ACE Network Subject Information Guide

Martingales

Semester 1, 2025

Administration and contact details

Host department	**School Mathematics**
Host institution	**Monash University**
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Subject details

Handbook entry URL	TBA
Subject homepage URL	TBA
Honours student hand-out URL	TBA
Teaching period (start and end date):	3 March – 30 May
Exam period (start and end date):	1–27 Jun
Contact hours per week:	TBA
ACE enrolment closure date:	
Lecture day(s) and time(s):	
Description of electronic access arrangements for students (for example, LMS)	


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Subject content

1. Subject content description

Welcome to MTH5220! The aim of this course is to study martingale theory. In particular, we will focus on the following topics. Definition and examples of martingales. Doob's convergence theorem. Optional sampling theorem. Discrete Stochastic integral. Martingale inequalities such as Doob and Burkholder-Davis-Gundy inequalities. We will emphasise applications of martingales to other fields and real-life problems. Bucy-Kalman filter. Applications to finance: Option pricing - discrete Black-Scholes formula. Control theory.

2. Week-by-week topic overview

Introduction to martingales, super (sub) martingales. Examples and overview of the unit.

More examples and motivation.

Optional Sampling Theorem.

Stopping times, Stochastic Integral (discrete version) Applications.

Doob Convergence Theorem. Applications.

Inequalities I

Inequalities II

Uniform Integrability I

Uniform Integrability II (generalization of dominated convergence theorem)

Kakutani Theorem

Austin and Burkholder Theorems and applications.

Review and more applications.

3. Assumed prerequisite knowledge and capabilities

Second year probability unit. It would be good if the student has some familiarity with stochastic processes.

4. Learning outcomes and objectives

On successful completion of this unit, you should be able to:

1.

Develop specialised mathematical knowledge and skills within the theory of martingales.

2.

Apply sophisticated stochastic modelling skills within a variety of contexts, from population biology to finance to management science, and more.

3.

Apply critical thinking to problems in discrete-time stochastic processes in general, and in the theory of discrete-time martingales in particular.

4.

Formulate expert solutions to practical financial, engineering or scientific problems using specialised cognitive technical skills within the theory of discrete-time martingales.

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject
1	K1, S1, S2, S3, S5
2	K1, K2, S2, S3, S5
3	K1, K2, S1 S3, S4, S5
4	A1, A2, A3, A4

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

Insert texts, printed notes and/or software required

6. Assessment

Exam/assignment/classwork breakdown					
Exam	**60%**	**Assignment**	**10+15+15%**	**Class work**	Enter %
Assignment due dates		Week 5	Week 10	Week 12	Click here to enter a date.
Approximate exam date				Click here to enter a date.	

Institution honours program details

Weight of subject in total honours assessment at host department	8.3%
Thesis/subject split at host department	31.25%
Honours grade ranges at host department:	
H1	80-100%
H2a	70-79 %
H2b	60-69 %
H3	50-59 %