The course establishes a basic mathematical foundation for SDEs, shows some analytic solutions, and develops simple numerical schemes for simulation. Throughout the course basics of technical communication in the mathematical sciences are developed. This course is offered only in odd numbered years.

OBJECTIVES

On completion of this course students will be able to:

- understand random processes of various types including discrete time Markov chains, the Poisson process and birth/death process;
- apply Markov queue techniques in science, finance and engineering problems;
- solve and interpret classes of stochastic differential equations (SDEs);
- construct and justify numerical schemes to simulate SDEs;
- apply SDEs to solve some problems in financial applications;
- structure, prepare and deliver documents and presentations of technical material

TOPICS

| Description | Weighting (%) |
|--|---------------|
| 1. Stochastic Processes Queuing systems; Model events as a Poisson process; Queues are birth and death processes; Markov chains [S7] | 30.00 |
| 2. Scientist must write English usage [H4]; LaTeX | 10.00 |
| 3. Financial indices appear to be stochastic processes: Brownian motion is also called a Wiener process, Stochastic drift and volatility are unique, Basic numerics simulate a stochastic differential equation, The binomial lattice model prices call options. | 10.00 |
| 4. Ito's stochastic calculus introduced: Multiplicative noise stabilises exponential growth, Ito's formula solves some SDEs, The Black-Scholes equation prices options, solve parabolic PDEs numerically. | 20.00 |
| 5. Stochastic integration proves Ito's formula: The Ito integral, The Ito formula. | 15.00 |
| 6. The Fokker-Plank equations describe the probability distribution: The Kolmogorov backward equation is the adjoint, solve the Black-Scholes equation stochastically. | 15.00 |

TEXT and MATERIALS required to be PURCHASED or ACCESSED:

Books can be ordered by fax or telephone. For costs and further details use the 'Book Search' facility at <http://bookshop.usq.edu.au> by entering the author or title of the text.

Access to computer or internet facilities for mathematical typesetting.

Introductory Book 2003, *Course MAT3104 Random Processes to Financial Mathematics*, USQ Distance Education Centre, Toowoomba.

Study Book 2003, *Course MAT3104 Random Processes to Financial Mathematics*, USQ Distance Education Centre, Toowoomba.

REFERENCE MATERIALS

Reference materials are materials that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.

' (Available:) .

(Some electronic resources for this course may be available via its home page:
<http://www.sci.edu.au/courses/mat3104>)

Baxter, M. & Rennie, A. 1996, *Financial Calculus. An Introduction to Derivative Pricing*, Cambridge University Press, New York.

Bouleau, N. & Lepingue, D. 1994, *Numerical Methods for Stochastic Processes*, John Wiley & Sons, New York.

Dept Maths & Computing *Mathematics and Computing CD Rom Set S2 2003*, University of Southern Queensland, (purchased from Bookshop).

Higham, N.J. 1998, *Handbook of writing for the mathematical sciences*, 2nd edition, SIAM, Philadelphia.

Kloeden, P. & Platen, E. 1992, *Numerical Solution of Stochastic Differential Equations*, Springer-Verlag, New York.

Mikosch, T. 1998, *Elementary stochastic calculus with finance in view*, *Adv Series on Stat Sci & Appl Prob*, World Scientific, River Edge, NJ, Vol 6.

Stampfli, J. & Goodman, V. 2001, *The Mathematics of Finance : Modeling & Hedging*, Brooks/Cole Series in Adv Maths, Pacific Grove, CA.

Svobodny, Thomas 1998, *Mathematical Modeling for Industry and Engineering*, Prentice Hall, Upper Saddle River, NJ.

STUDENT WORKLOAD REQUIREMENTS

| ACTIVITY | HOURS |
|---------------|-------|
| Assessment | 30 |
| Examinations | 3 |
| Lectures | 48 |
| Private Study | 65 |
| Workshops | 24 |

ASSESSMENT DETAILS

| Description | Marks Out of | Wtg(%) | Required | Due Date |
|-------------------------|--------------|--------|----------|-------------|
| HOMEWORK | 9.00 | 9.00 | Y | 22 Jul 2003 |
| ASSIGNMENT 1 | 9.00 | 9.00 | Y | 22 Aug 2003 |
| ASSIGNMENT 2 | 9.00 | 9.00 | Y | 12 Sep 2003 |
| ASSIGNMENT 3 | 9.00 | 9.00 | Y | 17 Oct 2003 |
| 3 HOUR OPEN EXAMINATION | 64.00 | 64.00 | Y | END S2 |

IMPORTANT ASSESSMENT INFORMATION

- 1 Attendance requirements:

It is the students' responsibility to attend and participate appropriately in all activities (such as lectures, tutorials, laboratories and practical work) scheduled for them, and to study all material provided to them or required to be accessed by them to maximise their chance of meeting the objectives of the course and to be informed of course-related activities and administration.

- 2 Requirements for students to complete each assessment item satisfactorily:
To complete each of the assessment items satisfactorily, students must obtain at least 50% of the total marks available for each assessment item.
- 3 Penalties for late submission of required work:
If students submit assignments after the due date without prior approval then a penalty of 20% of the total marks gained by the student for the assignment will apply for each working day late.
- 4 Requirements for student to be awarded a passing grade in the course:
To be assured of a passing grade, students must demonstrate, via the summative assessment items, that they have achieved the required minimum standards in relation to the objectives of the course by: (i) satisfactorily completing the examination and assignments; and (ii) obtaining at least 50% of the total weighted marks available for all summative assessment items. Students who do not qualify for a Passing grade may, at the discretion of the Examiner, be awarded a Supplementary Examination and/or assigned additional work to demonstrate to the Examiner that they have achieved the required standard. It is expected that such students will have gained at least 45 % of the total marks available for all summative assessment items.
- 5 Method used to combine assessment results to attain final grade:
The final grades for students will be assigned on the basis of the weighted aggregate of the marks obtained for each of the summative assessment items in the course.
- 6 Examination information:
In an Open Examination, candidates may have access to any material during the examination except the following: electronic communication devices, bulky materials, devices requiring mains power and material likely to disturb other students.
- 7 Examination period when Deferred/Supplementary examinations will be held:
Any Deferred or Supplementary examinations for this course will be held during the examination period at the end of the semester of the next offering of this course.
- 8 University Regulations:
Students should read USQ Regulations 5.1 Definitions, 5.6. Assessment, and 5.10 Academic Misconduct for further information and to avoid actions which might contravene University Regulations. These regulations can be found at the URL <http://www.usq.edu.au/SECARIAT/calendar/Part5/> or in the printed version of the current USQ Handbook.

ASSESSMENT NOTES

- 9 Students must retain a copy of each item submitted for assessment. If requested, students will be required to provide a copy of assignments submitted for assessment purposes. Such copies should be despatched to USQ within 24 hours of receipt of a request being made. The due date for an assignment is the date by which a student

must despatch the assignment to the USQ. The onus is on the student to provide proof of the despatch date, if requested by the Examiner. The examiner may grant an extension of the due date of an assignment in extenuating circumstances. The Faculty will normally only accept assessments that have been written, typed or printed on paper-based media. The Faculty will NOT accept submission of assignments by facsimile. Students who do not have regular access to postal services or who are otherwise disadvantaged by these regulations may be given special consideration. They should contact the examiner of the course to negotiate such special arrangements. In the event that a due date for an assignment falls on a local public holiday in their area, such as a Show holiday, the due date for the assignment will be the next day. Students are to note on the assignment cover the date of the public holiday for the Examiner's convenience. Students who, for medical, family/personal, or employment-related reasons, are unable to complete an assignment or to sit for an examination at the scheduled time may apply to defer an assessment in a course. Such a request must be accompanied by appropriate supporting documentation. One of the following temporary grades may be awarded IDS (Incomplete - Deferred Examination); IDM (Incomplete Deferred Make-up); IDB (Incomplete - Both Deferred Examination and Deferred Make-up).