Life Insurance Mathematics A

Lecturer: Tom Fischer
Office: Colin Maclaurin Building, room F.14
Tel: 0131 451 4371; E-mail: c.t.w.fischer@hw.ac.uk

Module Web Page: `www.ma.hw.ac.uk/~fischer/LIM_A`

contains general information, problem sheets, solutions etc.

Introduction

This module will follow on from the second-year course Probabilistic Actuarial Models. We will consider some more general models for mortality, before moving on to the introduction of life insurance policies and the calculation of premiums and reserves.

Syllabus

- Selection and select life tables,
- actuarial functions using ultimate and select life tables,
- net and gross premiums,
- equations of value,
- impaired lives,
- with-profits policies,
- expenses and bonuses,
- net and gross premium policy values,
- recursive relationship between policy values,
- Thiele's differential equation and its numerical solution.

Learning Outcomes

By the end of the course students should be able to:

- demonstrate an understanding of select mortality rates;
- construct a select-life mortality table;
- derive financial functions for non-select and select lives;
- express the variance of the present value of a stream of payments in terms of compound interest and life table functions, and evaluate the expression;
- describe (for a single life) the cash flows implied by pure endowments, level annuities, level whole life, endowment, and term assurances;
- derive expressions for the present value and accumulation of the contracts described above;

- calculate financial functions for benefits payable more frequently than annually;
- list the types of expenses incurred in writing a life insurance contract;
- describe the different types of bonus on a with-profits contract;
- calculate net and gross premiums for different types of life insurance and annuity contracts;
- describe how reserves arise, under long-term insurance contracts covering mortality risk;
- define the policy value as the expected future loss, and calculate the net and gross policy values for non-profit and with-profits contracts;
- derive the recursive relationship between policy values at different durations, and use it to calculate policy values at non-integer durations;
- derive and explain Thiele's differential equation in the two-state continuous-time model;
- use an Euler scheme to solve Thiele's differential equation numerically;
- use the Central Limit Theorem to show why risk reserves are needed, and to calculate risk reserves for insurance portfolios of different sizes;
- state and prove Lidstone's theorem, and use it to describe the traditional with-profits model of implicit risk reserving.

Lectures and Tutorials

There will be three lectures each week for 12 weeks. There are two tutorial sessions or computer lab sessions each week (not in the first week) and students should attend one of these sessions weekly. Tutorial problems will be handed out in advance of the sessions. From time to time the lecturer may ask for homework to be handed in for marking.

Students should bring their copy of *Formulae and Tables for Actuarial Examinations* (Yellow Tables) and a calculator along to all lectures and tutorials.

Assessment

This module and F70LB (Life Insurance Mathematics B) are examined together in one 3 hour exam (80%) at the end of the 2nd semester. Each module has an Excel-based assignment (10% each).

Getting Help

If you have any problems with the course and are unable to resolve these during tutorials I am available for consultation in my office.

Books

- *Formulae and Tables for Actuarial Examinations* (Yellow Tables)
- *Introduction to Survival Models, Volumes 1, 2 and 3* by Hardy, Macdonald, Waters and McCutcheon