**COURSE DETAILS**

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

**DELIVERY LEVEL**

<table>
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<tr>
<th>Undergraduate:</th>
<th>Yes</th>
<th>Postgraduate Taught:</th>
<th>No</th>
<th>Postgraduate Research:</th>
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<td>Additional Information:</td>
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**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>
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<tr>
<th>Course Code</th>
<th>Level</th>
<th>Title</th>
<th>School</th>
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<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>
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<td>Stochastic Processes</td>
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LOCATION AND ASSESSMENT METHODS

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