UCLouvain

lactu2170

2025

Financial valuation of actuarial liabilities

The version you're consulting is not final. This course description may change. The final version will be published on 1st June.

7.00 credits	45.0 h + 15.0 h	Q2

Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	Mastery of basic concepts in statistics and probability calculation, at the level of courses in the FSA1BA, INGE1BA, MATH1BA programs or the access minor in statistics, actuarial sciences and data science.
Main themes	Interest mathematics, yield curve, stochastic calculus, options, variable annuities, unit linked funds with death guarantees.
Learning outcomes	
Evaluation methods	The assessment consists of a project and of a written exam covering both theory and practical work, for which the student is provided with a form by the instructor. The instructor reserves the right to orally question the student both on the exam answers and on the project content.
Teaching methods	The course consists of 11 theoretical lessons of 4 hours and 7 practical sessions which the student is required to attend.

Content	The course consists of 8 sections:
	1. Mathematics of interest
	  1. Internal rate of return, annuities, indexed and fractional annuities
	  2. Bullet and amortized loans
	  3. The bond market and extraction of zero-coupon rates
	  4. Best estimate of life insurance liabilities
	  5. Introduction to duration and convexity
	2. Valuation of embedded options in insurance contracts
	  1. Variable annuities
	  2. Options: general characteristics
	  3. Valuation by trees
	  4. Evaluation of variable annuities
	3. Analytical valuation of embedded options
	  1. Brownian motion
	  2. Black & Scholes formula
	  3. GMAB with ratchet
	4. Elements of stochastic calculus
	  1. Processes and Itô's lemma
	  2. Application to portfolio insurance
	5. Changes of measure
	  1. Change from P to Q
	  2. Portfolio insurance with cap
	  3. Change of numéraire
	  4. Max-return insurance
	6. Other numerical methods
	  1. Feynman-Kac equation
	  2. Simulation of assets and death times
	7. Interest rate modeling
	  1. Hull-White and Vasicek models
	  2. Model calibration

	8. Interest rate options 1. Options on zero-coupon and variable annuities 2. Options on bonds 3. Trinomial trees for interest rate options 4. Floating rate notes, swaps, swaptions 5. Contracts with capped profit sharing
Inline resources	Moodle website
Bibliography	Les diapositives disponibles sur moodle peuvent être complétées si besoin par • Actuarial Mathematics for Life Contingent Risks. Dickson, D.C.M., Hardy, M.R., Waters, H.R. 2009, Cambridge University Press. • Options, futures and other derivatives. J.C. Hull (Pearson). • Interest Rate Models - Theory and Practice: With Smile, Inflation and Credit. Brigo D. Mercurio F. (Springer). • Stochastic calculus for finance (vol 1 ,2) Shreve S (Springer) • Martingales Methods in Financial Modelling. Musiela M. Rutkowski M. (Springer) • Introduction to Stochastic calculus applied to finance. Lamberton D. Lapeyre B. (Chapman&Hall)
Faculty or entity in charge	LSBA

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Mathematics	MATH2M	7		
Master [120] in Actuarial Science	ACTU2M	7		
Master [120] in Mathematical Engineering	MAP2M	7		
Master [120] in Data Science Engineering	DATE2M	7		
Master [120] in Data Science: Information Technology	DATI2M	7		