UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Actuarial Mathematics

2122-2-F1601M065-F1601M045M

Learning objectives

The main learning objectives are:

-Knowledge of the probabilistic models for the duration of human life (life and death probabilities, mortality tables, mortality force, deterministic laws, stochastic mortality).

-Calculatation of the actuarial present values of the main actuarial contracts

-Understanding of the dynamics involved in the mathematical reserve;

-Understanding the theoretical aspects of premium principles and their relations with the thory of pricing financial derivatives, risk measures and expected utility.

-Understanding the options embedded in insurance contracts with minimum guaranteed.

Contents

1) Modeling the duration of human life (life and death probabilities, mortality tables, mortality force, deterministic laws, stochastic mortality).

2) Classical actuarial mathematics (actuarial present values, premium calculation, mathematical reserve, recursive formulas, risk premium and saving premium, decomposition of the profit).

3) Premium principles (indifference premium, exponential premium, Esscher premium, axiomatic theory of premium principles, distorted risk measures).

4) Options and insurance contracts (implicit options, participating policies, unit linked, index linked). Introduction to Solvency II.

Detailed program

1) Modeling the duration of human life. Survival function and conditional survival function. International actuarial notation. Life tables. Mortality force. Complete and curtate expected future life time. Gompertz-Makeham law. Stochastic mortality models. Lee-Carter model and its properties).

2) Actuarial present values. Valuation of traditional insurance contracts: term insurance, endowment insurance,whole life insurance, annuities, term annuities. Recursive formula. Premium calculation: single premium, periodic premiums, natural premiums, constant premium. Mathematical reserve, recursive formulas. Fourteen equation. Premium decomposition in risk premium and saving premium. Decomposition of the profit, Homans formula).

3) Notions of expected utility theory. Indifference premium, exponential premium and its properties. Esscher transform and Esscher premium properties and examples. Ester premium and option pricing: the Black-and-Scholes formula. Axiomatic theory of premium principles and distorted risk measures, properties and examples. Value-at-Risk and Expected Shortfall).

4) Options and insurance contracts. Implicit options in life insurance. Pricing examples. Forward start and cliquet options. Participating policies, unit linked, index linked, mortality derivatives. Introduction to Solvency II.

Prerequisites

Basic knowledge of probability theory, calculus and financial mathematics.

Teaching methods

Frontal lesson.

In case the Covid19 emergency will continue the lessons will be streaming

Assessment methods

Oral exam on the course program;
for students that attend regularly the course there will be the possibility to have a written exam at the end of the course (2 open questions and two exercises)

Textbooks and Reading Materials

-Lecture slides

- Dickson, Hardy, Waters, Actuarial mathematics for Life-Contingent Risks

- Gerber, Life Insurance Mathematics, Springer

- A. Olivieri, E. Pitacco, Introduction to Insurance Mathematics

Semester

Second term

Teaching language

English