# F70CF Continuous-Time Finance

## Course Details

<table>
<thead>
<tr>
<th>Course Code:</th>
<th>F70CF</th>
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<tbody>
<tr>
<td>Full Course Title:</td>
<td>Continuous-Time Finance</td>
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<tr>
<td>SCQF Level:</td>
<td>10</td>
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<tr>
<td>SCAF Credits:</td>
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<td>Available as Elective:</td>
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## Delivery Level

<table>
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<tr>
<th>Undergraduate:</th>
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<th>Postgraduate Taught:</th>
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<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;
### LEARNING OUTCOMES

- 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>
<th>Type</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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<th>SBC</th>
<th>Ork</th>
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