

MATH0095 Topics in Financial and Insurance Mathematics

Year: 2022-2023
Code: MATH0095
Value: 15 UCL credits (= 7.5 ECTS)
Term: 2

Structure: On Campus
Assessment: Final examination (100%). To pass the course, students must obtain an overall mark of at least 50%.

Pre-requisites: Asset pricing in continuous time (MATH0085 or equivalent)

Lecturers: Dr A Macrina & Dr C Kenyon

Course description and objectives

This module aims at offering an introduction to mathematical, statistical and financial concepts, techniques and methods necessary to get familiar with state-of-the-art research topics in Financial and Insurance Mathematics as found in academia but also in industry practice.

This year, the set of lectures delivered on this course will be focussed on **Mathematical Sustainable Finance**. The taught material includes:

Introduction

- Concepts and terminology of climate finance such as "green", sustainability, ESG, carbon-equivalence principle, mitigation, adaptation, etc. Relevant reading will include excerpts of the IPCC and World Bank reports.

Derivative Pricing

- Pricing of interest rate instruments, including zero-coupon bonds and interest rate swaps, term structures and curve bootstrapping, data and implementation.
- Introduction to pricing of commodities, spot and futures markets, convenience yield. Schwartz and Longstaff-Schwartz models.
- Carbon markets (e.g., EUA), study of carbon prices and scenario generation based NGFS and DICE. Link to commodities pricing and markets.
- Asset pricing and valuation: (semi-) replication in (in-) complete markets, Black-Scholes with jumps, Feynman-Kac, multi-dimensional BS-PDE, Monte Carlo.
- Valuation-adjustments (xVA): credit (CVA), funding (FVA/MVA), capital/profit (KVA), climate (CCVA).

Risk Management

- Climate change impact on credit risk: effect on PFE and IFRS9.
- Carbon valuation adjustment: CO₂eVA

Product Design

- Carbon permanence valuation and offset schemes. Design and pricing of fitting financial products. Financialization of carbon capture permanence. Ethical and regulatory design.

September, 2022