COURSE DETAILS

Course Code: F70CF
Full Course Title: Continuous-Time Finance
SCQF Level: 10
SCAF Credits: 15
Available as Elective: No

DELIVERY LEVEL

Undergraduate: Yes  Postgraduate Taught: No  Postgraduate Research: No
Additional Information:

COURSE AIMS

This course develops the theory and practice of financial derivatives pricing in continuous time

LEARNING OUTCOMES – SUBJECT MASTERY

At the end of studying this course, students should be able to:

• Demonstrate a knowledge of Brownian motion and its properties;

• Show how to calibrate the Binomial model as an approximation to Brownian motion using empirical data;

• Apply Ito’s Formula, the Girsanov theorem and the martingale representation theorem;

• Work with martingale measures, and understand their connection with arbitrage free/complete markets;

• Understand the concepts of replication, hedging, and delta hedging in continuous time;

• Derive the Black-Scholes formula and the Black-Scholes PDE;

• Price contingent claims (in particular European style options and forward contracts);

• Extend the Black-Scholes formula to foreign currencies and dividend paying stocks;

• Understand the role of the Greeks in portfolio risk management;

• Derive relationships between forward interest rates, spot rates and zero coupon bond prices;
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- Understand issues involved in selecting and using short rate models for pricing bonds and bond derivatives;
- Manipulate explicit bond price formulae for the Vasicek and CIR models, and derive the implied forward rate curves;
- Define the different approaches to modelling credit risk
- Define and apply the Merton model for credit risk to price simple corporate bonds and calculate credit spreads
- Define and apply the 2-state model for credit risk with deterministic and stochastic transition intensities.

LEARNING OUTCOMES – PERSONAL ABILITIES

- Demonstrate the ability to learn independently and as part of a group
- Manage time, work to deadlines and prioritise workloads
- Present results in a way that demonstrates that they have understood the technical and broader issues of derivative pricing and interest-rate modelling in continuous time

SYLLABUS

- Theory of Martingales in continuous time
- Brownian motion; definitions and properties
- Brownian motion as the limit of a binomial random-walk process
- Introduction to stochastic integration, stochastic differential equations and Ito’s formula
- Geometric Brownian motion; the Ornstein-Uhlenbeck process
- Introduction to Girsanov’s theorem and the martingale representation theorem
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- The Black-Scholes model
- Derivatives pricing using the Black-Scholes model using the martingale and PDE approaches to pricing
- Extensions to foreign currencies and dividend-paying stocks
- Portfolio risk management using the Greeks
- Introduction to interest rate models
- Introduction to credit risk models

### COURSE RELATIONSHIPS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Level</th>
<th>Title</th>
<th>School</th>
<th>Type</th>
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<tbody>
<tr>
<td>F79DF</td>
<td>9</td>
<td>Derivative Markets and Discrete Time Finance</td>
<td>School of Math and Comp Sci.</td>
<td>Pre-Requisite</td>
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<td>F79SP</td>
<td>9</td>
<td>Stochastic Processes</td>
<td>School of Math and Comp Sci.</td>
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### LOCATION AND ASSESSMENT METHODS

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<th>Method</th>
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<td>Assessment</td>
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<td>Coursework</td>
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