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## **MATH37001**

Martingales with Applications to Finance

<b>Unit code:</b>	MATH37001
<b>Credit Rating:</b>	10
<b>Unit level:</b>	Level 3
<b>Teaching period(s):</b>	Semester 1
<b>Offered by</b>	School of Mathematics
<b>Available as a free choice unit?:</b>	N

### **Requisites**

#### **Prerequisite**

- [MATH20701 - Probability 2](#) (Compulsory)

### **Additional Requirements**

Pre-requisites for MATH37001

Students are not permitted to take, for credit, MATH37001 and then MATH47201 or MATH67201 in a postgraduate programme at the University of Manchester, as the contents of the two courses overlap significantly.

### **Aims**

To provide a firm grasp of a range of basic concepts and fundamental results in the theory of martingales and to give some simple applications in the rapid developing area of financial mathematics.

### **Overview**

An introduction to a circle of ideas and fundamental results of the theory of martingales, which play a vital role in stochastic calculus and in the modern theory of finance.

## Assessment Further Information

End of semester examination: two hours weighting 100%

## Learning outcomes

On successful completion of this course unit students will

- have a good understanding of the basic concept of integration with respect to a probability measure and the basic properties of fair games;
- be able to answer simple questions on martingales;
- experience applications of stochastic processes in discrete financial models.

## Syllabus

- Probability spaces, events,  $\mathcal{F}$ -fields, probability measures and random variables. Integration with respect to a probability measure. Convergence theorems (dominated, monotone and Fatou). [5]
- Conditional expectations. Fair games and martingales, submartingales and supermartingales. Doob decomposition theorem. Stopping times and the optional sampling theorem. The upcrossing inequality and the martingale convergence theorem. The Doob maximal inequality and the martingale modification theorem. [13]
- Applications. Discrete time random models in financial markets. Price processes, self-financing portfolio and value processes. Arbitrage opportunities and equivalent martingale measures. Completeness of the markets. Options and option pricing. [6]

## Recommended reading

- O. Kallenberg, Foundations of Modern Probability, Springer-Verlag, 2001.
- N. H. Bingham and R. Kiesel, Risk-Neutral Valuation, Springer-Verlag, 1998.
- D. Williams, Probability with Martingales, Cambridge Univ. Press, 1991.
- A. N. Shiryaev, Probability, Springer-Verlag, 1996.

## Feedback methods

Tutorials will provide an opportunity for students' work to be discussed and provide feedback on their understanding.

## Study hours

- Lectures - 22 hours
- Tutorials - 11 hours
- Independent study hours - 67 hours

## **Teaching staff**

Tusheng Zhang - Unit coordinator