

MATH0095 Mathematical Sustainable Finance (Topics in Financial & Insurance Mathematics)

<i>Year:</i>	2023-2024
<i>Code:</i>	MATH0095
<i>Value:</i>	UCL credits (= 7.5 ECTS)
<i>Term:</i>	2
<i>Structure:</i>	On Campus
<i>Assessment:</i>	Final examination (100%). To pass the course, students must obtain an overall mark of at least 50%.
<i>Pre-requisites:</i>	Asset pricing in continuous time (MATH0085 or equivalent)
<i>Lecturers:</i>	Prof. 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 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 2023